

01 Jan 2015

## Direct Strength Method for Steel Deck

Randall Keith Dudenbostel

Thomas Sputo

Walter Schultz

Follow this and additional works at: <https://scholarsmine.mst.edu/ccfss-aisi-spec>



Part of the [Structural Engineering Commons](#)

---

### Recommended Citation

Dudenbostel, Randall Keith; Sputo, Thomas; and Schultz, Walter, "Direct Strength Method for Steel Deck" (2015). *AISI-Specifications for the Design of Cold-Formed Steel Structural Members*. 116.

<https://scholarsmine.mst.edu/ccfss-aisi-spec/116>

This Technical Report is brought to you for free and open access by Scholars' Mine. It has been accepted for inclusion in AISI-Specifications for the Design of Cold-Formed Steel Structural Members by an authorized administrator of Scholars' Mine. This work is protected by U. S. Copyright Law. Unauthorized use including reproduction for redistribution requires the permission of the copyright holder. For more information, please contact [scholarsmine@mst.edu](mailto:scholarsmine@mst.edu).

# **Direct Strength Method for Steel Deck**

**RESEARCH REPORT RP15-1**

**January 2015**

Committee on Specifications  
for the Design of Cold-Formed  
Steel Structural Members



**American Iron and Steel Institute**

**DISCLAIMER**

The material contained herein has been developed by researchers based on their research findings and is for general information only. The information in it should not be used without first securing competent advice with respect to its suitability for any given application. The publication of the information is not intended as a representation or warranty on the part of the American Iron and Steel Institute or of any other person named herein, that the information is suitable for any general or particular use or of freedom from infringement of any patent or patents. Anyone making use of the information assumes all liability arising from such use.

## **PREFACE**

The American Iron and Steel Institute (AISI) Standards Council selected this project as one of four winning research proposals for its 2014 Small Project Fellowship Program. Project selections were based on several factors, including the potential for long-term impact on the industry; steel industry engagement and co-funding; and results for the AISI standards development committee, the student, and the academic institution.

The objective of this project was to determine and compare the behavior and usable strength of existing floor and roof deck sections with both the Direct Strength Method (DSM) and Effective Width Method (EWM). It is anticipated that the results of this study will guide future research and development efforts.

DIRECT STRENGTH METHOD FOR STEEL DECK

By

RANDALL KEITH DUDENBOSTEL, E.I.  
RESEARCH ASSOCIATE

THOMAS SPUTO, PH.D., P.E., S.E., SECB  
ACADEMIC ADVISOR

WALTER SCHULTZ, P.E.  
NUCOR NEW PRODUCT DEVELOPMENT  
INDUSTRY ADVISOR

A RESEARCH PROJECT SPONSERED BY THE AMERICAN IRON AND STEEL  
INSTITUTE AND THE STEEL DECK INSTITUTE

JANUARY 2015

ENGINEERING SCHOOL OF SUSTAINABLE INFRASTRUCTURE & ENVIRONMENT  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA

# TABLE OF CONTENTS

|   | <u>page</u> |
|---|-------------|
| LIST OF TABLES .....                                | 5           |
| LIST OF FIGURES .....                               | 6           |
| LIST OF SYMBOLS AND DEFINITIONS.....                | 7           |
| ABSTRACT.....                                       | 9           |
| CHAPTER 1: INTRODUCTION.....                        | 10          |
| 1.0 Acknowledgements .....                          | 10          |
| 1.1 Research Goals.....                             | 10          |
| 1.2 Direct Strength Method.....                     | 11          |
| 1.3 Effective Width Method.....                     | 13          |
| 1.4 Cornell University Finite Strip Method .....    | 14          |
| 1.5 Deck Sections.....                              | 15          |
| CHAPTER 2: PROCESS OF MODELING AND ANALYSIS.....    | 16          |
| 2.0 DSM Analysis Procedure.....                     | 16          |
| 2.1 DSM Preprocessor.....                           | 16          |
| 2.2 DSM Deck Model .....                            | 17          |
| 2.3 DSM Deck Analysis.....                          | 18          |
| 2.4 EWM Deck Analysis.....                          | 19          |
| CHAPTER 3: ANALYSIS   1F DECK   $\pm$ BENDING ..... | 20          |
| 3.0 Executive Summary .....                         | 20          |
| 3.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot.....   | 21          |
| 3.2 Analysis Results Summary.....                   | 23          |
| 3.3 Direct Strength Method Calculations.....        | 25          |
| 3.4 Effective Width Method Calculations.....        | 42          |
| CHAPTER 4: ANALYSIS   1.5B DECK   + BENDING.....    | 59          |
| 4.0 Executive Summary .....                         | 59          |
| 4.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot.....   | 60          |
| 4.2 Analysis Results Summary.....                   | 62          |
| 4.3 Direct Strength Method Calculations.....        | 64          |
| 4.4 Effective Width Method Calculations.....        | 85          |

|  |     |
|--|-----|
| CHAPTER 5: ANALYSIS   1.5B DECK   - BENDING .....              | 106 |
| 5.0 Executive Summary .....                                    | 106 |
| 5.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot .....             | 107 |
| 5.2 Analysis Results Summary .....                             | 109 |
| 5.3 Direct Strength Method Calculations .....                  | 111 |
| 5.4 Effective Width Method Calculations .....                  | 132 |
| CHAPTER 6: ANALYSIS   1.5B DECK (STIFFENED)   + BENDING .....  | 153 |
| 6.0 Executive Summary .....                                    | 153 |
| 6.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot .....             | 154 |
| 6.2 Analysis Results Summary .....                             | 156 |
| 6.3 Direct Strength Method Calculations .....                  | 158 |
| 6.4 Effective Width Method Calculations .....                  | 179 |
| CHAPTER 7: ANALYSIS   1.5B DECK (STIFFENED)   - BENDING .....  | 200 |
| 7.0 Executive Summary .....                                    | 200 |
| 7.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot .....             | 201 |
| 7.2 Analysis Results Summary .....                             | 203 |
| 7.3 Direct Strength Method Calculations .....                  | 205 |
| 7.4 Effective Width Method Calculations .....                  | 226 |
| CHAPTER 8: ANALYSIS   2 DECK (STIFFENED)   $\pm$ BENDING ..... | 247 |
| 8.0 Executive Summary .....                                    | 247 |
| 8.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot .....             | 248 |
| 8.2 Analysis Results Summary .....                             | 250 |
| 8.3 Direct Strength Method Calculations .....                  | 252 |
| 8.4 Effective Width Method Calculations .....                  | 269 |
| CHAPTER 9: ANALYSIS   3 DECK (STIFFENED)   $\pm$ BENDING ..... | 286 |
| 9.0 Executive Summary .....                                    | 286 |
| 9.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot .....             | 287 |
| 9.2 Analysis Results Summary .....                             | 289 |
| 9.3 Direct Strength Method Calculations .....                  | 291 |
| 9.4 Effective Width Method Calculations .....                  | 308 |
| CHAPTER 10: RESULTS .....                                      | 325 |
| 10.0 Comparison of Data .....                                  | 325 |

|      |                          |     |
|------|--------------------------|-----|
| 10.1 | Comments on Results..... | 325 |
| 10.2 | Recommendations:.....    | 325 |
| 10.3 | Future Work: .....       | 326 |



## LIST OF TABLES

|  | <u>page</u> |
|--|-------------|
| Table 1 - Parallel Axis Theorem Applied to Obtain Effective Section Properties ..... | 14          |
| Table 2 - Range of Yield Stresses and Thicknesses for Deck Sections.....             | 15          |
| Table 3 - 1F   Analysis Results Summary   +/- Flexure .....                          | 24          |
| Table 4 - 1.5B (unstiffened)   Analysis Results Summary   + Flexure .....            | 63          |
| Table 5 - 1.5B (unstiffened)   Analysis Results Summary   - Flexure .....            | 110         |
| Table 6 - 1.5B (stiffened)   Analysis Results Summary   + Flexure .....              | 157         |
| Table 7 - 1.5B (stiffened)   Analysis Results Summary   - Flexure .....              | 204         |
| Table 8 - 2C   Analysis Results Summary   +/- Flexure.....                           | 251         |
| Table 9 - 3C   Analysis Results Summary   +/- Flexure.....                           | 290         |

## LIST OF FIGURES

|   | <u>page</u> |
|---|-------------|
| Figure 1 - 1.5B 22GA Deck 33 KSI Local Buckling (CUFSM Output) .....                    | 11          |
| Figure 2 - 1.5B 22GA Deck 33 KSI Distortional Buckling (CUFSM Output) .....             | 12          |
| Figure 3 - 1.5B 22GA Deck 33 KSI Global Buckling (CUFSM Output).....                    | 12          |
| Figure 4 – Flange under Compressive Stress   Effective Element Width, b.....            | 13          |
| Figure 5 - Web under Stress Gradient.....   | 13          |
| Figure 6 - Straight Corner Model   Buckling Modes .....                                 | 17          |
| Figure 7 - Curved Corner Model   Elastic Strength .....                                 | 17          |
| Figure 8 - CUFSM General Input .....  | 18          |
| Figure 9 - 1F   MnDSM / MnEWM vs. Thickness   +/- Flexure.....                          | 22          |
| Figure 10 - 1.5B (unstiffened)   MnDSM / MnEWM vs. Thickness   + Flexure .....          | 61          |
| Figure 11 - 1.5B (unstiffened)   MnDSM / MnEWM vs. Thickness   - Flexure.....           | 108         |
| Figure 12 - 1.5B (stiffened)   MnDSM / MnEWM vs. Thickness   + Flexure .....            | 155         |
| Figure 13 - 1.5B (stiffened)   MnDSM / MnEWM vs. Thickness   - Flexure.....             | 202         |
| Figure 14 - 2C   MnDSM / MnEWM vs. Thickness   +/- Flexure .....                        | 249         |
| Figure 15 - 3C   MnDSM / MnEWM vs. Thickness   +/- Flexure .....                        | 288         |
| Figure 16 - Data Comparison (unstiffened sections) - MnDSM / MnEWM vs. b/t .....        | 327         |
| Figure 17 - Data Comparison (stiffened sections) - MnDSM / MnEWM vs. b/t .....          | 328         |
| Figure 18 - Data Comparison (unstiffened sections) - (MnDSM / MnEWM) / Fy vs. b/t ..... | 329         |
| Figure 19 - Data Comparison (stiffened sections) - (MnDSM / MnEWM) / Fy vs. b/t .....   | 330         |

## LIST OF SYMBOLS AND DEFINITIONS

| <u>Symbol</u> | <u>Definition</u>  |
|---------------|--|
| $A_g$         | Gross area of element including stiffeners                                 |
| $b$           | Flange width   |
| $b_e$         | Effective element width  |
| $b_o$         | Total flat width of stiffened element                                      |
| $b_p$         | Largest sub-element flat width   |
| $f$           | Stress   |
| $F_{cr}$      | Plate elastic buckling stress  |
| $F_y$         | Yield Stress   |
| $h$           | Width of elements adjoining stiffened element (depth of web)               |
| $I_G$         | Moment of inertia of gross section   |
| $I_{sp}$      | Moment of inertia of stiffener about centerline of flat portion of element |
| $I'_x$        | Moment of inertia about element's own axis                                 |
| $k$           | Plate buckling coefficient   |
| $k_d$         | Plate buckling coefficient for distortional buckling                       |
| $k_{loc}$     | Plate buckling coefficient for local sub-element buckling                  |
| $L$           | Element length   |
| $M_{crd}$     | Critical elastic distortional buckling moment                              |
| $M_{cre}$     | Critical elastic lateral-torsional buckling moment                         |
| $M_{crl}$     | Critical elastic local buckling moment                                     |
| $M_n$         | Nominal flexural strength  |
| $M_{nd}$      | Nominal flexural strength for distortional buckling                        |

|                      |   |
|----------------------|---|
| $M_{nDSM}$           | Nominal flexural strength calculated using direct strength method |
| $M_{ne}$             | Nominal flexural strength for lateral-torsional buckling          |
| $M_{nEWM}$           | Nominal flexural strength calculated using effective width method |
| $M_{nl}$             | Nominal flexural strength for local buckling                      |
| $M_y$                | Yield Moment ( $S_g F_y$ )  |
| $n$                  | Number of stiffeners in element                                   |
| $R$                  | Modification factor for distortional plate buckling coefficient   |
| $S_e$                | Elastic section modulus of effective section                      |
| $S_g, S_{xx}$        | Elastic section modulus of gross section                          |
| $t$                  | Thickness   |
| $w$                  | Actual element width  |
| $\bar{y}$            | Distance from neutral axis to extreme fiber of section            |
| $\beta$              | Coefficient   |
| $\gamma$             | Coefficient   |
| $\delta$             | Coefficient   |
| $\Theta$             | Web angle from horizontal   |
| $\Theta_{stiff}$     | Stiffener angle from horizontal                                   |
| $\lambda, \lambda_l$ | Slenderness factors   |
| $\rho$               | Reduction factor  |

## ABSTRACT

With the proposed reorganization of the AISI S100 Standard, the Direct Strength Method (DSM) will take a position of equal footing with the Equivalent Width Method (EWM) for calculating strength. The majority of previous DSM studies focus on C and Z profiles while little study of panel sections, especially steel deck sections, has been performed. A study was undertaken to determine and compare the behavior and usable strength of existing floor and roof deck sections with both DSM and EWM. The Cornell University – Finite Strip Method (CUFSM) was used for the elastic buckling analysis, taking into account the wide, continuous nature of installed deck sections. Flexural capacity was analyzed for positive and negative flexure to account for gravity loading as well as uplift of the steel deck sections. We have included graphical representations of the relationships for DSM strength to the EWM strength ratio vs. material width to thickness ratio. While we are not exactly sure what the relationships mean yet, DSM strength seems to suffer vs. EWM strength for sections with relatively wide and thin compression flanges or in other words, large  $b/t$  ratios.

## CHAPTER 1: INTRODUCTION

### 1.0 Acknowledgements

The presented research has been performed with the financial support of the American Iron and Steel Institute and the Steel Deck Institute.

### 1.1 Research Goals

As the Direct Strength Method (DSM) will be taking equal footing as the Effective Width Method (EWM) in the proposed reorganization of the AISI S100, we set following goals: Firstly, we aimed to analyze a variety of existing floor and roof deck sections to observe the behavior and compare the usable flexural strengths using both DSM and EWM. DSM has mostly been previously applied to C and Z profiles so it was necessary to develop a finite strip method (FSM) model that would accurately model and account for multi-web deck sections installed in an adjacent fashion. Once we developed a FSM model that would accurately represent installed floor and roof deck, we studied potential enhancements to existing deck sections that would take advantage of DSM (i.e. DSM predicts higher flexural strength than EWM).

## 1.2 Direct Strength Method

“A new design method: Direct Strength, has been created that aims to alleviate the current complexity, ease calculation, provide a more robust and flexible design procedure, and integrate with available, established, numerical methods” (DSM Design Guide *Preface*).

The Direct Strength Method (DSM) is one method of analyzing cold-formed steel (wide, light gauge) members. In DSM, the elastic buckling capacity is determined over the entire cross section rather than neglecting less “effective” portions of the cross section.

In order to apply DSM, the elastic local, distortional, and global buckling capacities are first computed. Graphical representations of local, distortional, and global buckling are illustrated below in Figures 1, 2, and 3 respectively. The lateral-torsional buckling, local buckling, and distortional buckling flexural strengths are calculated to observe the governing buckling mode per DSM 1.2.2.1, 1.2.2.2, and 1.2.2.3. In this study, we used the Cornell University Finite Strip Method to find the elastic local, distortional, and global buckling capacities.

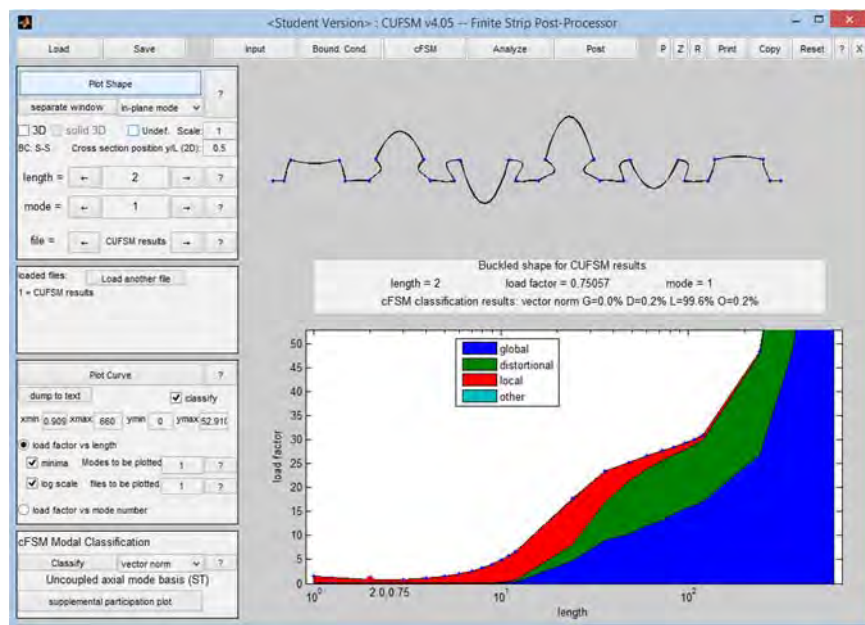


Figure 1 - 1.5B 22GA Deck 33 KSI Local Buckling (CUFSM Output)

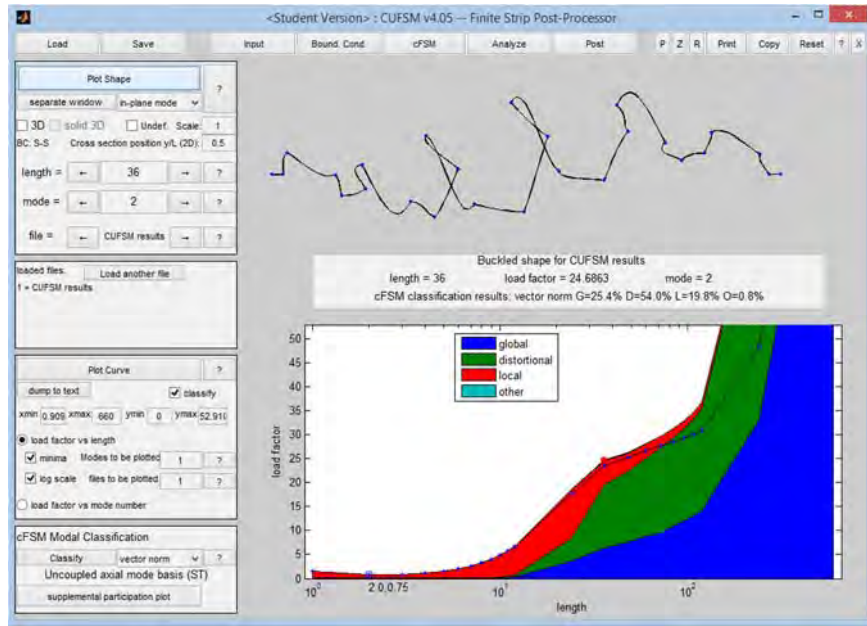


Figure 2 - 1.5B 22GA Deck 33 KSI Distortional Buckling (CUFSM Output)

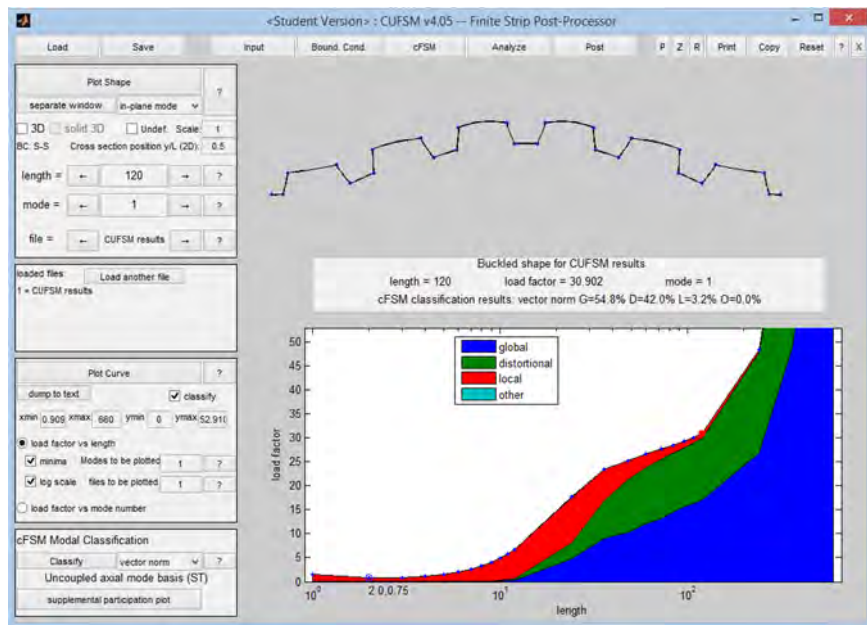


Figure 3 - 1.5B 22GA Deck 33 KSI Global Buckling (CUFSM Output)



### 1.3 Effective Width Method

The Effective Width Method (EWM) is another method for analyzing cold-formed steel members. In the EWM, an effective width of compression elements is computed and used as the lightly stressed areas, near the center of an element, are neglected. The regions near junctions or stiffeners are considered to be fully effective, as these areas are most effective in resisting the applied stress. Figure 4 shows the actual compression element and the effective width,  $b$ , of the element when subjected to compressive stress.

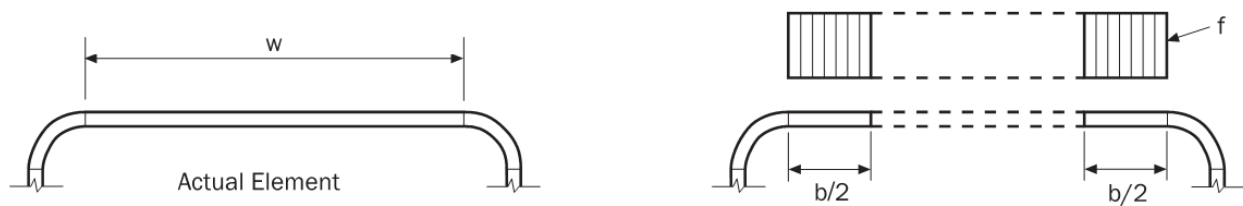


Figure 4 – Flange under Compressive Stress / Effective Element Width,  $b$

The same stress concentrations can be seen for a web element experiencing a stress gradient in Figure 5.

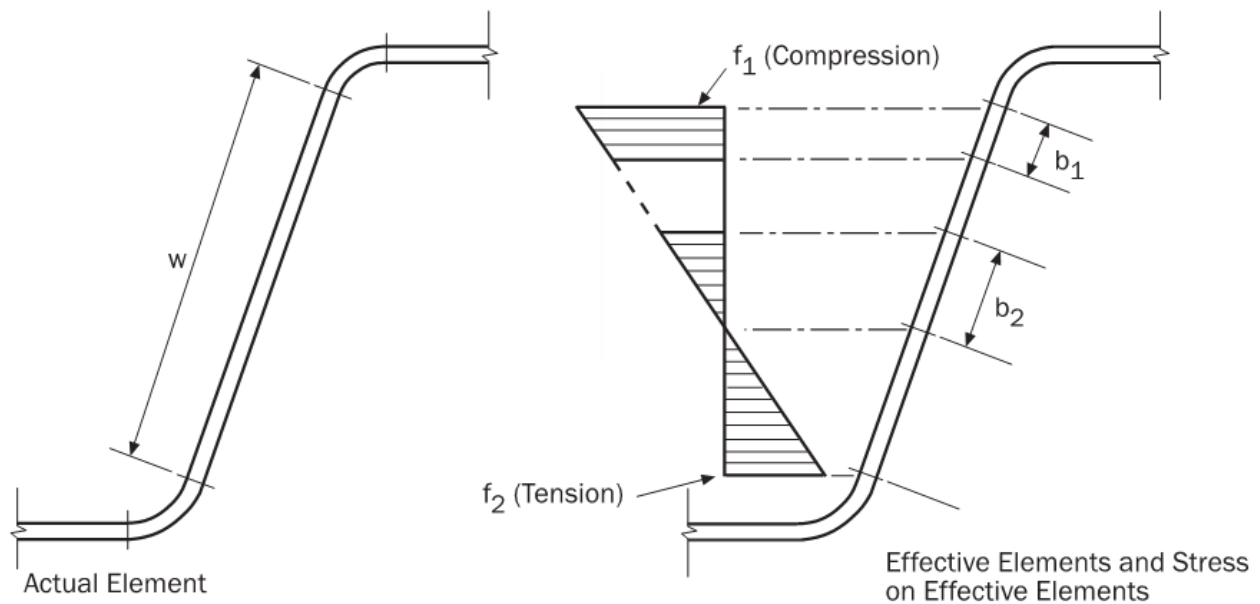


Figure 5 - Web under Stress Gradient

Once the effective width of a compression element is calculated, the effective section properties, center of gravity, and moment of inertia can be found by applying the parallel axis theorem in a tabular format as shown in Table 1.

Table 1 - Parallel Axis Theorem Applied to Obtain Effective Section Properties

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.998            | 0.659                           | 0.657                             | --                                |
| Bottom Corner | 18       | 2.083      | 0.870            | 1.812                           | 1.577                             | 0.000                             |
| Web           | 18       | 22.386     | 0.508            | 11.370                          | 5.775                             | 1.513                             |
| Top Corner    | 18       | 2.083      | 0.146            | 0.303                           | 0.044                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.018            | 0.127                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.998            | 6.272                           | 6.259                             | --                                |
|               | $\Sigma$ | 40.568     |                  | 20.543                          | 14.314                            | 1.513                             |

$$\begin{aligned}
 \text{Solved } \bar{y} &= \Sigma Ly / \Sigma L = 0.506 \text{ in.} \\
 \bar{y}_{\text{EXTREME FIBER}} &= \max(\bar{y}, h - \bar{y}) = 0.509 \text{ in.} \\
 I_x &= [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t = 0.194 \text{ in.}^4 \\
 S_e &= I_x / \bar{y} = 0.381 \text{ in.}^3
 \end{aligned}$$

As the effective width of an element is dependent on the location of the neutral axis and the neutral axis is dependent on the effective width of an element, this becomes an iterative process involving a guess as to where the neutral axis actually lies. Often, an initial guess of the gross cross-sectional neutral axis is used. After the first iteration, the solved location of the neutral axis can be used as the new guess value until the guess location and the solved location are in agreement.

#### 1.4 Cornell University Finite Strip Method

The Cornell University Finite Strip Method (CUFSM) is a tool that provides cross-section elastic buckling solutions. This powerful program allows the user to define a cross-section based on nodal coordinates, member end designations, fixities, etc. CUFSM allows the

user to apply axial and flexure stress and observe the elastic buckling solutions over a variety of user-defined unbraced lengths.

The analysis procedure is “specialized to apply to plate deformations beyond conventional beam theory. The semi-analytical finite strip method is a variant of the more common finite element method. A thin-walled cross-section is discretized into a series of longitudinal strips, or elements. Based on these strips elastic and geometric stiffness matrices can be formulated” (Ben Schafer).

### 1.5 Deck Sections

This study observes the comparison and behavior of DSM and EWM for both stiffened and unstiffened deck sections. The unstiffened deck sections are 1F and 1.5B. The stiffened deck sections are 1.5B, 2C, and 3C. The stiffened 1.5B Deck section is a non-standard shape. As a point of reference, we added the 2C compression flange stiffener to the compression flange of the 1.5B Deck section and performed the analysis to observe the benefits. The 1.5B and 2C Deck both include flange stiffeners 0.37 inches deep and 1.25 inches wide. The 3C Deck includes flange stiffeners 0.37 inches deep and 1 inch wide. Each deck section was checked for positive and negative flexure. Deck sections symmetric about the axis they bend in were analyzed for flexure in one direction. Each deck section was checked for yield stresses of 33, 40, 50, and 60 KSI at various gage thicknesses shown in Table 2. No cold working or cold forming was done to strengthen the deck sections.

*Table 2 - Range of Yield Stresses and Thicknesses for Deck Sections*

| <b>Deck Type</b> | <b>Yield Stress (KSI)</b> | <b>Thickness (GA)</b> |
|------------------|---------------------------|-----------------------|
| 1F               | 33, 40, 50, 60            | 26, 24, 22, 20        |
| 1.5B             | 33, 40, 50, 60            | 24, 22, 20, 18, 16    |
| 2C               | 33, 40, 50, 60            | 22, 20, 18, 16        |
| 3C               | 33, 40, 50, 60            | 22, 20, 18, 16        |

## CHAPTER 2: PROCESS OF MODELING AND ANALYSIS

### 2.0 DSM Analysis Procedure

For DSM analysis, we developed a preprocessor to process input files for the elastic buckling analysis done with CUFSM. We then applied the CUFSM output (load factors) to the DSM equations to predict strength.

### 2.1 DSM Preprocessor

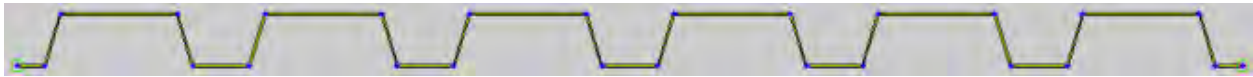
In order to run CUFSM to obtain the elastic buckling solutions, the user must define the cross-section's parameters. CUFSM takes in information such as the material properties, nodes, elements, and boundary conditions. As it can be very tedious to calculate nodal locations, assign member end designations, and enter other parameters manually, a preprocessor was created to expedite the process.

A preprocessor processes its input data to produce output that is used as input for another program. In this case, a MATLAB code was written to preprocess the information required to run CUFSM. This eased the process of segmenting and refining members to obtain more accurate results (i.e. the curved corners at joints could be segmented into many line elements that adequately represent a curve).

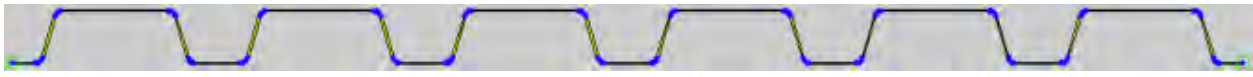
The preprocessor used in this study produced the input data for the Nodes, Members, and Lengths input areas for CUFSM. Once the information was entered, program files for each deck section and each thickness were retained for later accessibility for analyzing the deck sections at a variety of thicknesses and yield stresses.

## 2.2 DSM Deck Model

With Dr. Ben Schafer's advice, we ran two sets of models for each deck section: Curved Corner models and Straight Corner models. Curved corners were added at each point an element would change direction (i.e. the corners where the web and flange meet as well as where the flange and stiffener meet). Although the curved corner models provided more representative elastic buckling solutions, straight corner models, where no curvature appears at the element junctions, were modeled to accurately capture the buckling classification. The straight corner models were not used to evaluate strength because the models would have overly penalized the DSM by misrepresenting the actual flat length of the compression flange. The end nodal locations of the deck profile were restrained to account for adjacent deck sections and represent the wide and continuous nature of installed floor and roof deck.



*Figure 6 - Straight Corner Model | Buckling Modes*



*Figure 7 - Curved Corner Model | Elastic Strength*

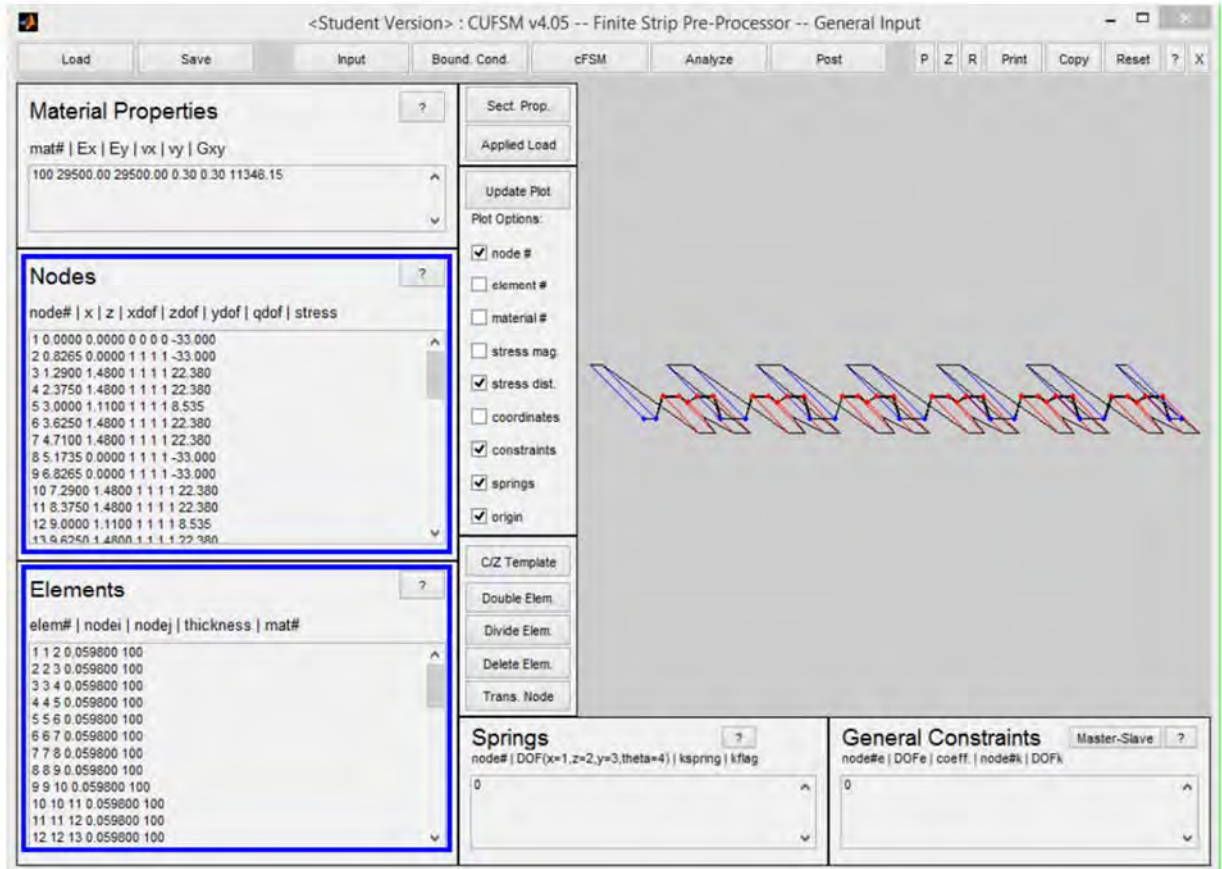


Figure 8 - CUFSM General Input

### 2.3 DSM Deck Analysis

The deck profile models were analyzed at stresses of 33, 40, 50, and 60 KSI for positive flexure and likewise at stresses of -33, -40, -50, and -60 KSI for negative flexure for a variety of unbraced lengths ranging from 1 inch to 50 feet. The CUFSM output supplies the load factors (nominal buckling moment to yield moment) which are used as input for the strength prediction for the deck profile,  $M_{nDSM}$ .

## 2.4 EWM Deck Analysis

As stated above, for EWM, an effective width of compression elements is computed and used as the lightly stressed areas, near the center of an element, are neglected. For each deck section, the parallel axis theorem was used in a tabular format to provide the effective section properties to obtain the effective nominal flexural strength using EWM,  $M_{nEWM}$ . The deck sections bend about their neutral axis for positive and negative flexure. The compression elements of the cross-section consist of the compression flange as well as a portion of the web element. The junctions are considered to be fully effective. For each deck section at each variety of thickness and stress, the webs were found to be fully effective. Only the compression flange then needed to be computed for its effective width before iterating to convergence to obtain the nominal flexural capacity of the effective section,  $M_{nEWM}$ .

## CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING



### 3.0 Executive Summary

The Direct Strength Method predicted higher strengths for all of the 1F Deck sections analyzed for positive and negative flexure in this study, 33-40KSI and 26-20GA. DSM is able to take advantage the short, flat compression flange. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 1.060 and 1.126.



## CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

### 3.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

33 KSI   40 KSI   50 KSI   60 KSI

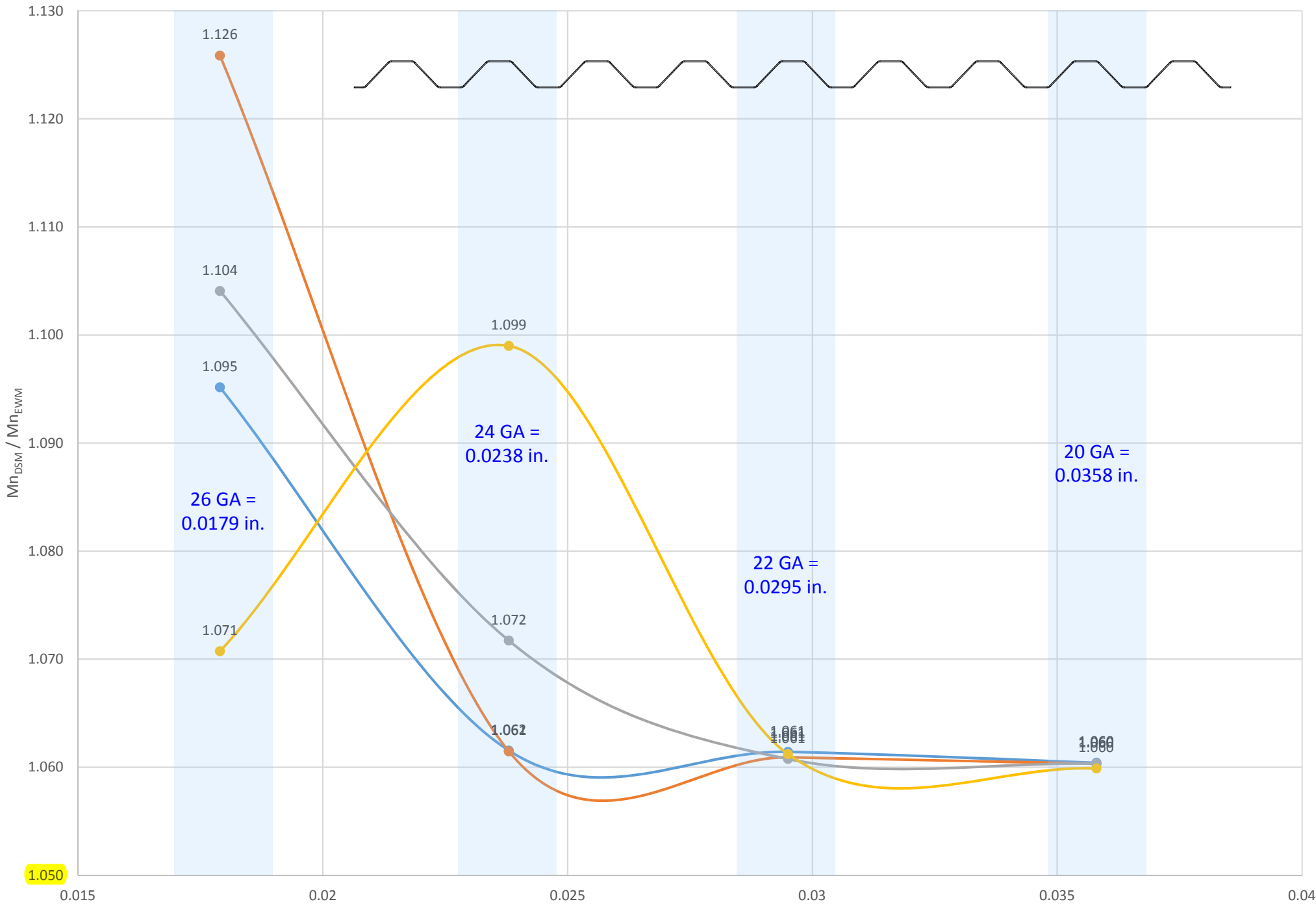


Figure 9 - 1F | Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness | +/- Flexure

1F Deck +/- Bending

## CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

### 3.2 Analysis Results Summary

Table 3 - 1F | Analysis Results Summary | +/- Flexure

| 1F DECK - 33 KSI |        |        |        |        |
|------------------|--------|--------|--------|--------|
| Gage             | 26     | 24     | 22     | 20     |
| Thickness        | 0.0179 | 0.0238 | 0.0295 | 0.0358 |
| Curve Radius     | 0.1340 | 0.1369 | 0.1398 | 0.1429 |
| $I_g$ (CUFSM)    | 0.103  | 0.137  | 0.170  | 0.206  |
| $y$ -bar (CUFSM) | 0.500  | 0.503  | 0.506  | 0.509  |
| $S_{xx}$         | 0.206  | 0.272  | 0.335  | 0.404  |
| $M_y$            | 6.79   | 8.97   | 11.06  | 13.34  |
| $Mn_{DSM}$       | 6.79   | 8.97   | 11.06  | 13.34  |
| $Mn_{EWM}$       | 6.2    | 8.45   | 10.42  | 12.58  |
| % ERROR          | 8.689% | 5.797% | 5.787% | 5.697% |

| 1F DECK - 33 KSI |        |            |            |                       |
|------------------|--------|------------|------------|-----------------------|
| Thickness        |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 26               | 0.0179 | 6.79       | 6.20       | 1.095                 |
| 24               | 0.0238 | 8.97       | 8.45       | 1.062                 |
| 22               | 0.0295 | 11.06      | 10.42      | 1.061                 |
| 20               | 0.0358 | 13.34      | 12.58      | 1.060                 |

| 1F DECK - 40 KSI |         |        |        |        |
|------------------|---------|--------|--------|--------|
| Gage             | 26      | 24     | 22     | 20     |
| Thickness        | 0.0179  | 0.0238 | 0.0295 | 0.0358 |
| Curve Radius     | 0.1340  | 0.1369 | 0.1398 | 0.1429 |
| $I_g$ (CUFSM)    | 0.103   | 0.137  | 0.170  | 0.206  |
| $y$ -bar (CUFSM) | 0.500   | 0.503  | 0.506  | 0.509  |
| $S_{xx}$         | 0.206   | 0.272  | 0.335  | 0.404  |
| $M_y$            | 8.23    | 10.88  | 13.41  | 16.17  |
| $Mn_{DSM}$       | 8.23    | 10.88  | 13.41  | 16.17  |
| $Mn_{EWM}$       | 7.31    | 10.25  | 12.64  | 15.25  |
| % ERROR          | 11.179% | 5.790% | 5.742% | 5.690% |

| 1F DECK - 40 KSI |        |            |            |                       |
|------------------|--------|------------|------------|-----------------------|
| Thickness        |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 26               | 0.0179 | 8.23       | 7.31       | 1.126                 |
| 24               | 0.0238 | 10.88      | 10.25      | 1.061                 |
| 22               | 0.0295 | 13.41      | 12.64      | 1.061                 |
| 20               | 0.0358 | 16.17      | 15.25      | 1.060                 |

| 1F DECK - 50 KSI |        |        |        |        |
|------------------|--------|--------|--------|--------|
| Gage             | 26     | 24     | 22     | 20     |
| Thickness        | 0.0179 | 0.0238 | 0.0295 | 0.0358 |
| Curve Radius     | 0.1340 | 0.1369 | 0.1398 | 0.1429 |
| $I_g$ (CUFSM)    | 0.103  | 0.137  | 0.170  | 0.206  |
| $y$ -bar (CUFSM) | 0.500  | 0.503  | 0.506  | 0.509  |
| $S_{xx}$         | 0.206  | 0.272  | 0.335  | 0.404  |
| $M_y$            | 10.29  | 13.60  | 16.76  | 20.21  |
| $Mn_{DSM}$       | 9.76   | 13.60  | 16.76  | 20.21  |
| $Mn_{EWM}$       | 8.84   | 12.69  | 15.8   | 19.06  |
| % ERROR          | 9.426% | 6.691% | 5.728% | 5.690% |

| 1F DECK - 50 KSI |        |            |            |                       |
|------------------|--------|------------|------------|-----------------------|
| Thickness        |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 26               | 0.0179 | 9.76       | 8.84       | 1.104                 |
| 24               | 0.0238 | 13.60      | 12.69      | 1.072                 |
| 22               | 0.0295 | 16.76      | 15.80      | 1.061                 |
| 20               | 0.0358 | 20.21      | 19.06      | 1.060                 |

| 1F DECK - 60 KSI |        |        |        |        |
|------------------|--------|--------|--------|--------|
| Gage             | 26     | 24     | 22     | 20     |
| Thickness        | 0.0179 | 0.0238 | 0.0295 | 0.0358 |
| Curve Radius     | 0.1340 | 0.1369 | 0.1398 | 0.1429 |
| $I_g$ (CUFSM)    | 0.103  | 0.137  | 0.170  | 0.206  |
| $y$ -bar (CUFSM) | 0.500  | 0.503  | 0.506  | 0.509  |
| $S_{xx}$         | 0.206  | 0.272  | 0.335  | 0.404  |
| $M_y$            | 12.35  | 16.32  | 20.11  | 24.25  |
| $Mn_{DSM}$       | 11.05  | 16.32  | 20.11  | 24.25  |
| $Mn_{EWM}$       | 10.32  | 14.85  | 18.95  | 22.88  |
| % ERROR          | 6.606% | 9.007% | 5.768% | 5.649% |

| 1F DECK - 60 KSI |        |            |            |                       |
|------------------|--------|------------|------------|-----------------------|
| Thickness        |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 26               | 0.0179 | 11.05      | 10.32      | 1.071                 |
| 24               | 0.0238 | 16.32      | 14.85      | 1.099                 |
| 22               | 0.0295 | 20.11      | 18.95      | 1.061                 |
| 20               | 0.0358 | 24.25      | 22.88      | 1.060                 |

## CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

### 3.3 Direct Strength Method Calculations

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | 33      | KSI         |                  |         |
|               | $M_v =$         | 13.34   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 8.29880 | $M_{crf} =$ | 110.70599 kip-in | 1 in    |
| dist.         | $M_{crd}/M_v =$ | 5.00000 | $M_{crd} =$ | 66.7 kip-in      | - in    |
| global        | $M_{cre}/M_v =$ | 5.00000 | $M_{cre} =$ | 66.7 kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 13.34$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.35$  (local-global slenderness)  
 **$M_{n\ell} = 13.34$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 13.34$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 13.34$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | 40      | KSI         |                  |         |
|               | $M_y =$         | 16.17   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 6.84650 | $M_{crf} =$ | 110.70791 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 80.85 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 80.85 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 16.17$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.38$  (local-global slenderness)  
 **$M_{n\ell} = 16.17$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 16.17$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 16.17$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | 50      | KSI         |                  |         |
|               | $M_y =$         | 20.21   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 5.47720 | $M_{crf} =$ | 110.69421 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 101.05 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 101.05 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 20.21$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.43$  (local-global slenderness)  
 **$M_{n\ell} = 20.21$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 20.21$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 20.21$  kip-in (local-global controls)**



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | 60      | KSI         |                  |         |
|               | $M_v =$         | 24.25   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 4.56430 | $M_{crf} =$ | 110.68428 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 121.25 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 121.25 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 24.25$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.47$  (local-global slenderness)  
 **$M_{n\ell} = 24.25$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 24.25$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 24.25$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |             |      |
|---------------|-----------------|---------|-----------------------|-------------|------|
| <b>Given:</b> | Deck:           | 1F      |                       |             |      |
|               | Gage:           | 22      | GA                    |             |      |
|               | Strength:       | 33      | KSI                   |             |      |
|               | $M_y =$         | 11.06   | kip-in                | Length:     |      |
| local         | $M_{crf}/M_y =$ | 5.68610 | $M_{crf} = 62.888266$ | kip-in      | 1 in |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$           | 55.3 kip-in | - in |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$           | 55.3 kip-in | - in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$

$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$

$$M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

for  $M_{cre} > 2.78M_y$

$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 11.06 \text{ kip-in}$$

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$

$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

for  $\lambda_\ell > 0.776$

$$M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.42 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 11.06 \text{ kip-in} \quad (\text{fully effective section for local buckling})$$

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$

$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

for  $\lambda_d > 0.673$

$$M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.45 \quad (\text{distortional slenderness})$$

$$M_{nd} = 11.06 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

#### Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 11.06 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 22      | GA          |                  |         |
|               | Strength:       | 40      | KSI         |                  |         |
|               | $M_v =$         | 13.41   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 4.69110 | $M_{crf} =$ | 62.907651 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 67.05 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 67.05 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 13.41$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.46$  (local-global slenderness)  
 **$M_{n\ell} = 13.41$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 13.41$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 13.41$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 22      | GA          |                  |         |
|               | Strength:       | 50      | KSI         |                  |         |
|               | $M_y =$         | 16.76   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 3.75280 | $M_{crf} =$ | 62.896928 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 83.8 kip-in      | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 83.8 kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 16.76$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.52$  (local-global slenderness)  
 **$M_{n\ell} = 16.76$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 16.76$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 16.76$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |         |
|---------------|-----------------|---------|-----------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |                       |         |
|               | Gage:           | 22      | GA                    |         |
|               | Strength:       | 60      | KSI                   |         |
|               | $M_y =$         | 20.11   | kip-in                | Length: |
| local         | $M_{crf}/M_y =$ | 3.12740 | $M_{crf} = 62.892014$ | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} = 100.55$    | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} = 100.55$    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 20.11$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.57$  (local-global slenderness)  
 **$M_{n\ell} = 20.11$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 20.11$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 20.11$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 24      | GA          |                  |         |
|               | Strength:       | 33      | KSI         |                  |         |
|               | $M_v =$         | 8.97    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 3.72310 | $M_{crf} =$ | 33.396207 kip-in | 1 in    |
| dist.         | $M_{crd}/M_v =$ | 5.00000 | $M_{crd} =$ | 44.85 kip-in     | - in    |
| global        | $M_{cre}/M_v =$ | 5.00000 | $M_{cre} =$ | 44.85 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 8.97$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.52$  (local-global slenderness)  
 **$M_{n\ell} = 8.97$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 8.97$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 8.97$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 24      | GA          |                  |         |
|               | Strength:       | 40      | KSI         |                  |         |
|               | $M_y =$         | 10.88   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 3.07160 | $M_{crf} =$ | 33.419008 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 54.4 kip-in      | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 54.4 kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 10.88$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.57$  (local-global slenderness)  
 **$M_{n\ell} = 10.88$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 10.88$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 10.88$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                 |         |
|               | Gage:           | 24      | GA          |                 |         |
|               | Strength:       | 50      | KSI         |                 |         |
|               | $M_y =$         | 13.60   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 2.45730 | $M_{crf} =$ | 33.41928 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 68 kip-in       | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 68 kip-in       | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 13.60$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.64$  (local-global slenderness)  
 **$M_{n\ell} = 13.60$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 13.60$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 13.60$  kip-in (local-global controls)**



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 24      | GA          |                  |         |
|               | Strength:       | 60      | KSI         |                  |         |
|               | $M_v =$         | 16.32   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 2.04770 | $M_{crf} =$ | 33.418464 kip-in | 1 in    |
| dist.         | $M_{crd}/M_v =$ | 5.00000 | $M_{crd} =$ | 81.6 kip-in      | - in    |
| global        | $M_{cre}/M_v =$ | 5.00000 | $M_{cre} =$ | 81.6 kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 16.32$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.70$  (local-global slenderness)  
 **$M_{n\ell} = 16.32$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 16.32$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 16.32$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 26      | GA          |                  |         |
|               | Strength:       | 33      | KSI         |                  |         |
|               | $M_v =$         | 6.79    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 2.12660 | $M_{crf} =$ | 14.439614 kip-in | 1 in    |
| dist.         | $M_{crd}/M_v =$ | 5.00000 | $M_{crd} =$ | 33.95 kip-in     | - in    |
| global        | $M_{cre}/M_v =$ | 5.00000 | $M_{cre} =$ | 33.95 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 6.79$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.69$  (local-global slenderness)  
 **$M_{n\ell} = 6.79$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 6.79$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 6.79$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 1F      |                       |        |         |
|               | Gage:           | 26      | GA                    |        |         |
|               | Strength:       | 40      | KSI                   |        |         |
|               | $M_v =$         | 8.23    | kip-in                |        | Length: |
| local         | $M_{crf}/M_v =$ | 1.75450 | $M_{crf} = 14.439535$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} = 41.15$     | kip-in | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} = 41.15$     | kip-in | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 8.23$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.75$  (local-global slenderness)  
 **$M_{n\ell} = 8.23$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 8.23$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 8.23$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 26      | GA          |                  |         |
|               | Strength:       | 50      | KSI         |                  |         |
|               | $M_y =$         | 10.29   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 1.40360 | $M_{crf} =$ | 14.443044 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 51.45 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 51.45 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 10.29$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.84$  (local-global slenderness)  
 **$M_{n\ell} = 9.76$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 10.29$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 9.76$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1F      |             |                  |         |
|               | Gage:           | 26      | GA          |                  |         |
|               | Strength:       | 60      | KSI         |                  |         |
|               | $M_v =$         | 12.35   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 1.16970 | $M_{crf} =$ | 14.445795 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 5.00000 | $M_{crd} =$ | 61.75 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 5.00000 | $M_{cre} =$ | 61.75 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 12.35$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.92$  (local-global slenderness)  
 **$M_{n\ell} = 11.05$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)  
 **$M_{nd} = 12.35$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 11.05$  kip-in (local-global controls)**

## CHAPTER 3: ANALYSIS | 1F DECK | $\pm$ BENDING

### 3.4 Effective Width Method Calculations

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 20 GA  
 Strength: 33 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.016 in.  
 Radius: 0.1429 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000021 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.998            |
| Corners       | 0.116   | 0.146            |
| Bottom Flange | 0.786   | 0.998            |
| Web           | 1.244   | 0.508            |
| Top Flange    | 0.786   | 0.018            |

Guess  $\bar{y}$ : 0.506 in.

Stress in Flange: 32.803 ksi  
 k: 4  
 Fcr: 221.414 ksi  
 $\lambda$ : 0.385  
 $\rho$ : 1.113  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.998            | 0.659                           | 0.657                             | --                                |
| Bottom Corner | 18       | 2.083      | 0.870            | 1.812                           | 1.577                             | 0.000                             |
| Web           | 18       | 22.386     | 0.508            | 11.370                          | 5.775                             | 1.513                             |
| Top Corner    | 18       | 2.083      | 0.146            | 0.303                           | 0.044                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.018            | 0.127                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.998            | 6.272                           | 6.259                             | --                                |
|               | $\Sigma$ | 40.568     |                  | 20.543                          | 14.314                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.506 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.509 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.194 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.381 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **12.58** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 20 GA  
 Strength: 40 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.016 in.  
 Radius: 0.1429 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000021 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.998            |
| Corners       | 0.116   | 0.146            |
| Bottom Flange | 0.786   | 0.998            |
| Web           | 1.244   | 0.508            |
| Top Flange    | 0.786   | 0.018            |

Guess  $\bar{y}$ : 0.506 in.

Stress in Flange: 39.762 ksi  
 k: 4  
 Fcr: 221.414 ksi  
 $\lambda$ : 0.424  
 $\rho$ : 1.135  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.998            | 0.659                           | 0.657                             | --                                |
| Bottom Corner | 18       | 2.083      | 0.870            | 1.812                           | 1.577                             | 0.000                             |
| Web           | 18       | 22.386     | 0.508            | 11.370                          | 5.775                             | 1.513                             |
| Top Corner    | 18       | 2.083      | 0.146            | 0.303                           | 0.044                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.018            | 0.127                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.998            | 6.272                           | 6.259                             | --                                |
|               | $\Sigma$ | 40.568     |                  | 20.543                          | 14.314                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.506 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.509 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.194 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.381 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 15.25 k-in.



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 20 GA  
 Strength: 50 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.016 in.  
 Radius: 0.1429 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000021 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.998            |
| Corners       | 0.116   | 0.146            |
| Bottom Flange | 0.786   | 0.998            |
| Web           | 1.244   | 0.508            |
| Top Flange    | 0.786   | 0.018            |

Guess  $\bar{y}$ : 0.506 in.

Stress in Flange: 49.702 ksi  
 k: 4  
 Fcr: 221.414 ksi  
 $\lambda$ : 0.474  
 $\rho$ : 1.131  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.998            | 0.659                           | 0.657                             | --                                |
| Bottom Corner | 18       | 2.083      | 0.870            | 1.812                           | 1.577                             | 0.000                             |
| Web           | 18       | 22.386     | 0.508            | 11.370                          | 5.775                             | 1.513                             |
| Top Corner    | 18       | 2.083      | 0.146            | 0.303                           | 0.044                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.018            | 0.127                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.998            | 6.272                           | 6.259                             | --                                |
|               | $\Sigma$ | 40.568     |                  | 20.543                          | 14.314                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.506 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.509 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.194 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.381 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **19.06** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 20 GA  
 Strength: 60 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.016 in.  
 Radius: 0.1429 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000021 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.998            |
| Corners       | 0.116   | 0.146            |
| Bottom Flange | 0.786   | 0.998            |
| Web           | 1.244   | 0.508            |
| Top Flange    | 0.786   | 0.018            |

Guess  $\bar{y}$ : 0.506 in.

Stress in Flange: 59.642 ksi  
 k: 4  
 Fcr: 221.414 ksi  
 $\lambda$ : 0.519  
 $\rho$ : 1.110  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.998            | 0.659                           | 0.657                             | --                                |
| Bottom Corner | 18       | 2.083      | 0.870            | 1.812                           | 1.577                             | 0.000                             |
| Web           | 18       | 22.386     | 0.508            | 11.370                          | 5.775                             | 1.513                             |
| Top Corner    | 18       | 2.083      | 0.146            | 0.303                           | 0.044                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.018            | 0.127                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.998            | 6.272                           | 6.259                             | --                                |
|               | $\Sigma$ | 40.568     |                  | 20.543                          | 14.314                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.506 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.509 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.194 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.381 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **22.88** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 22 GA  
 Strength: 33 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.010 in.  
 Radius: 0.13975 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000019 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.995            |
| Corners       | 0.113   | 0.140            |
| Bottom Flange | 0.786   | 0.995            |
| Web           | 1.244   | 0.505            |
| Top Flange    | 0.786   | 0.015            |

Guess  $\bar{y}$ : 0.503 in.

Stress in Flange: 32.802 ksi  
 k: 4  
 Fcr: 150.343 ksi  
 $\lambda$ : 0.467  
 $\rho$ : 1.133  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.995            | 0.657                           | 0.653                             | --                                |
| Bottom Corner | 18       | 2.037      | 0.870            | 1.771                           | 1.541                             | 0.000                             |
| Web           | 18       | 22.386     | 0.505            | 11.299                          | 5.703                             | 1.513                             |
| Top Corner    | 18       | 2.037      | 0.140            | 0.285                           | 0.040                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.015            | 0.104                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.995            | 6.253                           | 6.220                             | --                                |
|               | $\Sigma$ | 40.476     |                  | 20.369                          | 14.158                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.503 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.506 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.160 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.316 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **10.42** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 22 GA  
 Strength: 40 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.010 in.  
 Radius: 0.13975 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000019 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.995            |
| Corners       | 0.113   | 0.140            |
| Bottom Flange | 0.786   | 0.995            |
| Web           | 1.244   | 0.505            |
| Top Flange    | 0.786   | 0.015            |

Guess  $\bar{y}$ : 0.503 in.

Stress in Flange: 39.760 ksi  
 k: 4  
 Fcr: 150.343 ksi  
 $\lambda$ : 0.514  
 $\rho$ : 1.113  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.995            | 0.657                           | 0.653                             | --                                |
| Bottom Corner | 18       | 2.037      | 0.870            | 1.771                           | 1.541                             | 0.000                             |
| Web           | 18       | 22.386     | 0.505            | 11.299                          | 5.703                             | 1.513                             |
| Top Corner    | 18       | 2.037      | 0.140            | 0.285                           | 0.040                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.015            | 0.104                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.995            | 6.253                           | 6.220                             | --                                |
|               | $\Sigma$ | 40.476     |                  | 20.369                          | 14.158                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.503 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.506 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.160 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.316 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 12.64 k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 22 GA  
 Strength: 50 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.010 in.  
 Radius: 0.13975 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000019 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.995            |
| Corners       | 0.113   | 0.140            |
| Bottom Flange | 0.786   | 0.995            |
| Web           | 1.244   | 0.505            |
| Top Flange    | 0.786   | 0.015            |

Guess  $\bar{y}$ : 0.503 in.

Stress in Flange: 49.699 ksi  
 k: 4  
 Fcr: 150.343 ksi  
 $\lambda$ : 0.575  
 $\rho$ : 1.074  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.995            | 0.657                           | 0.653                             | --                                |
| Bottom Corner | 18       | 2.037      | 0.870            | 1.771                           | 1.541                             | 0.000                             |
| Web           | 18       | 22.386     | 0.505            | 11.299                          | 5.703                             | 1.513                             |
| Top Corner    | 18       | 2.037      | 0.140            | 0.285                           | 0.040                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.015            | 0.104                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.995            | 6.253                           | 6.220                             | --                                |
|               | $\Sigma$ | 40.476     |                  | 20.369                          | 14.158                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.503 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.506 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.160 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.316 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **15.80** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 22 GA  
 Strength: 60 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.010 in.  
 Radius: 0.13975 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000019 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.995            |
| Corners       | 0.113   | 0.140            |
| Bottom Flange | 0.786   | 0.995            |
| Web           | 1.244   | 0.505            |
| Top Flange    | 0.786   | 0.015            |

Guess  $\bar{y}$ : 0.503 in.

Stress in Flange: 59.639 ksi  
 k: 4  
 Fcr: 150.343 ksi  
 $\lambda$ : 0.630  
 $\rho$ : 1.033  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.995            | 0.657                           | 0.653                             | --                                |
| Bottom Corner | 18       | 2.037      | 0.870            | 1.771                           | 1.541                             | 0.000                             |
| Web           | 18       | 22.386     | 0.505            | 11.299                          | 5.703                             | 1.513                             |
| Top Corner    | 18       | 2.037      | 0.140            | 0.285                           | 0.040                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.015            | 0.104                           | 0.002                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.995            | 6.253                           | 6.220                             | --                                |
|               | $\Sigma$ | 40.476     |                  | 20.369                          | 14.158                            | 1.513                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.503 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.506 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.160 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.316 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **18.95** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 24 GA  
 Strength: 33 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.004 in.  
 Radius: 0.1369 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000018 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.992            |
| Corners       | 0.111   | 0.134            |
| Bottom Flange | 0.786   | 0.992            |
| Web           | 1.244   | 0.502            |
| Top Flange    | 0.786   | 0.012            |

Guess  $\bar{y}$ : 0.500 in.

Stress in Flange: 32.800 ksi  
 k: 4  
 Fcr: 97.857 ksi  
 $\lambda$ : 0.579  
 $\rho$ : 1.071  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.992            | 0.655                           | 0.649                             | --                                |
| Bottom Corner | 18       | 1.995      | 0.869            | 1.735                           | 1.508                             | 0.000                             |
| Web           | 18       | 22.386     | 0.502            | 11.235                          | 5.639                             | 1.513                             |
| Top Corner    | 18       | 1.995      | 0.134            | 0.268                           | 0.036                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.012            | 0.084                           | 0.001                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.992            | 6.235                           | 6.184                             | --                                |
|               | $\Sigma$ | 40.393     |                  | 20.212                          | 14.018                            | 1.513                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.500 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.503 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.129 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.256 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **8.45** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 24 GA  
 Strength: 40 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.004 in.  
 Radius: 0.1369 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000018 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.992            |
| Corners       | 0.111   | 0.134            |
| Bottom Flange | 0.786   | 0.992            |
| Web           | 1.244   | 0.502            |
| Top Flange    | 0.786   | 0.012            |

Guess  $\bar{y}$ : 0.500 in.

Stress in Flange: 39.758 ksi  
 k: 4  
 Fcr: 97.857 ksi  
 $\lambda$ : 0.637  
 $\rho$ : 1.027  
 Effective Width: 0.786 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.992            | 0.655                           | 0.649                             | --                                |
| Bottom Corner | 18       | 1.995      | 0.869            | 1.735                           | 1.508                             | 0.000                             |
| Web           | 18       | 22.386     | 0.502            | 11.235                          | 5.639                             | 1.513                             |
| Top Corner    | 18       | 1.995      | 0.134            | 0.268                           | 0.036                             | 0.000                             |
| Top Flange    | 9        | 7.071      | 0.012            | 0.084                           | 0.001                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.992            | 6.235                           | 6.184                             | --                                |
|               | $\Sigma$ | 40.393     |                  | 20.212                          | 14.018                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.500 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.503 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.129 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.256 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **10.25 k-in.**



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 24 GA  
 Strength: 50 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.004 in.  
 Radius: 0.1369 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000018 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.992            |
| Corners       | 0.111   | 0.134            |
| Bottom Flange | 0.786   | 0.992            |
| Web           | 1.244   | 0.502            |
| Top Flange    | 0.786   | 0.012            |

Guess  $\bar{y}$ : 0.503 in.

Stress in Flange: 50.000 ksi  
 k: 4  
 Fcr: 97.857 ksi  
 $\lambda$ : 0.715  
 $\rho$ : 0.968  
 Effective Width: 0.761 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.992            | 0.655                           | 0.649                             | --                                |
| Bottom Corner | 18       | 1.995      | 0.869            | 1.735                           | 1.508                             | 0.000                             |
| Web           | 18       | 22.386     | 0.502            | 11.235                          | 5.639                             | 1.513                             |
| Top Corner    | 18       | 1.995      | 0.134            | 0.268                           | 0.036                             | 0.000                             |
| Top Flange    | 9        | 6.848      | 0.012            | 0.081                           | 0.001                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.992            | 6.235                           | 6.184                             | --                                |
|               | $\Sigma$ | 40.170     |                  | 20.209                          | 14.018                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.503 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.503 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.128 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.254 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **12.69** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 24 GA  
 Strength: 60 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.004 in.  
 Radius: 0.1369 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000018 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.992            |
| Corners       | 0.111   | 0.134            |
| Bottom Flange | 0.786   | 0.992            |
| Web           | 1.244   | 0.502            |
| Top Flange    | 0.786   | 0.012            |

Guess  $\bar{y}$ : 0.507 in.

Stress in Flange: 60.000 ksi  
 k: 4  
 Fcr: 97.857 ksi  
 $\lambda$ : 0.783  
 $\rho$ : 0.918  
 Effective Width: 0.721 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.992            | 0.655                           | 0.649                             | --                                |
| Bottom Corner | 18       | 1.995      | 0.869            | 1.735                           | 1.508                             | 0.000                             |
| Web           | 18       | 22.386     | 0.502            | 11.235                          | 5.639                             | 1.513                             |
| Top Corner    | 18       | 1.995      | 0.134            | 0.268                           | 0.036                             | 0.000                             |
| Top Flange    | 9        | 6.493      | 0.012            | 0.077                           | 0.001                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.992            | 6.235                           | 6.184                             | --                                |
|               | $\Sigma$ | 39.815     |                  | 20.205                          | 14.018                            | 1.513                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.507 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.507 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.126 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.248 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **14.85** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 26 GA  
 Strength: 33 ksi  
 Thickness: 0.0179 in.  
 Total Height: 0.998 in.  
 Radius: 0.13395 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000017 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.989            |
| Corners       | 0.108   | 0.129            |
| Bottom Flange | 0.786   | 0.989            |
| Web           | 1.244   | 0.499            |
| Top Flange    | 0.786   | 0.009            |

Guess  $\bar{y}$ : 0.504 in.

Stress in Flange: 33.000 ksi  
 k: 4  
 Fcr: 55.353 ksi  
 $\lambda$ : 0.772  
 $\rho$ : 0.926  
 Effective Width: 0.728 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.989            | 0.653                           | 0.645                             | --                                |
| Bottom Corner | 18       | 1.952      | 0.869            | 1.697                           | 1.475                             | 0.000                             |
| Web           | 18       | 22.386     | 0.499            | 11.169                          | 5.573                             | 1.513                             |
| Top Corner    | 18       | 1.952      | 0.129            | 0.251                           | 0.032                             | 0.000                             |
| Top Flange    | 9        | 6.549      | 0.009            | 0.059                           | 0.001                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.989            | 6.216                           | 6.148                             | --                                |
|               | $\Sigma$ | 39.784     |                  | 20.045                          | 13.874                            | 1.513                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.504 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.504 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.095 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.188 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **6.20** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 26 GA  
 Strength: 40 ksi  
 Thickness: 0.0179 in.  
 Total Height: 0.998 in.  
 Radius: 0.13395 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000017 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.989            |
| Corners       | 0.108   | 0.129            |
| Bottom Flange | 0.786   | 0.989            |
| Web           | 1.244   | 0.499            |
| Top Flange    | 0.786   | 0.009            |

Guess  $\bar{y}$ : 0.509 in.

Stress in Flange: 40.000 ksi  
 k: 4  
 Fcr: 55.353 ksi  
 $\lambda$ : 0.850  
 $\rho$ : 0.872  
 Effective Width: 0.685 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.989            | 0.653                           | 0.645                             | --                                |
| Bottom Corner | 18       | 1.952      | 0.869            | 1.697                           | 1.475                             | 0.000                             |
| Web           | 18       | 22.386     | 0.499            | 11.169                          | 5.573                             | 1.513                             |
| Top Corner    | 18       | 1.952      | 0.129            | 0.251                           | 0.032                             | 0.000                             |
| Top Flange    | 9        | 6.166      | 0.009            | 0.055                           | 0.000                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.989            | 6.216                           | 6.148                             | --                                |
|               | $\Sigma$ | 39.401     |                  | 20.041                          | 13.874                            | 1.513                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.509 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.509 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.093 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.183 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **7.31** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 26 GA  
 Strength: 50 ksi  
 Thickness: 0.0179 in.  
 Total Height: 0.998 in.  
 Radius: 0.13395 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000017 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.989            |
| Corners       | 0.108   | 0.129            |
| Bottom Flange | 0.786   | 0.989            |
| Web           | 1.244   | 0.499            |
| Top Flange    | 0.786   | 0.009            |

Guess  $\bar{y}$ : 0.514 in.

Stress in Flange: 50.000 ksi  
 k: 4  
 Fcr: 55.353 ksi  
 $\lambda$ : 0.950  
 $\rho$ : 0.809  
 Effective Width: 0.635 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.989            | 0.653                           | 0.645                             | --                                |
| Bottom Corner | 18       | 1.952      | 0.869            | 1.697                           | 1.475                             | 0.000                             |
| Web           | 18       | 22.386     | 0.499            | 11.169                          | 5.573                             | 1.513                             |
| Top Corner    | 18       | 1.952      | 0.129            | 0.251                           | 0.032                             | 0.000                             |
| Top Flange    | 9        | 5.718      | 0.009            | 0.051                           | 0.000                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.989            | 6.216                           | 6.148                             | --                                |
|               | $\Sigma$ | 38.954     |                  | 20.037                          | 13.873                            | 1.513                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.514 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.514 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.091 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.177 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **8.84** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1F  
 Gage: 26 GA  
 Strength: 60 ksi  
 Thickness: 0.0179 in.  
 Total Height: 0.998 in.  
 Radius: 0.13395 in.  
 $\theta$ : 46.39 deg  
 $\theta$ : 0.810 rad  
 Curve  $I'_x$ : 0.000017 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.330   | 0.989            |
| Corners       | 0.108   | 0.129            |
| Bottom Flange | 0.786   | 0.989            |
| Web           | 1.244   | 0.499            |
| Top Flange    | 0.786   | 0.009            |

Guess  $\bar{y}$ : 0.519 in.

Stress in Flange: 60.000 ksi  
 k: 4  
 Fcr: 55.353 ksi  
 $\lambda$ : 1.041  
 $\rho$ : 0.758  
 Effective Width: 0.595 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 0.660      | 0.989            | 0.653                           | 0.645                             | --                                |
| Bottom Corner | 18       | 1.952      | 0.869            | 1.697                           | 1.475                             | 0.000                             |
| Web           | 18       | 22.386     | 0.499            | 11.169                          | 5.573                             | 1.513                             |
| Top Corner    | 18       | 1.952      | 0.129            | 0.251                           | 0.032                             | 0.000                             |
| Top Flange    | 9        | 5.357      | 0.009            | 0.048                           | 0.000                             | --                                |
| Bottom Flange | 8        | 6.286      | 0.989            | 6.216                           | 6.148                             | --                                |
|               | $\Sigma$ | 38.592     |                  | 20.034                          | 13.873                            | 1.513                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.519 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.519 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.089 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.172 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **10.32** k-in.

## CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING



### 4.0 Executive Summary

The Direct Strength Method predicted lower strengths for the majority of the 1.5B Deck sections undergoing positive flexure. It appears that DSM predicts lower strengths for sections with thin and wide compression elements. DSM predicted higher strengths than the EWM for 16GA at each yield stress and 18GA at 33 KSI and 40 KSI. DSM predicted lower strengths for all other sections of 1.5B Deck analyzed for positive flexure in this study. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 0.756 and 1.072.

## CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

### 4.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot



# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

● 33 KSI ● 40 KSI ● 50 KSI ● 60 KSI

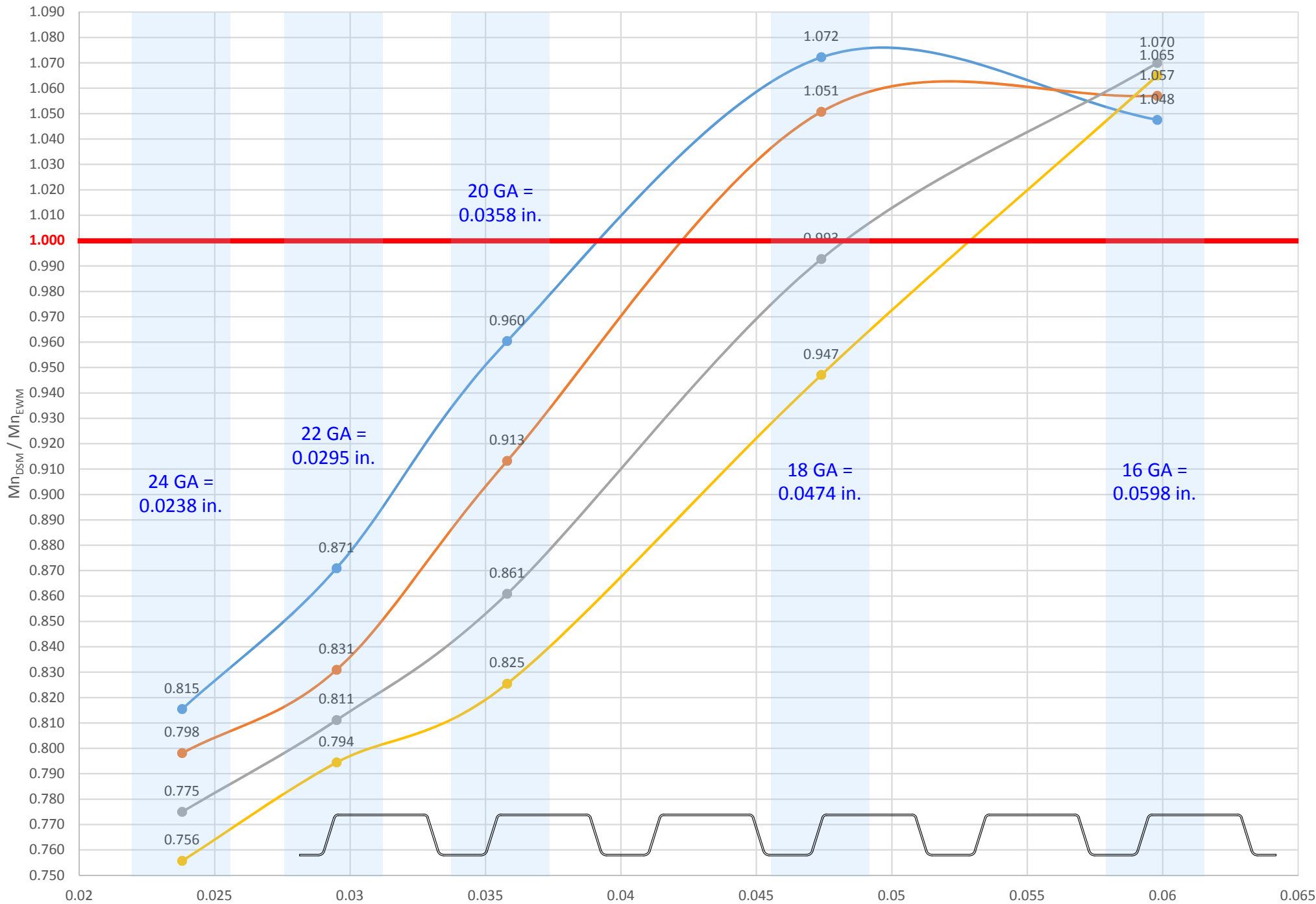


Figure 10 - 1.5B (unstiffened) | Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness | + Flexure

1.5B Deck Positive Bending

## CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

### 4.2 Analysis Results Summary

Table 4 - 1.5B (unstiffened) | Analysis Results Summary | + Flexure

| 1.5 B DECK - 33 KSI |          |          |         |        |        |
|---------------------|----------|----------|---------|--------|--------|
| Gage                | 24       | 22       | 20      | 18     | 16     |
| Thickness           | 0.0238   | 0.0295   | 0.0358  | 0.0474 | 0.0598 |
| CL Radius           | 0.1999   | 0.2028   | 0.2059  | 0.2117 | 0.2179 |
| $I_G$               | 0.4345   | 0.5389   | 0.6543  | 0.8674 | 1.0957 |
| $\bar{y}_G$         | 0.9127   | 0.9150   | 0.9176  | 0.9223 | 0.9273 |
| $S_{xx}$            | 0.4761   | 0.5889   | 0.7131  | 0.9405 | 1.1816 |
| My                  | 15.71    | 19.43    | 23.53   | 31.04  | 38.99  |
| $Mn_{DSM}$          | 10.43    | 14.85    | 20.36   | 31.04  | 38.99  |
| $Mn_{EWM}$          | 12.79    | 17.05    | 21.2    | 28.95  | 37.22  |
| % ERROR             | -22.627% | -14.815% | -4.126% | 6.733% | 4.540% |

| 1.5 B DECK - 33 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 10.430     | 12.79      | 0.815                 |
| 22                  | 0.0295 | 14.850     | 17.05      | 0.871                 |
| 20                  | 0.0358 | 20.360     | 21.2       | 0.960                 |
| 18                  | 0.0474 | 31.040     | 28.95      | 1.072                 |
| 16                  | 0.0598 | 38.990     | 37.22      | 1.048                 |

| 1.5 B DECK - 40 KSI |          |          |         |        |        |
|---------------------|----------|----------|---------|--------|--------|
| Gage                | 24       | 22       | 20      | 18     | 16     |
| Thickness           | 0.0238   | 0.0295   | 0.0358  | 0.0474 | 0.0598 |
| CL Radius           | 0.1999   | 0.2028   | 0.2059  | 0.2117 | 0.2179 |
| $I_G$               | 0.4345   | 0.5389   | 0.6543  | 0.8674 | 1.0957 |
| $\bar{y}_G$         | 0.9127   | 0.9150   | 0.9176  | 0.9223 | 0.9273 |
| $S_{xx}$            | 0.4761   | 0.5889   | 0.7131  | 0.9405 | 1.1816 |
| My                  | 19.04    | 23.56    | 28.53   | 37.62  | 47.26  |
| $Mn_{DSM}$          | 11.82    | 16.86    | 23.16   | 36.45  | 47.26  |
| $Mn_{EWM}$          | 14.81    | 20.29    | 25.36   | 34.69  | 44.71  |
| % ERROR             | -25.296% | -20.344% | -9.499% | 4.829% | 5.396% |

| 1.5 B DECK - 40 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 11.820     | 14.81      | 0.798                 |
| 22                  | 0.0295 | 16.860     | 20.29      | 0.831                 |
| 20                  | 0.0358 | 23.160     | 25.36      | 0.913                 |
| 18                  | 0.0474 | 36.450     | 34.69      | 1.051                 |
| 16                  | 0.0598 | 47.260     | 44.71      | 1.057                 |

| 1.5 B DECK - 50 KSI |          |          |          |         |        |
|---------------------|----------|----------|----------|---------|--------|
| Gage                | 24       | 22       | 20       | 18      | 16     |
| Thickness           | 0.0238   | 0.0295   | 0.0358   | 0.0474  | 0.0598 |
| CL Radius           | 0.1999   | 0.2028   | 0.2059   | 0.2117  | 0.2179 |
| $I_G$               | 0.4345   | 0.5389   | 0.6543   | 0.8674  | 1.0957 |
| $\bar{y}_G$         | 0.9127   | 0.9150   | 0.9176   | 0.9223  | 0.9273 |
| $S_{xx}$            | 0.4761   | 0.5889   | 0.7131   | 0.9405  | 1.1816 |
| My                  | 23.80    | 29.45    | 35.66    | 47.02   | 59.08  |
| $Mn_{DSM}$          | 13.64    | 19.50    | 26.86    | 42.43   | 59.08  |
| $Mn_{EWM}$          | 17.6     | 24.04    | 31.2     | 42.74   | 55.22  |
| % ERROR             | -29.032% | -23.282% | -16.158% | -0.731% | 6.534% |

| 1.5 B DECK - 50 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 13.640     | 17.6       | 0.775                 |
| 22                  | 0.0295 | 19.500     | 24.04      | 0.811                 |
| 20                  | 0.0358 | 26.860     | 31.2       | 0.861                 |
| 18                  | 0.0474 | 42.430     | 42.74      | 0.993                 |
| 16                  | 0.0598 | 59.080     | 55.22      | 1.070                 |

| 1.5 B DECK - 60 KSI |          |          |          |         |        |
|---------------------|----------|----------|----------|---------|--------|
| Gage                | 24       | 22       | 20       | 18      | 16     |
| Thickness           | 0.0238   | 0.0295   | 0.0358   | 0.0474  | 0.0598 |
| CL Radius           | 0.1999   | 0.2028   | 0.2059   | 0.2117  | 0.2179 |
| $I_G$               | 0.4345   | 0.5389   | 0.6543   | 0.8674  | 1.0957 |
| $\bar{y}_G$         | 0.9127   | 0.9150   | 0.9176   | 0.9223  | 0.9273 |
| $S_{xx}$            | 0.4761   | 0.5889   | 0.7131   | 0.9405  | 1.1816 |
| My                  | 28.57    | 35.34    | 42.79    | 56.43   | 70.90  |
| $Mn_{DSM}$          | 15.34    | 21.95    | 30.27    | 47.98   | 69.81  |
| $Mn_{EWM}$          | 20.3     | 27.63    | 36.67    | 50.66   | 65.55  |
| % ERROR             | -32.334% | -25.877% | -21.143% | -5.586% | 6.102% |

| 1.5 B DECK - 60 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 15.340     | 20.3       | 0.756                 |
| 22                  | 0.0295 | 21.950     | 27.63      | 0.794                 |
| 20                  | 0.0358 | 30.270     | 36.67      | 0.825                 |
| 18                  | 0.0474 | 47.980     | 50.66      | 0.947                 |
| 16                  | 0.0598 | 69.810     | 65.55      | 1.065                 |

## CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

### 4.3 Direct Strength Method Calculations

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 16       | GA          |                  |         |
|               | Strength:       | 33       | KSI         |                  |         |
|               | $M_y =$         | 38.99    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 2.87320  | $M_{crf} =$ | 112.02607 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 389.9 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 389.9 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 38.99$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.59$  (local-global slenderness)  
 **$M_{n\ell} = 38.99$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 38.99$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 38.99$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                 |         |
|---------------|-----------------|----------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                 |         |
|               | Gage:           | 16       | GA          |                 |         |
|               | Strength:       | 40       | KSI         |                 |         |
|               | $M_y =$         | 47.26    | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 2.37040  | $M_{crf} =$ | 112.0251 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 472.6 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 472.6 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 47.26$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.65$  (local-global slenderness)  
 **$M_{n\ell} = 47.26$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 47.26$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 47.26$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                 |         |
|---------------|-----------------|----------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                 |         |
|               | Gage:           | 16       | GA          |                 |         |
|               | Strength:       | 50       | KSI         |                 |         |
|               | $M_v =$         | 59.08    | kip-in      |                 | Length: |
| local         | $M_{crf}/M_v =$ | 1.89630  | $M_{crf} =$ | 112.0334 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 590.8 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 590.8 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 59.08$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.73$  (local-global slenderness)  
 **$M_{n\ell} = 59.08$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 59.08$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 59.08$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 16       | GA          |                  |         |
|               | Strength:       | 60       | KSI         |                  |         |
|               | $M_y =$         | 70.90    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 1.58030  | $M_{crf} =$ | 112.04327 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 709 kip-in       | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 709 kip-in       | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 70.90$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.80$  (local-global slenderness)  
 **$M_{n\ell} = 69.81$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 70.90$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 69.81$  kip-in (local-global controls)**



Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                |         |
|---------------|-----------------|----------|-------------|----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                |         |
|               | Gage:           | 18       | GA          |                |         |
|               | Strength:       | 33       | KSI         |                |         |
|               | $M_y =$         | 31.04    | kip-in      |                | Length: |
| local         | $M_{crf}/M_y =$ | 1.82000  | $M_{crf} =$ | 56.4928 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 310.4 kip-in   | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 310.4 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 31.04$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.74$  (local-global slenderness)  
 **$M_{n\ell} = 31.04$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 31.04$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 31.04$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                 |         |
|---------------|-----------------|----------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                 |         |
|               | Gage:           | 18       | GA          |                 |         |
|               | Strength:       | 40       | KSI         |                 |         |
|               | $M_y =$         | 37.62    | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.50150  | $M_{crf} =$ | 56.48643 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 376.2 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 376.2 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 37.62$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.82$  (local-global slenderness)  
 **$M_{n\ell} = 36.45$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 37.62$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 36.45$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 18       | GA          |                  |         |
|               | Strength:       | 50       | KSI         |                  |         |
|               | $M_y =$         | 47.02    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 1.20120  | $M_{crf} =$ | 56.480424 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 470.2 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 470.2 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 47.02$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.91$  (local-global slenderness)  
 **$M_{n\ell} = 42.43$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 47.02$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 42.43$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                 |         |
|---------------|-----------------|----------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                 |         |
|               | Gage:           | 18       | GA          |                 |         |
|               | Strength:       | 60       | KSI         |                 |         |
|               | $M_y =$         | 56.43    | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.00100  | $M_{crf} =$ | 56.48643 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 564.3 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 564.3 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 56.43$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.00$  (local-global slenderness)  
 **$M_{n\ell} = 47.98$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 56.43$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 47.98$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |                       |        |         |
|---------------|-----------------|----------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |                       |        |         |
|               | Gage:           | 20       | GA                    |        |         |
|               | Strength:       | 33       | KSI                   |        |         |
|               | $M_y =$         | 23.53    | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 1.05570  | $M_{crf} =$ 24.840621 | kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ 235.3     | kip-in | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ 235.3     | kip-in | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 23.53$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.97$  (local-global slenderness)  
 **$M_{n\ell} = 20.36$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 23.53$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 20.36$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |                       |        |         |
|---------------|-----------------|----------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |                       |        |         |
|               | Gage:           | 20       | GA                    |        |         |
|               | Strength:       | 40       | KSI                   |        |         |
|               | $M_v =$         | 28.53    | kip-in                |        | Length: |
| local         | $M_{crf}/M_v =$ | 0.87099  | $M_{crf} = 24.849345$ | kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} = 285.3$     | kip-in | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} = 285.3$     | kip-in | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 28.53$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.07$  (local-global slenderness)  
 **$M_{n\ell} = 23.16$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 28.53$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 23.16$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |                              |  |         |
|---------------|-----------------|----------|------------------------------|--|---------|
| <b>Given:</b> | Deck:           | 1.5B     |                              |  |         |
|               | Gage:           | 20       | GA                           |  |         |
|               | Strength:       | 50       | KSI                          |  |         |
|               | $M_v =$         | 35.66    | kip-in                       |  | Length: |
| local         | $M_{crf}/M_v =$ | 0.69678  | $M_{crf} =$ 24.847175 kip-in |  | 2 in    |
| dist.         | $M_{crd}/M_v =$ | 10.00000 | $M_{crd} =$ 356.6 kip-in     |  | - in    |
| global        | $M_{cre}/M_v =$ | 10.00000 | $M_{cre} =$ 356.6 kip-in     |  | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 35.66$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.20$  (local-global slenderness)  
 **$M_{n\ell} = 26.86$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 35.66$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 26.86$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 20       | GA          |                  |         |
|               | Strength:       | 60       | KSI         |                  |         |
|               | $M_y =$         | 42.79    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 0.58066  | $M_{crf} =$ | 24.846441 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 427.9 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 427.9 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 42.79$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.31$  (local-global slenderness)  
 **$M_{n\ell} = 30.27$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 42.79$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 30.27$  kip-in (local-global controls)**



Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 22       | GA          |                  |         |
|               | Strength:       | 33       | KSI         |                  |         |
|               | $M_v =$         | 19.43    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 0.72750  | $M_{crf} =$ | 14.135325 kip-in | 2 in    |
| dist.         | $M_{crd}/M_v =$ | 10.00000 | $M_{crd} =$ | 194.3 kip-in     | - in    |
| global        | $M_{cre}/M_v =$ | 10.00000 | $M_{cre} =$ | 194.3 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 19.43$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.17$  (local-global slenderness)  
 **$M_{n\ell} = 14.85$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 19.43$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 14.85$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 22       | GA          |                  |         |
|               | Strength:       | 40       | KSI         |                  |         |
|               | $M_v =$         | 23.56    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 0.60020  | $M_{crf} =$ | 14.140712 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 235.6 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 235.6 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 23.56$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.29$  (local-global slenderness)  
 **$M_{n\ell} = 16.86$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 23.56$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 16.86$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 22       | GA          |                  |         |
|               | Strength:       | 50       | KSI         |                  |         |
|               | $M_y =$         | 29.45    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 0.48016  | $M_{crf} =$ | 14.140712 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 294.5 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 294.5 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 29.45$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.44$  (local-global slenderness)  
 **$M_{n\ell} = 19.50$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 29.45$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 19.50$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 22       | GA          |                  |         |
|               | Strength:       | 60       | KSI         |                  |         |
|               | $M_v =$         | 35.34    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 0.40013  | $M_{crf} =$ | 14.140594 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 353.4 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 353.4 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 35.34$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.58$  (local-global slenderness)  
 **$M_{n\ell} = 21.95$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 35.34$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 21.95$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |                       |        |         |
|---------------|-----------------|----------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |                       |        |         |
|               | Gage:           | 24       | GA                    |        |         |
|               | Strength:       | 33       | KSI                   |        |         |
|               | $M_y =$         | 15.71    | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 0.48401  | $M_{crf} = 7.6037971$ | kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} = 157.1$     | kip-in | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} = 157.1$     | kip-in | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 15.71$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.44$  (local-global slenderness)  
 **$M_{n\ell} = 10.43$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 15.71$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 10.43$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |                       |              |         |
|---------------|-----------------|----------|-----------------------|--------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |                       |              |         |
|               | Gage:           | 24       | GA                    |              |         |
|               | Strength:       | 40       | KSI                   |              |         |
|               | $M_y =$         | 19.04    | kip-in                |              | Length: |
| local         | $M_{crf}/M_y =$ | 0.39931  | $M_{crf} = 7.6028624$ | kip-in       | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$           | 190.4 kip-in | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$           | 190.4 kip-in | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 19.04$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.58$  (local-global slenderness)  
 **$M_{n\ell} = 11.82$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 19.04$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 11.82$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                |         |
|---------------|-----------------|----------|-------------|----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                |         |
|               | Gage:           | 24       | GA          |                |         |
|               | Strength:       | 50       | KSI         |                |         |
|               | $M_v =$         | 23.80    | kip-in      |                | Length: |
| local         | $M_{crf}/M_v =$ | 0.31945  | $M_{crf} =$ | 7.60291 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 10.00000 | $M_{crd} =$ | 238 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 10.00000 | $M_{cre} =$ | 238 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 23.80$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.77$  (local-global slenderness)  
 **$M_{n\ell} = 13.64$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 23.80$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 13.64$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                  |         |
|---------------|-----------------|----------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B     |             |                  |         |
|               | Gage:           | 24       | GA          |                  |         |
|               | Strength:       | 60       | KSI         |                  |         |
|               | $M_v =$         | 28.57    | kip-in      |                  | Length: |
| local         | $M_{crf}/M_v =$ | 0.26621  | $M_{crf} =$ | 7.6056197 kip-in | 2 in    |
| dist.         | $M_{crd}/M_v =$ | 10.00000 | $M_{crd} =$ | 285.7 kip-in     | - in    |
| global        | $M_{cre}/M_v =$ | 10.00000 | $M_{cre} =$ | 285.7 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 28.57$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.94$  (local-global slenderness)  
 **$M_{n\ell} = 15.34$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)  
 **$M_{nd} = 28.57$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 15.34$  kip-in (local-global controls)**



## CHAPTER 4: ANALYSIS | 1.5B DECK | + BENDING

### 4.4 Effective Width Method Calculations

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 33 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.510            |
| Corners       | 0.276   | 0.194            |
| Bottom Flange | 1.377   | 1.510            |
| Web           | 1.275   | 0.770            |
| Top Flange    | 3.144   | 0.030            |

Guess  $\bar{y}$ : 0.626 in.

Stress in Flange: 22.588 ksi  
 k: 4  
 Fcr: 38.589 ksi  
 $\lambda$ : 0.765  
 $\rho$ : 0.931  
 Effective Width: 2.928 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.510            | 2.080                           | 3.141                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 17.565     | 0.030            | 0.525                           | 0.016                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
|               | $\Sigma$ | 47.739     |                  | 29.870                          | 34.033                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.626 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.914 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.031 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.128 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **37.22** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 40 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.510            |
| Corners       | 0.276   | 0.194            |
| Bottom Flange | 1.377   | 1.510            |
| Web           | 1.275   | 0.770            |
| Top Flange    | 3.144   | 0.030            |

Guess  $\bar{y}$ : 0.642 in.

Stress in Flange: 28.581 ksi  
 k: 4  
 Fcr: 38.589 ksi  
 $\lambda$ : 0.861  
 $\rho$ : 0.865  
 Effective Width: 2.719 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.510            | 2.080                           | 3.141                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 16.315     | 0.030            | 0.488                           | 0.015                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
|               | $\Sigma$ | 46.489     |                  | 29.832                          | 34.031                            | 1.898                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.642 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.898 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 1.004 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.118 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **44.71** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 50 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.510            |
| Corners       | 0.276   | 0.194            |
| Bottom Flange | 1.377   | 1.510            |
| Web           | 1.275   | 0.770            |
| Top Flange    | 3.144   | 0.030            |

Guess  $\bar{y}$ : 0.662 in.

Stress in Flange: 37.686 ksi  
 k: 4  
 Fcr: 38.589 ksi  
 $\lambda$ : 0.988  
 $\rho$ : 0.787  
 Effective Width: 2.473 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.510            | 2.080                           | 3.141                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 14.838     | 0.030            | 0.444                           | 0.013                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
|               | $\Sigma$ | 45.012     |                  | 29.788                          | 34.030                            | 1.898                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.662 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.878 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.970 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.104 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **55.22** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 60 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.510            |
| Corners       | 0.276   | 0.194            |
| Bottom Flange | 1.377   | 1.510            |
| Web           | 1.275   | 0.770            |
| Top Flange    | 3.144   | 0.030            |

Guess  $\bar{y}$ : 0.679 in.

Stress in Flange: 47.317 ksi  
 k: 4  
 Fcr: 38.589 ksi  
 $\lambda$ : 1.107  
 $\rho$ : 0.724  
 Effective Width: 2.275 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.510            | 2.080                           | 3.141                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 13.650     | 0.030            | 0.408                           | 0.012                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
|               | $\Sigma$ | 43.824     |                  | 29.753                          | 34.029                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.679 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) =$  0.861 in.  
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.940 in.<sup>4</sup>  
 $S_e = I_x / \bar{y} =$  1.092 in.<sup>3</sup>  
**Mn = Se \* Fy = 65.55 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 33 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.504            |
| Corners       | 0.268   | 0.183            |
| Bottom Flange | 1.377   | 1.504            |
| Web           | 1.275   | 0.764            |
| Top Flange    | 3.144   | 0.024            |

Guess  $\bar{y}$ : 0.659 in.

Stress in Flange: 25.070 ksi  
 k: 4  
 Fcr: 24.245 ksi  
 $\lambda$ : 1.017  
 $\rho$ : 0.771  
 Effective Width: 2.423 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.504            | 2.072                           | 3.115                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 14.536     | 0.024            | 0.345                           | 0.008                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
|               | $\Sigma$ | 44.522     |                  | 29.358                          | 33.525                            | 1.897                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.659 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.868 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.761 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.877 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **28.95** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 40 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.504            |
| Corners       | 0.268   | 0.183            |
| Bottom Flange | 1.377   | 1.504            |
| Web           | 1.275   | 0.764            |
| Top Flange    | 3.144   | 0.024            |

Guess  $\bar{y}$ : 0.678 in.

Stress in Flange: 31.905 ksi  
 k: 4  
 Fcr: 24.245 ksi  
 $\lambda$ : 1.147  
 $\rho$ : 0.705  
 Effective Width: 2.215 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.504            | 2.072                           | 3.115                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 13.290     | 0.024            | 0.315                           | 0.007                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
|               | $\Sigma$ | 43.276     |                  | 29.329                          | 33.524                            | 1.897                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.678 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.850 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.737 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.867 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **34.69** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 50 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.504            |
| Corners       | 0.268   | 0.183            |
| Bottom Flange | 1.377   | 1.504            |
| Web           | 1.275   | 0.764            |
| Top Flange    | 3.144   | 0.024            |

Guess  $\bar{y}$ : 0.699 in.

Stress in Flange: 42.216 ksi  
 k: 4  
 Fcr: 24.245 ksi  
 $\lambda$ : 1.320  
 $\rho$ : 0.631  
 Effective Width: 1.985 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.504            | 2.072                           | 3.115                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 11.911     | 0.024            | 0.282                           | 0.007                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
|               | $\Sigma$ | 41.897     |                  | 29.296                          | 33.523                            | 1.897                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.699 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.828 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.708 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.855 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **42.74** k-in.



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 60 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.504            |
| Corners       | 0.268   | 0.183            |
| Bottom Flange | 1.377   | 1.504            |
| Web           | 1.275   | 0.764            |
| Top Flange    | 3.144   | 0.024            |

Guess  $\bar{y}$ : 0.717 in.

Stress in Flange: 53.042 ksi  
 k: 4  
 Fcr: 24.245 ksi  
 $\lambda$ : 1.479  
 $\rho$ : 0.576  
 Effective Width: 1.809 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.504            | 2.072                           | 3.115                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 10.856     | 0.024            | 0.257                           | 0.006                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
|               | $\Sigma$ | 40.842     |                  | 29.271                          | 33.523                            | 1.897                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.717 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.811 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.685 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.844 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **50.66** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 33 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.498            |
| Corners       | 0.261   | 0.173            |
| Bottom Flange | 1.377   | 1.498            |
| Web           | 1.275   | 0.758            |
| Top Flange    | 3.144   | 0.018            |

Guess  $\bar{y}$ : 0.707 in.

Stress in Flange: 28.850 ksi  
 k: 4  
 Fcr: 13.830 ksi  
 $\lambda$ : 1.444  
 $\rho$ : 0.587  
 Effective Width: 1.845 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.498            | 2.064                           | 3.091                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 11.071     | 0.018            | 0.198                           | 0.004                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
|               | $\Sigma$ | 40.880     |                  | 28.904                          | 33.056                            | 1.896                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.707 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.809 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.520 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.643 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **21.20** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 40 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.498            |
| Corners       | 0.261   | 0.173            |
| Bottom Flange | 1.377   | 1.498            |
| Web           | 1.275   | 0.758            |
| Top Flange    | 3.144   | 0.018            |

Guess  $\bar{y}$ : 0.725 in.

Stress in Flange: 36.702 ksi  
 k: 4  
 Fcr: 13.830 ksi  
 $\lambda$ : 1.629  
 $\rho$ : 0.531  
 Effective Width: 1.669 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.498            | 2.064                           | 3.091                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 10.015     | 0.018            | 0.179                           | 0.003                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
|               | $\Sigma$ | 39.825     |                  | 28.886                          | 33.056                            | 1.896                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.725 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.790 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.501 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.634 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **25.36** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 50 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.498            |
| Corners       | 0.261   | 0.173            |
| Bottom Flange | 1.377   | 1.498            |
| Web           | 1.275   | 0.758            |
| Top Flange    | 3.144   | 0.018            |

Guess  $\bar{y}$ : 0.746 in.

Stress in Flange: 48.426 ksi  
 k: 4  
 Fcr: 13.830 ksi  
 $\lambda$ : 1.871  
 $\rho$ : 0.472  
 Effective Width: 1.483 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.498            | 2.064                           | 3.091                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 8.895      | 0.018            | 0.159                           | 0.003                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
|               | $\Sigma$ | 38.705     |                  | 28.866                          | 33.055                            | 1.896                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.746 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.770 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.481 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.624 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **31.20** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 60 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.498            |
| Corners       | 0.261   | 0.173            |
| Bottom Flange | 1.377   | 1.498            |
| Web           | 1.275   | 0.758            |
| Top Flange    | 3.144   | 0.018            |

Guess  $\bar{y}$ : 0.761 in.

Stress in Flange: 60.000 ksi  
 k: 4  
 Fcr: 13.830 ksi  
 $\lambda$ : 2.083  
 $\rho$ : 0.429  
 Effective Width: 1.350 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.498            | 2.064                           | 3.091                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 8.100      | 0.018            | 0.145                           | 0.003                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
|               | $\Sigma$ | 37.909     |                  | 28.851                          | 33.055                            | 1.896                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.761 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.761 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.465 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.611 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **36.67** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 33 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.495            |
| Corners       | 0.257   | 0.168            |
| Bottom Flange | 1.377   | 1.495            |
| Web           | 1.275   | 0.755            |
| Top Flange    | 3.144   | 0.015            |

Guess  $\bar{y}$ : 0.740 in.

Stress in Flange: 31.737 ksi  
 k: 4  
 Fcr: 9.391 ksi  
 $\lambda$ : 1.838  
 $\rho$ : 0.479  
 Effective Width: 1.505 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.495            | 2.059                           | 3.078                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 9.033      | 0.015            | 0.133                           | 0.002                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
|               | $\Sigma$ | 38.747     |                  | 28.673                          | 32.804                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.740 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.769 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.398 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.517 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **17.05** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 40 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.495            |
| Corners       | 0.257   | 0.168            |
| Bottom Flange | 1.377   | 1.495            |
| Web           | 1.275   | 0.755            |
| Top Flange    | 3.144   | 0.015            |

Guess  $\bar{y}$ : 0.757 in.

Stress in Flange: 40.000 ksi  
 k: 4  
 Fcr: 9.391 ksi  
 $\lambda$ : 2.064  
 $\rho$ : 0.433  
 Effective Width: 1.361 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.495            | 2.059                           | 3.078                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 8.165      | 0.015            | 0.120                           | 0.002                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
|               | $\Sigma$ | 37.879     |                  | 28.661                          | 32.804                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.757 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.757 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.384 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.507 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 20.29 k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 50 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.495            |
| Corners       | 0.257   | 0.168            |
| Bottom Flange | 1.377   | 1.495            |
| Web           | 1.275   | 0.755            |
| Top Flange    | 3.144   | 0.015            |

Guess  $\bar{y}$ : 0.772 in.

Stress in Flange: 50.000 ksi  
 k: 4  
 Fcr: 9.391 ksi  
 $\lambda$ : 2.307  
 $\rho$ : 0.392  
 Effective Width: 1.233 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.495            | 2.059                           | 3.078                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 7.395      | 0.015            | 0.109                           | 0.002                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
|               | $\Sigma$ | 37.109     |                  | 28.649                          | 32.803                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L = 0.772$  in.  
 $\bar{Y}_{\text{EXTREME FIBER}} = \max(\bar{y}, h - \bar{y}) = 0.772$  in.  
 $I_x = [\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t = 0.371$  in.<sup>4</sup>  
 $S_e = I_x / \bar{y} = 0.481$  in.<sup>3</sup>  
**Mn = Se \* Fy = 24.04** k-in.



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 60 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.495            |
| Corners       | 0.257   | 0.168            |
| Bottom Flange | 1.377   | 1.495            |
| Web           | 1.275   | 0.755            |
| Top Flange    | 3.144   | 0.015            |

Guess  $\bar{y}$ : 0.784 in.

Stress in Flange: 60.000 ksi  
 k: 4  
 Fcr: 9.391 ksi  
 $\lambda$ : 2.528  
 $\rho$ : 0.361  
 Effective Width: 1.135 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.495            | 2.059                           | 3.078                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 6.813      | 0.015            | 0.100                           | 0.001                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
|               | $\Sigma$ | 36.527     |                  | 28.641                          | 32.803                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.784 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.784 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.361 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.461 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **27.63** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 33 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.492            |
| Corners       | 0.253   | 0.163            |
| Bottom Flange | 1.377   | 1.492            |
| Web           | 1.275   | 0.752            |
| Top Flange    | 3.144   | 0.012            |

Guess  $\bar{y}$ : 0.770 in.

Stress in Flange: 33.000 ksi  
 k: 4  
 Fcr: 6.112 ksi  
 $\lambda$ : 2.324  
 $\rho$ : 0.390  
 Effective Width: 1.225 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.492            | 2.055                           | 3.066                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 7.349      | 0.012            | 0.087                           | 0.001                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.492            | 10.270                          | 15.322                            | --                                |
|               | $\Sigma$ | 36.977     |                  | 28.478                          | 32.577                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.770 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.770 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.298 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.387 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **12.79** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 40 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.492            |
| Corners       | 0.253   | 0.163            |
| Bottom Flange | 1.377   | 1.492            |
| Web           | 1.275   | 0.752            |
| Top Flange    | 3.144   | 0.012            |

Guess  $\bar{y}$ : 0.783 in.

Stress in Flange: 40.000 ksi  
 k: 4  
 Fcr: 6.112 ksi  
 $\lambda$ : 2.558  
 $\rho$ : 0.357  
 Effective Width: 1.123 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.492            | 2.055                           | 3.066                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 6.739      | 0.012            | 0.080                           | 0.001                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.492            | 10.270                          | 15.322                            | --                                |
|               | $\Sigma$ | 36.367     |                  | 28.471                          | 32.577                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.783 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.783 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.290 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.370 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **14.81** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 50 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.492            |
| Corners       | 0.253   | 0.163            |
| Bottom Flange | 1.377   | 1.492            |
| Web           | 1.275   | 0.752            |
| Top Flange    | 3.144   | 0.012            |

Guess  $\bar{y}$ : 0.797 in.

Stress in Flange: 50.000 ksi  
 k: 4  
 Fcr: 6.112 ksi  
 $\lambda$ : 2.860  
 $\rho$ : 0.323  
 Effective Width: 1.015 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.492            | 2.055                           | 3.066                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 6.088      | 0.012            | 0.072                           | 0.001                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.492            | 10.270                          | 15.322                            | --                                |
|               | $\Sigma$ | 35.715     |                  | 28.463                          | 32.577                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.797 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.797 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.281 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.352 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 17.60 k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 60 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 1.492            |
| Corners       | 0.253   | 0.163            |
| Bottom Flange | 1.377   | 1.492            |
| Web           | 1.275   | 0.752            |
| Top Flange    | 3.144   | 0.012            |

Guess  $\bar{y}$ : 0.808 in.

Stress in Flange: 60.000 ksi  
 k: 4  
 Fcr: 6.112 ksi  
 $\lambda$ : 3.133  
 $\rho$ : 0.297  
 Effective Width: 0.933 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 2        | 1.378      | 1.492            | 2.055                           | 3.066                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 5.598      | 0.012            | 0.067                           | 0.001                             | --                                |
| Bottom Flange | 5        | 6.884      | 1.492            | 10.270                          | 15.322                            | --                                |
|               | $\Sigma$ | 35.225     |                  | 28.457                          | 32.577                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.808 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.808 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.273 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.338 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **20.30** k-in.

## CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING



### 5.0 Executive Summary

The Direct Strength Method predicted higher strengths for the majority of the 1.5B Deck sections undergoing negative flexure. The compression flange is the lower flange for this section and DSM is able to take advantage of the shorter compression flange width. DSM predicted lower strengths than the EWM for 24GA at yield stresses of 50 and 60 KSI and for 22GA at 60 KSI. DSM predicted higher strengths for all other sections of 1.5B Deck analyzed for negative flexure in this study. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 0.929 and 1.059.

## CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING

### 5.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

33 KSI   40 KSI   50 KSI   60 KSI

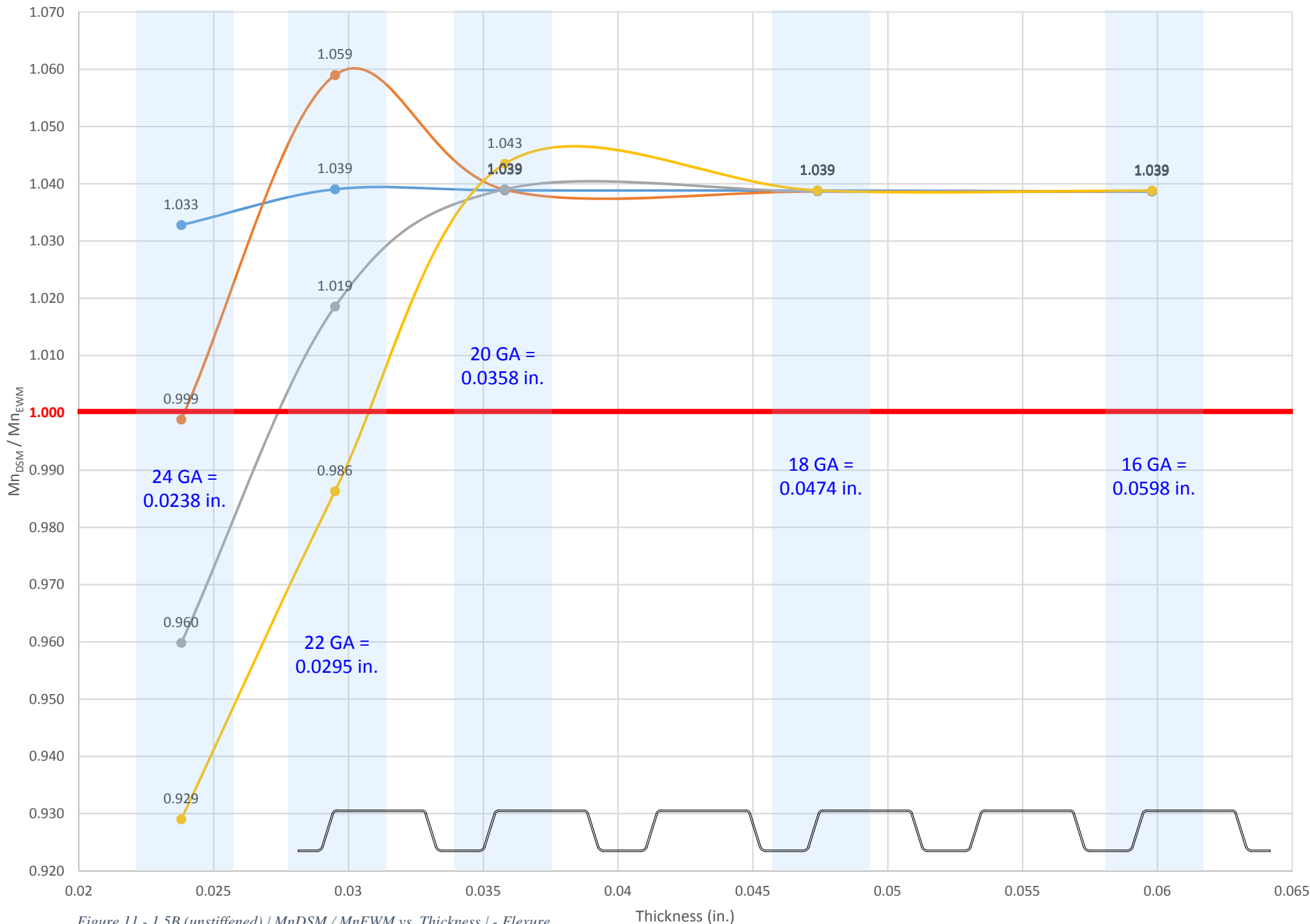


Figure 11 - 1.5B (unstiffened) | Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness | - Flexure

1.5B Deck Negative Bending



## CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING

### 5.2 Analysis Results Summary

Table 5 - 1.5B (unstiffened) | Analysis Results Summary | - Flexure

| 1.5 B DECK - 33 KSI |        |        |        |        |        |
|---------------------|--------|--------|--------|--------|--------|
| Gage                | 24     | 22     | 20     | 18     | 16     |
| Thickness           | 0.0238 | 0.0295 | 0.0358 | 0.0474 | 0.0598 |
| CL Radius           | 0.1999 | 0.2028 | 0.2059 | 0.2117 | 0.2179 |
| $I_G$               | 0.4345 | 0.5389 | 0.6543 | 0.8674 | 1.0957 |
| $\bar{y}_G$         | 0.9127 | 0.9150 | 0.9176 | 0.9223 | 0.9273 |
| $S_{xx}$            | 0.4761 | 0.5889 | 0.7131 | 0.9405 | 1.1816 |
| My                  | 15.71  | 19.43  | 23.53  | 31.04  | 38.99  |
| $Mn_{DSM}$          | 14.80  | 19.43  | 23.53  | 31.04  | 38.99  |
| $Mn_{EWM}$          | 14.33  | 18.7   | 22.65  | 29.88  | 37.54  |
| % ERROR             | 3.176% | 3.757% | 3.740% | 3.737% | 3.719% |

| 1.5 B DECK - 33 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 14.800     | 14.33      | 1.033                 |
| 22                  | 0.0295 | 19.430     | 18.7       | 1.039                 |
| 20                  | 0.0358 | 23.530     | 22.65      | 1.039                 |
| 18                  | 0.0474 | 31.040     | 29.88      | 1.039                 |
| 16                  | 0.0598 | 38.990     | 37.54      | 1.039                 |

| 1.5 B DECK - 40 KSI |         |        |        |        |        |
|---------------------|---------|--------|--------|--------|--------|
| Gage                | 24      | 22     | 20     | 18     | 16     |
| Thickness           | 0.0238  | 0.0295 | 0.0358 | 0.0474 | 0.0598 |
| CL Radius           | 0.1999  | 0.2028 | 0.2059 | 0.2117 | 0.2179 |
| $I_G$               | 0.4345  | 0.5389 | 0.6543 | 0.8674 | 1.0957 |
| $\bar{y}_G$         | 0.9127  | 0.9150 | 0.9176 | 0.9223 | 0.9273 |
| $S_{xx}$            | 0.4761  | 0.5889 | 0.7131 | 0.9405 | 1.1816 |
| My                  | 19.04   | 23.56  | 28.53  | 37.62  | 47.26  |
| $Mn_{DSM}$          | 16.86   | 23.52  | 28.53  | 37.62  | 47.26  |
| $Mn_{EWM}$          | 16.88   | 22.21  | 27.46  | 36.22  | 45.5   |
| % ERROR             | -0.119% | 5.570% | 3.750% | 3.721% | 3.724% |

| 1.5 B DECK - 40 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 16.860     | 16.88      | 0.999                 |
| 22                  | 0.0295 | 23.520     | 22.21      | 1.059                 |
| 20                  | 0.0358 | 28.530     | 27.46      | 1.039                 |
| 18                  | 0.0474 | 37.620     | 36.22      | 1.039                 |
| 16                  | 0.0598 | 47.260     | 45.5       | 1.039                 |

| 1.5 B DECK - 50 KSI |         |        |        |        |        |
|---------------------|---------|--------|--------|--------|--------|
| Gage                | 24      | 22     | 20     | 18     | 16     |
| Thickness           | 0.0238  | 0.0295 | 0.0358 | 0.0474 | 0.0598 |
| CL Radius           | 0.1999  | 0.2028 | 0.2059 | 0.2117 | 0.2179 |
| $I_G$               | 0.4345  | 0.5389 | 0.6543 | 0.8674 | 1.0957 |
| $\bar{y}_G$         | 0.9127  | 0.9150 | 0.9176 | 0.9223 | 0.9273 |
| $S_{xx}$            | 0.4761  | 0.5889 | 0.7131 | 0.9405 | 1.1816 |
| My                  | 23.80   | 29.45  | 35.66  | 47.02  | 59.08  |
| $Mn_{DSM}$          | 19.58   | 27.41  | 35.66  | 47.02  | 59.08  |
| $Mn_{EWM}$          | 20.4    | 26.91  | 34.32  | 45.27  | 56.88  |
| % ERROR             | -4.188% | 1.824% | 3.758% | 3.722% | 3.724% |

| 1.5 B DECK - 50 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 19.580     | 20.4       | 0.960                 |
| 22                  | 0.0295 | 27.410     | 26.91      | 1.019                 |
| 20                  | 0.0358 | 35.660     | 34.32      | 1.039                 |
| 18                  | 0.0474 | 47.020     | 45.27      | 1.039                 |
| 16                  | 0.0598 | 59.080     | 56.88      | 1.039                 |

| 1.5 B DECK - 60 KSI |         |         |        |        |        |
|---------------------|---------|---------|--------|--------|--------|
| Gage                | 24      | 22      | 20     | 18     | 16     |
| Thickness           | 0.0238  | 0.0295  | 0.0358 | 0.0474 | 0.0598 |
| CL Radius           | 0.1999  | 0.2028  | 0.2059 | 0.2117 | 0.2179 |
| $I_G$               | 0.4345  | 0.5389  | 0.6543 | 0.8674 | 1.0957 |
| $\bar{y}_G$         | 0.9127  | 0.9150  | 0.9176 | 0.9223 | 0.9273 |
| $S_{xx}$            | 0.4761  | 0.5889  | 0.7131 | 0.9405 | 1.1816 |
| My                  | 28.57   | 35.34   | 42.79  | 56.43  | 70.90  |
| $Mn_{DSM}$          | 22.11   | 31.01   | 41.99  | 56.43  | 70.90  |
| $Mn_{EWM}$          | 23.8    | 31.44   | 40.24  | 54.32  | 68.25  |
| % ERROR             | -7.644% | -1.387% | 4.168% | 3.739% | 3.738% |

| 1.5 B DECK - 60 KSI |        |            |            |                       |
|---------------------|--------|------------|------------|-----------------------|
| Thickness           |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                  | 0.0238 | 22.110     | 23.8       | 0.929                 |
| 22                  | 0.0295 | 31.010     | 31.44      | 0.986                 |
| 20                  | 0.0358 | 41.990     | 40.24      | 1.043                 |
| 18                  | 0.0474 | 56.430     | 54.32      | 1.039                 |
| 16                  | 0.0598 | 70.900     | 68.25      | 1.039                 |

## CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING

### 5.3 Direct Strength Method Calculations

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |                       |        |         |
|               | Gage:           | 16      | GA                    |        |         |
|               | Strength:       | -33     | KSI                   |        |         |
|               | $M_y =$         | 38.99   | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 7.42470 | $M_{crf} =$ 289.48905 | kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ 233.94    | kip-in | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ 233.94    | kip-in | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 38.99$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.37$  (local-global slenderness)  
 **$M_{n\ell} = 38.99$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 38.99$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 38.99$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                 |         |
|               | Gage:           | 16      | GA          |                 |         |
|               | Strength:       | -40     | KSI         |                 |         |
|               | $M_v =$         | 47.26   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_v =$ | 6.12540 | $M_{crf} =$ | 289.4864 kip-in | 2 in    |
| dist.         | $M_{crd}/M_v =$ | 6.00000 | $M_{crd} =$ | 283.56 kip-in   | - in    |
| global        | $M_{cre}/M_v =$ | 6.00000 | $M_{cre} =$ | 283.56 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 47.26$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.40$  (local-global slenderness)  
 **$M_{n\ell} = 47.26$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 47.26$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 47.26$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 16      | GA          |                  |         |
|               | Strength:       | -50     | KSI         |                  |         |
|               | $M_y =$         | 59.08   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 4.90030 | $M_{crf} =$ | 289.50972 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 354.48 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 354.48 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 59.08$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.45$  (local-global slenderness)  
 **$M_{n\ell} = 59.08$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 59.08$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 59.08$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 16      | GA          |                  |         |
|               | Strength:       | -60     | KSI         |                  |         |
|               | $M_y =$         | 70.90   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 4.08360 | $M_{crf} =$ | 289.52724 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 425.4 kip-in     | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 425.4 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 70.90$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.49$  (local-global slenderness)  
 **$M_{n\ell} = 70.90$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 70.90$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 70.90$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 18      | GA          |                  |         |
|               | Strength:       | -33     | KSI         |                  |         |
|               | $M_y =$         | 31.04   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 4.77600 | $M_{crf} =$ | 148.24704 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 186.24 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 186.24 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 31.04$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.46$  (local-global slenderness)  
 **$M_{n\ell} = 31.04$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 31.04$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 31.04$  kip-in (local-global controls)**



Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 18      | GA          |                  |         |
|               | Strength:       | -40     | KSI         |                  |         |
|               | $M_y =$         | 37.62   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 3.94020 | $M_{crf} =$ | 148.23032 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 225.72 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 225.72 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 37.62$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.50$  (local-global slenderness)  
 **$M_{n\ell} = 37.62$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 37.62$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 37.62$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 18      | GA          |                  |         |
|               | Strength:       | -50     | KSI         |                  |         |
|               | $M_y =$         | 47.02   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 3.15220 | $M_{crf} =$ | 148.21644 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 282.12 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 282.12 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 47.02$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.56$  (local-global slenderness)  
 **$M_{n\ell} = 47.02$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 47.02$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 47.02$  kip-in (local-global controls)**

Date: 11/25/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 18      | GA          |                  |         |
|               | Strength:       | -60     | KSI         |                  |         |
|               | $M_y =$         | 56.43   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 2.62680 | $M_{crf} =$ | 148.23032 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 338.58 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 338.58 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 56.43$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.62$  (local-global slenderness)  
 **$M_{n\ell} = 56.43$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 56.43$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 56.43$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | -33     | KSI         |                  |         |
|               | $M_y =$         | 23.53   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 2.84230 | $M_{crf} =$ | 66.879319 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 141.18 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 141.18 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 23.53$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.59$  (local-global slenderness)  
 **$M_{n\ell} = 23.53$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 23.53$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 23.53$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | -40     | KSI         |                  |         |
|               | $M_y =$         | 28.53   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 2.34490 | $M_{crf} =$ | 66.899997 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 171.18 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 171.18 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 28.53$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.65$  (local-global slenderness)  
 **$M_{n\ell} = 28.53$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 28.53$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 28.53$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 20      | GA          |                  |         |
|               | Strength:       | -50     | KSI         |                  |         |
|               | $M_y =$         | 35.66   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 1.87590 | $M_{crf} =$ | 66.894594 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 213.96 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 213.96 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 35.66$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.73$  (local-global slenderness)  
 **$M_{n\ell} = 35.66$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 35.66$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 35.66$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |         |      |
|---------------|-----------------|---------|-----------------------|---------|------|
| <b>Given:</b> | Deck:           | 1.5B    |                       |         |      |
|               | Gage:           | 20      | GA                    |         |      |
|               | Strength:       | -60     | KSI                   |         |      |
|               | $M_v =$         | 42.79   | kip-in                | Length: |      |
| local         | $M_{crf}/M_v =$ | 1.56320 | $M_{crf} = 66.889328$ | kip-in  | 2 in |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} = 256.74$    | kip-in  | - in |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} = 256.74$    | kip-in  | - in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 42.79$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.80$  (local-global slenderness)  
 **$M_{n\ell} = 41.99$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 42.79$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 41.99$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 22      | GA          |                  |         |
|               | Strength:       | -33     | KSI         |                  |         |
|               | $M_y =$         | 19.43   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 2.00370 | $M_{crf} =$ | 38.931891 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 116.58 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 116.58 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 19.43$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.71$  (local-global slenderness)  
 **$M_{n\ell} = 19.43$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 19.43$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 19.43$  kip-in (local-global controls)**



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                 |         |
|               | Gage:           | 22      | GA          |                 |         |
|               | Strength:       | -40     | KSI         |                 |         |
|               | $M_y =$         | 23.56   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.65300 | $M_{crf} =$ | 38.94468 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 141.36 kip-in   | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 141.36 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 23.56$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.78$  (local-global slenderness)  
 **$M_{n\ell} = 23.52$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 23.56$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 23.52$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                 |         |
|               | Gage:           | 22      | GA          |                 |         |
|               | Strength:       | -50     | KSI         |                 |         |
|               | $M_y =$         | 29.45   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.32240 | $M_{crf} =$ | 38.94468 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 176.7 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 176.7 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 29.45$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.87$  (local-global slenderness)  
 **$M_{n\ell} = 27.41$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 29.45$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 27.41$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                 |         |
|               | Gage:           | 22      | GA          |                 |         |
|               | Strength:       | -60     | KSI         |                 |         |
|               | $M_y =$         | 35.34   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.10200 | $M_{crf} =$ | 38.94468 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 212.04 kip-in   | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 212.04 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 35.34$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.95$  (local-global slenderness)  
 **$M_{n\ell} = 31.01$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 35.34$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 31.01$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |      |
|---------------|-----------------|---------|-------------|------------------|------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |      |
|               | Gage:           | 24      | GA          |                  |      |
|               | Strength:       | -33     | KSI         |                  |      |
|               | $M_y =$         | 15.71   | kip-in      | Length:          |      |
| local         | $M_{crf}/M_y =$ | 1.37370 | $M_{crf} =$ | 21.580827 kip-in | 2 in |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 94.26 kip-in     | - in |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 94.26 kip-in     | - in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$

$$M_{ne} = M_{cre} \quad (Eq. 1.2.2-1)$$

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$

$$M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right) \quad (Eq. 1.2.2-2)$$

for  $M_{cre} > 2.78M_y$

$$M_{ne} = M_y \quad (Eq. 1.2.2-3)$$

$$M_{ne} = 15.71 \text{ kip-in}$$

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$

$$M_{n\ell} = M_{ne} \quad (Eq. 1.2.2-5)$$

for  $\lambda_\ell > 0.776$

$$M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

$$\lambda_\ell = 0.85 \quad (\text{local-global slenderness})$$

$$M_{n\ell} = 14.80 \text{ kip-in} \quad (\text{local-global interaction reduction})$$

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$

$$M_{nd} = M_y \quad (Eq. 1.2.2-8)$$

for  $\lambda_d > 0.673$

$$M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y \quad (Eq. 1.2.2-9)$$

$$\text{where } \lambda_d = \sqrt{M_y/M_{crd}} \quad (Eq. 1.2.2-10)$$

$$\lambda_d = 0.41 \quad (\text{distortional slenderness})$$

$$M_{nd} = 15.71 \text{ kip-in} \quad (\text{fully effective section for distortional buckling})$$

#### Nominal flexural strength of the beam per DSM 1.2.2

$$M_n = 14.80 \text{ kip-in} \quad (\text{local-global controls})$$

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                  |         |
|               | Gage:           | 24      | GA          |                  |         |
|               | Strength:       | -40     | KSI         |                  |         |
|               | $M_y =$         | 19.04   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 1.13330 | $M_{crf} =$ | 21.578032 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} =$ | 114.24 kip-in    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} =$ | 114.24 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 19.04$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.94$  (local-global slenderness)  
 **$M_{n\ell} = 16.86$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 19.04$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 16.86$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |             |                 |         |
|               | Gage:           | 24      | GA          |                 |         |
|               | Strength:       | -50     | KSI         |                 |         |
|               | $M_v =$         | 23.80   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_v =$ | 0.90665 | $M_{crf} =$ | 21.57827 kip-in | 2 in    |
| dist.         | $M_{crd}/M_v =$ | 6.00000 | $M_{crd} =$ | 142.8 kip-in    | - in    |
| global        | $M_{cre}/M_v =$ | 6.00000 | $M_{cre} =$ | 142.8 kip-in    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 23.80$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.05$  (local-global slenderness)  
 **$M_{n\ell} = 19.58$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 23.80$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 19.58$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |         |
|---------------|-----------------|---------|-----------------------|---------|
| <b>Given:</b> | Deck:           | 1.5B    |                       |         |
|               | Gage:           | 24      | GA                    |         |
|               | Strength:       | -60     | KSI                   |         |
|               | $M_y =$         | 28.57   | kip-in                | Length: |
| local         | $M_{crf}/M_y =$ | 0.75554 | $M_{crf} = 21.585778$ | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 6.00000 | $M_{crd} = 171.42$    | - in    |
| global        | $M_{cre}/M_y =$ | 6.00000 | $M_{cre} = 171.42$    | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 28.57$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.15$  (local-global slenderness)  
 **$M_{n\ell} = 22.11$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.41$  (distortional slenderness)  
 **$M_{nd} = 28.57$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 22.11$  kip-in (local-global controls)**

## CHAPTER 5: ANALYSIS | 1.5B DECK | - BENDING

### 5.4 Effective Width Method Calculations



**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 33 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.030            |
| Corners       | 0.276   | 0.194            |
| Top Flange    | 1.377   | 0.030            |
| Web           | 1.275   | 0.770            |
| Bottom Flange | 3.144   | 1.510            |

Guess  $\bar{y}$ : 0.610 in.

Stress in Flange: 21.644 ksi  
 k: 4  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.328  
 $\rho$ : 1.004  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.510            | 12.472                          | 18.832                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.030            | 0.564                           | 0.017                             | --                                |
|               | $\Sigma$ | 49.036     |                  | 29.907                          | 34.032                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.610 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.930 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  1.058 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.138 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **37.54** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 40 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.030            |
| Corners       | 0.276   | 0.194            |
| Top Flange    | 1.377   | 0.030            |
| Web           | 1.275   | 0.770            |
| Bottom Flange | 3.144   | 1.510            |

Guess  $\bar{y}$ : 0.610 in.

Stress in Flange: 26.235 ksi  
 k: 4  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.361  
 $\rho$ : 1.082  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.510            | 12.472                          | 18.832                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.030            | 0.564                           | 0.017                             | --                                |
|               | $\Sigma$ | 49.036     |                  | 29.907                          | 34.032                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.610 in.  
 $\bar{y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.930 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.058 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.138 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **45.50** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 50 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.030            |
| Corners       | 0.276   | 0.194            |
| Top Flange    | 1.377   | 0.030            |
| Web           | 1.275   | 0.770            |
| Bottom Flange | 3.144   | 1.510            |

Guess  $\bar{y}$ : 0.610 in.

Stress in Flange: 32.794 ksi  
 k: 4  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.404  
 $\rho$ : 1.127  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.510            | 12.472                          | 18.832                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.030            | 0.564                           | 0.017                             | --                                |
|               | $\Sigma$ | 49.036     |                  | 29.907                          | 34.032                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.610 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.930 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.058 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.138 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **56.88** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 16 GA  
 Strength: 60 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.030            |
| Corners       | 0.276   | 0.194            |
| Top Flange    | 1.377   | 0.030            |
| Web           | 1.275   | 0.770            |
| Bottom Flange | 3.144   | 1.510            |

Guess  $\bar{y}$ : 0.610 in.

Stress in Flange: 39.353 ksi  
 k: 4  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.442  
 $\rho$ : 1.136  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web           | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner    | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.510            | 12.472                          | 18.832                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.030            | 0.564                           | 0.017                             | --                                |
|               | $\Sigma$ | 49.036     |                  | 29.907                          | 34.032                            | 1.898                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.610 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.930 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 1.058 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.138 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **68.25** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 33 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.024            |
| Corners       | 0.268   | 0.183            |
| Top Flange    | 1.377   | 0.024            |
| Web           | 1.275   | 0.764            |
| Bottom Flange | 3.144   | 1.504            |

Guess  $\bar{y}$ : 0.603 in.

Stress in Flange: 21.532 ksi  
 k: 4  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.413  
 $\rho$ : 1.131  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.504            | 12.421                          | 18.678                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.024            | 0.447                           | 0.011                             | --                                |
|               | $\Sigma$ | 48.848     |                  | 29.459                          | 33.525                            | 1.897                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.603 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.924 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.837 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.905 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **29.88** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 40 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.024            |
| Corners       | 0.268   | 0.183            |
| Top Flange    | 1.377   | 0.024            |
| Web           | 1.275   | 0.764            |
| Bottom Flange | 3.144   | 1.504            |

Guess  $\bar{y}$ : 0.603 in.

Stress in Flange: 26.099 ksi  
 k: 4  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.454  
 $\rho$ : 1.135  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.504            | 12.421                          | 18.678                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.024            | 0.447                           | 0.011                             | --                                |
|               | $\Sigma$ | 48.848     |                  | 29.459                          | 33.525                            | 1.897                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.603 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.924 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.837 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.905 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **36.22 k-in.**

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 50 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.024            |
| Corners       | 0.268   | 0.183            |
| Top Flange    | 1.377   | 0.024            |
| Web           | 1.275   | 0.764            |
| Bottom Flange | 3.144   | 1.504            |

Guess  $\bar{y}$ : 0.603 in.

Stress in Flange: 32.624 ksi  
 k: 4  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.508  
 $\rho$ : 1.116  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.504            | 12.421                          | 18.678                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.024            | 0.447                           | 0.011                             | --                                |
|               | $\Sigma$ | 48.848     |                  | 29.459                          | 33.525                            | 1.897                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.603 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.924 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.837 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.905 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **45.27** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 18 GA  
 Strength: 60 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.024            |
| Corners       | 0.268   | 0.183            |
| Top Flange    | 1.377   | 0.024            |
| Web           | 1.275   | 0.764            |
| Bottom Flange | 3.144   | 1.504            |

Guess  $\bar{y}$ : 0.603 in.

Stress in Flange: 39.148 ksi  
 k: 4  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.556  
 $\rho$ : 1.087  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web           | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner    | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange    | 6        | 8.260      | 1.504            | 12.421                          | 18.678                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.024            | 0.447                           | 0.011                             | --                                |
|               | $\Sigma$ | 48.848     |                  | 29.459                          | 33.525                            | 1.897                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.603 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.924 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.837 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.905 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **54.32** k-in.



**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 33 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.018            |
| Corners       | 0.261   | 0.173            |
| Top Flange    | 1.377   | 0.018            |
| Web           | 1.275   | 0.758            |
| Bottom Flange | 3.144   | 1.498            |

Guess  $\bar{y}$ : 0.597 in.

Stress in Flange: 21.425 ksi  
 k: 4  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.545  
 $\rho$ : 1.094  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 8.260      | 1.498            | 12.373                          | 18.534                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.018            | 0.338                           | 0.006                             | --                                |
|               | $\Sigma$ | 48.671     |                  | 29.043                          | 33.056                            | 1.896                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.597 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.919 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.631 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.686 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **22.65** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 40 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.018            |
| Corners       | 0.261   | 0.173            |
| Top Flange    | 1.377   | 0.018            |
| Web           | 1.275   | 0.758            |
| Bottom Flange | 3.144   | 1.498            |

Guess  $\bar{y}$ : 0.597 in.

Stress in Flange: 25.969 ksi  
 k: 4  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.600  
 $\rho$ : 1.055  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 8.260      | 1.498            | 12.373                          | 18.534                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.018            | 0.338                           | 0.006                             | --                                |
|               | $\Sigma$ | 48.671     |                  | 29.043                          | 33.056                            | 1.896                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.597 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.919 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.631 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.686 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 27.46 k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 50 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.018            |
| Corners       | 0.261   | 0.173            |
| Top Flange    | 1.377   | 0.018            |
| Web           | 1.275   | 0.758            |
| Bottom Flange | 3.144   | 1.498            |

Guess  $\bar{y}$ : 0.597 in.

Stress in Flange: 32.462 ksi  
 k: 4  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.671  
 $\rho$ : 1.002  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 8.260      | 1.498            | 12.373                          | 18.534                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.018            | 0.338                           | 0.006                             | --                                |
|               | $\Sigma$ | 48.671     |                  | 29.043                          | 33.056                            | 1.896                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.597 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.919 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.631 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.686 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **34.32** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 20 GA  
 Strength: 60 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.018            |
| Corners       | 0.261   | 0.173            |
| Top Flange    | 1.377   | 0.018            |
| Web           | 1.275   | 0.758            |
| Bottom Flange | 3.144   | 1.498            |

Guess  $\bar{y}$ : 0.590 in.

Stress in Flange: 38.265 ksi  
 k: 4  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.728  
 $\rho$ : 0.958  
 Effective Width: 1.319 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web           | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner    | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange    | 6        | 7.915      | 1.498            | 11.856                          | 17.759                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.018            | 0.338                           | 0.006                             | --                                |
|               | $\Sigma$ | 48.326     |                  | 28.525                          | 32.281                            | 1.896                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.590 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.926 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.621 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.671 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **40.24** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 33 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.015            |
| Corners       | 0.257   | 0.168            |
| Top Flange    | 1.377   | 0.015            |
| Web           | 1.275   | 0.755            |
| Bottom Flange | 3.144   | 1.495            |

Guess  $\bar{y}$ : 0.593 in.

Stress in Flange: 21.366 ksi  
 k: 4  
 Fcr: 48.966 ksi  
 $\lambda$ : 0.661  
 $\rho$ : 1.010  
 Effective Width: 1.377 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 8.260      | 1.495            | 12.347                          | 18.456                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.015            | 0.278                           | 0.004                             | --                                |
|               | $\Sigma$ | 48.576     |                  | 28.817                          | 32.804                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.593 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.916 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.519 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.567 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **18.70** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 40 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.015            |
| Corners       | 0.257   | 0.168            |
| Top Flange    | 1.377   | 0.015            |
| Web           | 1.275   | 0.755            |
| Bottom Flange | 3.144   | 1.495            |

Guess  $\bar{y}$ : 0.588 in.

Stress in Flange: 25.494 ksi  
 k: 4  
 Fcr: 48.966 ksi  
 $\lambda$ : 0.722  
 $\rho$ : 0.963  
 Effective Width: 1.326 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 7.958      | 1.495            | 11.895                          | 17.780                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.015            | 0.278                           | 0.004                             | --                                |
|               | $\Sigma$ | 48.273     |                  | 28.364                          | 32.127                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.588 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.922 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.512 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.555 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **22.21** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 50 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.015            |
| Corners       | 0.257   | 0.168            |
| Top Flange    | 1.377   | 0.015            |
| Web           | 1.275   | 0.755            |
| Bottom Flange | 3.144   | 1.495            |

Guess  $\bar{y}$ : 0.579 in.

Stress in Flange: 31.109 ksi  
 k: 4  
 Fcr: 48.966 ksi  
 $\lambda$ : 0.797  
 $\rho$ : 0.908  
 Effective Width: 1.251 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 7.503      | 1.495            | 11.215                          | 16.764                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.015            | 0.278                           | 0.004                             | --                                |
|               | $\Sigma$ | 47.818     |                  | 27.685                          | 31.112                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.579 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.931 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.501 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.538 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **26.91 k-in.**

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 22 GA  
 Strength: 60 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.015            |
| Corners       | 0.257   | 0.168            |
| Top Flange    | 1.377   | 0.015            |
| Web           | 1.275   | 0.755            |
| Bottom Flange | 3.144   | 1.495            |

Guess  $\bar{y}$ : 0.572 in.

Stress in Flange: 36.573 ksi  
 k: 4  
 Fcr: 48.966 ksi  
 $\lambda$ : 0.864  
 $\rho$ : 0.863  
 Effective Width: 1.187 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web           | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner    | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange    | 6        | 7.125      | 1.495            | 10.650                          | 15.919                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.015            | 0.278                           | 0.004                             | --                                |
|               | $\Sigma$ | 47.440     |                  | 27.120                          | 30.267                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.572 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.938 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.491 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.524 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **31.44** k-in.



**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 33 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.012            |
| Corners       | 0.253   | 0.163            |
| Top Flange    | 1.377   | 0.012            |
| Web           | 1.275   | 0.752            |
| Bottom Flange | 3.144   | 1.492            |

Guess  $\bar{y}$ : 0.575 in.

Stress in Flange: 20.450 ksi  
 k: 4  
 Fcr: 31.872 ksi  
 $\lambda$ : 0.801  
 $\rho$ : 0.906  
 Effective Width: 1.247 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 7.480      | 1.492            | 11.160                          | 16.649                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.012            | 0.224                           | 0.003                             | --                                |
|               | $\Sigma$ | 47.709     |                  | 27.449                          | 30.840                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.575 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  0.928 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.403 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.434 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 14.33 k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 40 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.012            |
| Corners       | 0.253   | 0.163            |
| Top Flange    | 1.377   | 0.012            |
| Web           | 1.275   | 0.752            |
| Bottom Flange | 3.144   | 1.492            |

Guess  $\bar{y}$ : 0.568 in.

Stress in Flange: 24.253 ksi  
 k: 4  
 Fcr: 31.872 ksi  
 $\lambda$ : 0.872  
 $\rho$ : 0.857  
 Effective Width: 1.180 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 7.081      | 1.492            | 10.565                          | 15.761                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.012            | 0.224                           | 0.003                             | --                                |
|               | $\Sigma$ | 47.310     |                  | 26.854                          | 29.952                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.568 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.936 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.395 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.422 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **16.88** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 50 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.012            |
| Corners       | 0.253   | 0.163            |
| Top Flange    | 1.377   | 0.012            |
| Web           | 1.275   | 0.752            |
| Bottom Flange | 3.144   | 1.492            |

Guess  $\bar{y}$ : 0.559 in.

Stress in Flange: 29.542 ksi  
 k: 4  
 Fcr: 31.872 ksi  
 $\lambda$ : 0.963  
 $\rho$ : 0.801  
 Effective Width: 1.103 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 6.619      | 1.492            | 9.875                           | 14.733                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.012            | 0.224                           | 0.003                             | --                                |
|               | $\Sigma$ | 46.848     |                  | 26.165                          | 28.924                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.559 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.945 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.386 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.408 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **20.40** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 1.58  
 Gage: 24 GA  
 Strength: 60 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

| Element       | L (in.) | y from top (in.) |
|---------------|---------|------------------|
| Lip           | 0.689   | 0.012            |
| Corners       | 0.253   | 0.163            |
| Top Flange    | 1.377   | 0.012            |
| Web           | 1.275   | 0.752            |
| Bottom Flange | 3.144   | 1.492            |

Guess  $\bar{y}$ : 0.551 in.

Stress in Flange: 34.702 ksi  
 k: 4  
 Fcr: 31.872 ksi  
 $\lambda$ : 1.043  
 $\rho$ : 0.756  
 Effective Width: 1.041 in.

| Element       | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|---------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip           | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web           | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner    | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange    | 6        | 6.247      | 1.492            | 9.320                           | 13.905                            | --                                |
| Bottom Flange | 6        | 18.862     | 0.012            | 0.224                           | 0.003                             | --                                |
|               | $\Sigma$ | 46.476     |                  | 25.610                          | 28.096                            | 1.895                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.551 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.953 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.378 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.397 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **23.80** k-in.

## CHAPTER 6: ANALYSIS | 1.5B DECK (STIFFENED) | + BENDING



### 6.0 Executive Summary

To observe how a stiffened deck section performs compared to an unstiffened deck section, we created a non-standard shape by adding the compression flange stiffener from the 2C Deck to the 1.5B Deck. With the addition of the stiffener in the compression flange, the Direct Strength Method predicted higher strengths for each of the 1.5B Deck sections undergoing positive flexure. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 1.058 and 1.082. We believe that we see an increase in strength with DSM due to the decreased flat width of the compression flange.

## CHAPTER 6: ANALYSIS | 1.5B DECK (STIFFENED) | + BENDING

### 6.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

33 KSI   40 KSI   50 KSI   60 KSI

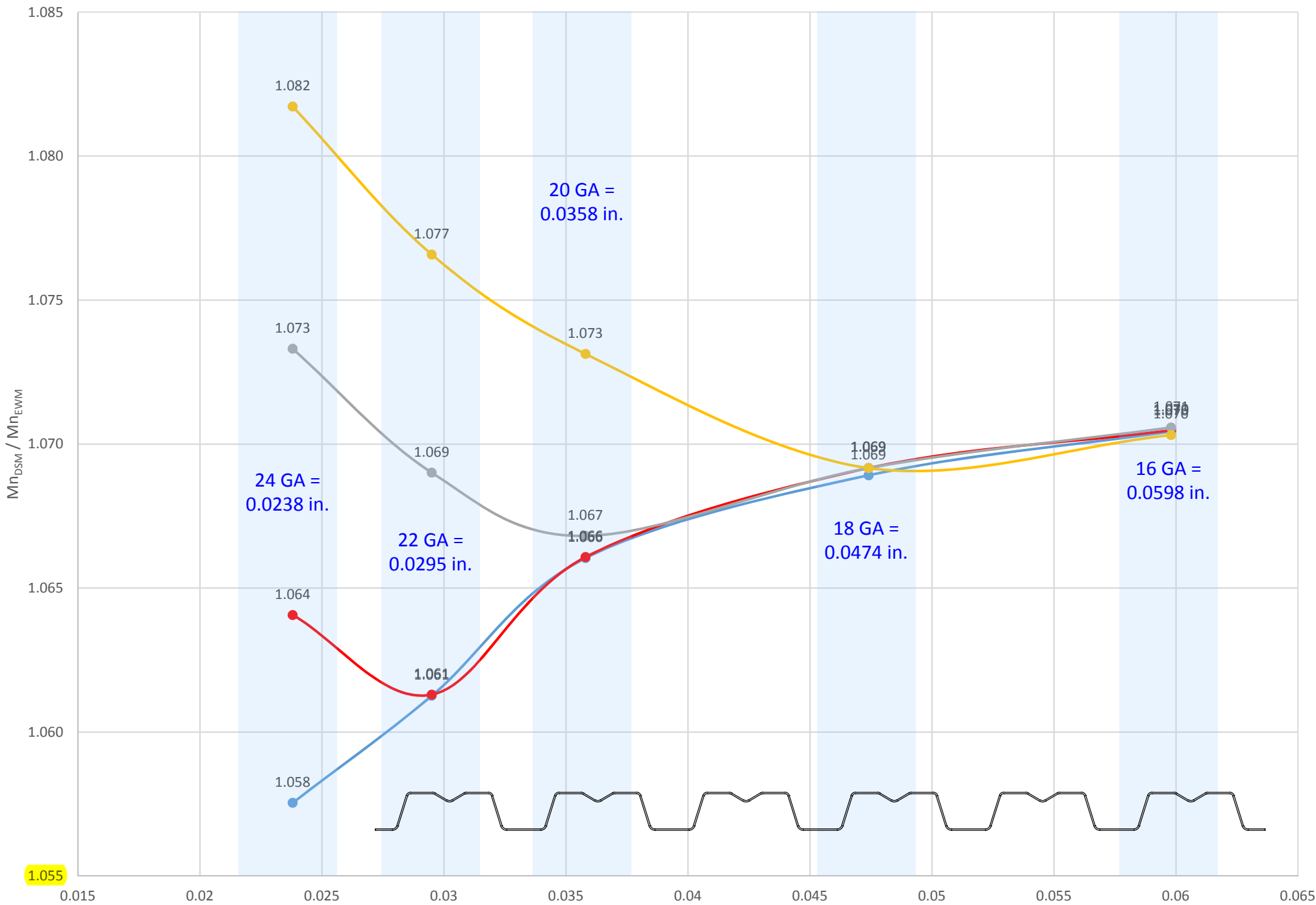


Figure 12 - 1.5B (stiffened) | Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness | + Flexure

1.5B Deck w/ Stiffeners Positive Bending

## 6.2 Analysis Results Summary



Table 6 - 1.5B (stiffened) | Analysis Results Summary | + Flexure

| 1.5B DECK (stiffeners) - 33 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| I <sub>g</sub> (CUFSM)          | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| y-bar (CUFSM)                   | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| S <sub>xx</sub>                 | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| My                              | 15.07   | 18.71   | 22.76   | 30.09   | 37.84   |
| Mn <sub>DSM</sub>               | 15.07   | 18.71   | 22.76   | 30.09   | 37.84   |
| Mn <sub>EWM</sub>               | 14.25   | 17.63   | 21.35   | 28.15   | 35.35   |
| % ERROR                         | 5.441%  | 5.772%  | 6.195%  | 6.447%  | 6.580%  |

| 1.5B DECK (stiffeners) - 33 KSI |        |                   |                   |                                       |
|---------------------------------|--------|-------------------|-------------------|---------------------------------------|
| Thickness                       |        | Mn <sub>DSM</sub> | Mn <sub>EWM</sub> | Mn <sub>DSM</sub> / Mn <sub>EWM</sub> |
| 24                              | 0.0238 | 15.07             | 14.25             | 1.058                                 |
| 22                              | 0.0295 | 18.71             | 17.63             | 1.061                                 |
| 20                              | 0.0358 | 22.76             | 21.35             | 1.066                                 |
| 18                              | 0.0474 | 30.09             | 28.15             | 1.069                                 |
| 16                              | 0.0598 | 37.84             | 35.35             | 1.070                                 |

| 1.5B DECK (stiffeners) - 40 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| I <sub>g</sub> (CUFSM)          | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| y-bar (CUFSM)                   | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| S <sub>xx</sub>                 | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| My                              | 18.27   | 22.68   | 27.59   | 36.48   | 45.87   |
| Mn <sub>DSM</sub>               | 18.27   | 22.68   | 27.59   | 36.48   | 45.87   |
| Mn <sub>EWM</sub>               | 17.17   | 21.37   | 25.88   | 34.12   | 42.85   |
| % ERROR                         | 6.021%  | 5.776%  | 6.198%  | 6.469%  | 6.584%  |

| 1.5B DECK (stiffeners) - 40 KSI |        |                   |                   |                                       |
|---------------------------------|--------|-------------------|-------------------|---------------------------------------|
| Thickness                       |        | Mn <sub>DSM</sub> | Mn <sub>EWM</sub> | Mn <sub>DSM</sub> / Mn <sub>EWM</sub> |
| 24                              | 0.0238 | 18.27             | 17.17             | 1.064                                 |
| 22                              | 0.0295 | 22.68             | 21.37             | 1.061                                 |
| 20                              | 0.0358 | 27.59             | 25.88             | 1.066                                 |
| 18                              | 0.0474 | 36.48             | 34.12             | 1.069                                 |
| 16                              | 0.0598 | 45.87             | 42.85             | 1.070                                 |

| 1.5B DECK (stiffeners) - 50 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| I <sub>g</sub> (CUFSM)          | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| y-bar (CUFSM)                   | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| S <sub>xx</sub>                 | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| My                              | 22.84   | 28.35   | 34.49   | 45.60   | 57.34   |
| Mn <sub>DSM</sub>               | 22.84   | 28.35   | 34.49   | 45.6    | 57.34   |
| Mn <sub>EWM</sub>               | 21.28   | 26.52   | 32.33   | 42.65   | 53.56   |
| % ERROR                         | 6.830%  | 6.455%  | 6.263%  | 6.469%  | 6.592%  |

| 1.5B DECK (stiffeners) - 50 KSI |        |                   |                   |                                       |
|---------------------------------|--------|-------------------|-------------------|---------------------------------------|
| Thickness                       |        | Mn <sub>DSM</sub> | Mn <sub>EWM</sub> | Mn <sub>DSM</sub> / Mn <sub>EWM</sub> |
| 24                              | 0.0238 | 22.84             | 21.28             | 1.073                                 |
| 22                              | 0.0295 | 28.35             | 26.52             | 1.069                                 |
| 20                              | 0.0358 | 34.49             | 32.33             | 1.067                                 |
| 18                              | 0.0474 | 45.60             | 42.65             | 1.069                                 |
| 16                              | 0.0598 | 57.34             | 53.56             | 1.071                                 |

| 1.5B DECK (stiffeners) - 60 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| I <sub>g</sub> (CUFSM)          | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| y-bar (CUFSM)                   | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| S <sub>xx</sub>                 | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| My                              | 27.40   | 34.02   | 41.38   | 54.72   | 68.80   |
| Mn <sub>DSM</sub>               | 27.4    | 34.02   | 41.38   | 54.72   | 68.8    |
| Mn <sub>EWM</sub>               | 25.33   | 31.6    | 38.56   | 51.18   | 64.28   |
| % ERROR                         | 7.555%  | 7.113%  | 6.815%  | 6.469%  | 6.570%  |

| 1.5B DECK (stiffeners) - 60 KSI |        |                   |                   |                                       |
|---------------------------------|--------|-------------------|-------------------|---------------------------------------|
| Thickness                       |        | Mn <sub>DSM</sub> | Mn <sub>EWM</sub> | Mn <sub>DSM</sub> / Mn <sub>EWM</sub> |
| 24                              | 0.0238 | 27.4              | 25.33             | 1.082                                 |
| 22                              | 0.0295 | 34.02             | 31.60             | 1.077                                 |
| 20                              | 0.0358 | 41.38             | 38.56             | 1.073                                 |
| 18                              | 0.0474 | 54.72             | 51.18             | 1.069                                 |
| 16                              | 0.0598 | 68.80             | 64.28             | 1.070                                 |

### 6.3 Direct Strength Method Calculations

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 16       | GA                             |         |
|               | Strength:          | 33       | KSI                            |         |
|               | $M_y =$            | 37.84    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 22.34510 | $M_{cr\ell} = 845.5386$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 14.43000 | $M_{crd} = 546.0312$ kip-in    | 11 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1892$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 37.84$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.21$  (local-global slenderness)

**$M_{n\ell} = 37.84$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.26$  (distortional slenderness)

**$M_{nd} = 37.84$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 37.84$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |    |
|--------|--------------------|----------|--------------------------------|---------|----|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |    |
|        | Gage:              | 16       | GA                             |         |    |
|        | Strength:          | 40       | KSI                            |         |    |
|        | $M_y =$            | 45.87    | kip-in                         | Length: |    |
| local  | $M_{cr\ell}/M_y =$ | 18.43470 | $M_{cr\ell} =$ 845.5997 kip-in | 1       | in |
| dist.  | $M_{crd}/M_y =$    | 11.90000 | $M_{crd} =$ 545.853 kip-in     | 11      | in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 2293.5 kip-in      | -       | in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 45.87$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.23$  (local-global slenderness)

**$M_{n\ell} = 45.87$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.29$  (distortional slenderness)

**$M_{nd} = 45.87$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 45.87$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 16       | GA                             |         |
|               | Strength:          | 50       | KSI                            |         |
|               | $M_y =$            | 57.34    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 14.74770 | $M_{cr\ell} = 845.6331$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 9.52000  | $M_{crd} = 545.8768$ kip-in    | 11 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2867$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 57.34$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.26$  (local-global slenderness)

**$M_{n\ell} = 57.34$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)

**$M_{nd} = 57.34$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 57.34$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 16       | GA                             |         |
|               | Strength:          | 60       | KSI                            |         |
|               | $M_y =$            | 68.80    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 12.28990 | $M_{cr\ell} = 845.5451$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 7.93000  | $M_{crd} = 545.584$ kip-in     | 11 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 3440$ kip-in        | - in    |

### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 68.80$  kip-in**

### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.29$  (local-global slenderness)

**$M_{n\ell} = 68.80$  kip-in** (fully effective section for local buckling)

### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.36$  (distortional slenderness)

**$M_{nd} = 68.80$  kip-in** (fully effective section for distortional buckling)

### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 68.80$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 18       | GA                             |         |
|        | Strength:          | 33       | KSI                            |         |
|        | $M_y =$            | 30.09    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 14.84880 | $M_{cr\ell} = 446.8004$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 11.36000 | $M_{crd} = 341.8224$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1504.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 30.09$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.26$  (local-global slenderness)

**$M_{n\ell} = 30.09$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.30$  (distortional slenderness)

**$M_{nd} = 30.09$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 30.09$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 18       | GA                             |         |
|        | Strength:          | 40       | KSI                            |         |
|        | $M_y =$            | 36.48    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 12.25040 | $M_{cr\ell} = 446.8946$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 9.38000  | $M_{crd} = 342.1824$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1824$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 36.48$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.29$  (local-global slenderness)

**$M_{n\ell} = 36.48$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.33$  (distortional slenderness)

**$M_{nd} = 36.48$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 36.48$  kip-in (local-global controls)**



Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                         |         |       |
|--------|--------------------|----------|-------------------------|---------|-------|
| Given: | Deck:              | 1.5B     | (stiffeners)            |         |       |
|        | Gage:              | 18       | GA                      |         |       |
|        | Strength:          | 50       | KSI                     |         |       |
|        | $M_y =$            | 45.60    | kip-in                  | Length: |       |
| local  | $M_{cr\ell}/M_y =$ | 9.80020  | $M_{cr\ell} = 446.8891$ | kip-in  | 1 in  |
| dist.  | $M_{crd}/M_y =$    | 7.50000  | $M_{crd} = 342$         | kip-in  | 12 in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2280$        | kip-in  | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 45.60$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.32$  (local-global slenderness)

**$M_{n\ell} = 45.60$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.37$  (distortional slenderness)

**$M_{nd} = 45.60$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 45.60$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                         |         |       |
|--------|--------------------|----------|-------------------------|---------|-------|
| Given: | Deck:              | 1.5B     | (stiffeners)            |         |       |
|        | Gage:              | 18       | GA                      |         |       |
|        | Strength:          | 60       | KSI                     |         |       |
|        | $M_y =$            | 54.72    | kip-in                  | Length: |       |
| local  | $M_{cr\ell}/M_y =$ | 8.16690  | $M_{cr\ell} = 446.8928$ | kip-in  | 1 in  |
| dist.  | $M_{crd}/M_y =$    | 6.25000  | $M_{crd} = 342$         | kip-in  | 12 in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2736$        | kip-in  | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 54.72$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.35$  (local-global slenderness)

**$M_{n\ell} = 54.72$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.40$  (distortional slenderness)

**$M_{nd} = 54.72$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 54.72$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                               |         |    |
|--------|--------------------|----------|-------------------------------|---------|----|
| Given: | Deck:              | 1.5B     | (stiffeners)                  |         |    |
|        | Gage:              | 20       | GA                            |         |    |
|        | Strength:          | 33       | KSI                           |         |    |
|        | $M_y =$            | 22.76    | kip-in                        | Length: |    |
| local  | $M_{cr\ell}/M_y =$ | 8.94530  | $M_{cr\ell} =$ 203.595 kip-in | 1       | in |
| dist.  | $M_{crd}/M_y =$    | 8.76000  | $M_{crd} =$ 199.3776 kip-in   | 12      | in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 1138 kip-in       | -       | in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 22.76$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.33$  (local-global slenderness)

**$M_{n\ell} = 22.76$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.34$  (distortional slenderness)

**$M_{nd} = 22.76$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 22.76$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 20       | GA                             |         |
|        | Strength:          | 40       | KSI                            |         |
|        | $M_y =$            | 27.59    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 7.37980  | $M_{cr\ell} = 203.6087$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 7.23000  | $M_{crd} = 199.4757$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1379.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 27.59$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.37$  (local-global slenderness)

**$M_{n\ell} = 27.59$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.37$  (distortional slenderness)

**$M_{nd} = 27.59$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 27.59$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 20       | GA                             |         |
|               | Strength:          | 50       | KSI                            |         |
|               | $M_y =$            | 34.49    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 5.90380  | $M_{cr\ell} = 203.6221$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 5.78000  | $M_{crd} = 199.3522$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1724.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 34.49$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.41$  (local-global slenderness)

**$M_{n\ell} = 34.49$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.42$  (distortional slenderness)

**$M_{nd} = 34.49$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 34.49$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |    |
|--------|--------------------|----------|--------------------------------|---------|----|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |    |
|        | Gage:              | 20       | GA                             |         |    |
|        | Strength:          | 60       | KSI                            |         |    |
|        | $M_y =$            | 41.38    | kip-in                         | Length: |    |
| local  | $M_{cr\ell}/M_y =$ | 4.91990  | $M_{cr\ell} =$ 203.5855 kip-in | 1       | in |
| dist.  | $M_{crd}/M_y =$    | 4.82000  | $M_{crd} =$ 199.4516 kip-in    | 12      | in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 2069 kip-in        | -       | in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 41.38$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.45$  (local-global slenderness)

**$M_{n\ell} = 41.38$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.46$  (distortional slenderness)

**$M_{nd} = 41.38$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 41.38$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                               |         |    |
|--------|--------------------|----------|-------------------------------|---------|----|
| Given: | Deck:              | 1.5B     | (stiffeners)                  |         |    |
|        | Gage:              | 22       | GA                            |         |    |
|        | Strength:          | 33       | KSI                           |         |    |
|        | $M_y =$            | 18.71    | kip-in                        | Length: |    |
| local  | $M_{cr\ell}/M_y =$ | 6.31630  | $M_{cr\ell} =$ 118.178 kip-in | 1       | in |
| dist.  | $M_{crd}/M_y =$    | 7.43000  | $M_{crd} =$ 139.0153 kip-in   | 12      | in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 935.5 kip-in      | -       | in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 18.71$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.40$  (local-global slenderness)

**$M_{n\ell} = 18.71$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.37$  (distortional slenderness)

**$M_{nd} = 18.71$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 18.71$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 22       | GA                             |         |
|               | Strength:          | 40       | KSI                            |         |
|               | $M_y =$            | 22.68    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 5.21100  | $M_{cr\ell} = 118.1855$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 6.13000  | $M_{crd} = 139.0284$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1134$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 22.68$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.44$  (local-global slenderness)

**$M_{n\ell} = 22.68$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.40$  (distortional slenderness)

**$M_{nd} = 22.68$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 22.68$  kip-in (local-global controls)**



Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 22       | GA                             |         |
|               | Strength:          | 50       | KSI                            |         |
|               | $M_y =$            | 28.35    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 4.16880  | $M_{cr\ell} = 118.1855$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 4.91000  | $M_{crd} = 139.1985$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1417.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 28.35$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.49$  (local-global slenderness)

**$M_{n\ell} = 28.35$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.45$  (distortional slenderness)

**$M_{nd} = 28.35$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 28.35$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                         |         |       |
|--------|--------------------|----------|-------------------------|---------|-------|
| Given: | Deck:              | 1.5B     | (stiffeners)            |         |       |
|        | Gage:              | 22       | GA                      |         |       |
|        | Strength:          | 60       | KSI                     |         |       |
|        | $M_y =$            | 34.02    | kip-in                  | Length: |       |
| local  | $M_{cr\ell}/M_y =$ | 3.47400  | $M_{cr\ell} = 118.1855$ | kip-in  | 1 in  |
| dist.  | $M_{crd}/M_y =$    | 4.09000  | $M_{crd} = 139.1418$    | kip-in  | 12 in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1701$        | kip-in  | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 34.02$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.54$  (local-global slenderness)

**$M_{n\ell} = 34.02$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.49$  (distortional slenderness)

**$M_{nd} = 34.02$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 34.02$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 24       | GA                             |         |
|        | Strength:          | 33       | KSI                            |         |
|        | $M_y =$            | 15.07    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 4.25890  | $M_{cr\ell} = 64.18162$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 6.23000  | $M_{crd} = 93.8861$ kip-in     | 24 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 753.5$ kip-in       | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 15.07$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.48$  (local-global slenderness)

**$M_{n\ell} = 15.07$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.40$  (distortional slenderness)

**$M_{nd} = 15.07$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 15.07$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 24       | GA                             |         |
|        | Strength:          | 40       | KSI                            |         |
|        | $M_y =$            | 18.27    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 3.51360  | $M_{cr\ell} = 64.19347$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 5.14000  | $M_{crd} = 93.9078$ kip-in     | 24 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 913.5$ kip-in       | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 18.27$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.53$  (local-global slenderness)

**$M_{n\ell} = 18.27$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.44$  (distortional slenderness)

**$M_{nd} = 18.27$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 18.27$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 24       | GA                             |         |
|               | Strength:          | 50       | KSI                            |         |
|               | $M_y =$            | 22.84    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 2.81090  | $M_{cr\ell} = 64.20096$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 4.11000  | $M_{crd} = 93.8724$ kip-in     | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1142$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 22.84$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.60$  (local-global slenderness)

**$M_{n\ell} = 22.84$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.49$  (distortional slenderness)

**$M_{nd} = 22.84$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 22.84$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 24       | GA                             |         |
|        | Strength:          | 60       | KSI                            |         |
|        | $M_y =$            | 27.40    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 2.34240  | $M_{cr\ell} = 64.18176$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 3.42000  | $M_{crd} = 93.708$ kip-in      | 24 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1370$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 27.40$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.65$  (local-global slenderness)

**$M_{n\ell} = 27.40$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.54$  (distortional slenderness)

**$M_{nd} = 27.40$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 27.40$  kip-in (local-global controls)**

## 6.4 Effective Width Method Calculations

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 16 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 33 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0598 in.                | Ag:                                      | 0.199 in. <sup>2</sup>    |
| Total Height:           | 1.540 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2179 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000592 in. <sup>3</sup> |  |                           |

**Guess  $\bar{y}$ :** 0.629 in.

|                   |             |            |                        |
|-------------------|-------------|------------|------------------------|
| Stress in Flange: | 22.812 ksi  | $\delta$ : | 1.056                  |
| k:                | 13.475      | Isp:       | 0.004 in. <sup>4</sup> |
| Fcr:              | 130.002 ksi | $\gamma$ : | 63.186                 |
| $\lambda$ :       | 0.419       | $\beta$ :  | 3.359                  |
| $\rho$ :          | 1.000       | kd:        | 7.896                  |
| Effective Width:  | 3.320 in.   | kloc:      | 49.309                 |
|                   |             | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.510            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 1.510            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.320   | 0.110            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.510            | 2.079                           | 3.139                             | --                                |
| Bottom Corner                | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.110            | 2.183                           | 0.239                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.325            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.872            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 50.093     |                  | 31.527                          | 34.254                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.629 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.910 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.975 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.071 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **35.35 k-in.**



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 16 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 40 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0598 in.                | Ag:                                      | 0.199 in. <sup>2</sup>    |
| Total Height:           | 1.540 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2179 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000592 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.629 in.

|                   |             |            |                        |
|-------------------|-------------|------------|------------------------|
| Stress in Flange: | 27.651 ksi  | $\delta$ : | 1.056                  |
| k:                | 13.475      | Isp:       | 0.004 in. <sup>4</sup> |
| Fcr:              | 130.002 ksi | $\gamma$ : | 63.186                 |
| $\lambda$ :       | 0.461       | $\beta$ :  | 3.359                  |
| $\rho$ :          | 1.000       | kd:        | 7.896                  |
| Effective Width:  | 3.320 in.   | kloc:      | 49.309                 |
|                   |             | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.510            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 1.510            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.320   | 0.110            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.510            | 2.079                           | 3.139                             | --                                |
| Bottom Corner                | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.110            | 2.183                           | 0.239                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.325            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.872            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 50.093     |                  | 31.527                          | 34.254                            | 1.898                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.629 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.910 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.975 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.071 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **42.85 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 16 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 50 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0598 in.                | Ag:                                      | 0.199 in. <sup>2</sup>    |
| Total Height:           | 1.540 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2179 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000592 in. <sup>3</sup> |  |                           |

**Guess  $\bar{y}$ :** 0.629 in.

|                   |             |                   |                        |
|-------------------|-------------|-------------------|------------------------|
| Stress in Flange: | 34.563 ksi  | $\delta$ :        | 1.056                  |
| k:                | 13.475      | I <sub>sp</sub> : | 0.004 in. <sup>4</sup> |
| F <sub>cr</sub> : | 130.002 ksi | $\gamma$ :        | 63.186                 |
| $\lambda$ :       | 0.516       | $\beta$ :         | 3.359                  |
| $\rho$ :          | 1.000       | kd:               | 7.896                  |
| Effective Width:  | 3.320 in.   | kloc:             | 49.309                 |
|                   |             | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.510            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 1.510            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.320   | 0.110            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.510            | 2.079                           | 3.139                             | --                                |
| Bottom Corner                | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.110            | 2.183                           | 0.239                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.325            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.872            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 50.093     |                  | 31.527                          | 34.254                            | 1.898                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.629 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.910 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.975 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.071 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **53.56 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 16 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 60 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0598 in.                | Ag:                                      | 0.199 in. <sup>2</sup>    |
| Total Height:           | 1.540 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2179 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000592 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.629 in.

|                   |             |                   |                        |
|-------------------|-------------|-------------------|------------------------|
| Stress in Flange: | 41.476 ksi  | $\delta$ :        | 1.056                  |
| k:                | 13.475      | I <sub>sp</sub> : | 0.004 in. <sup>4</sup> |
| F <sub>cr</sub> : | 130.002 ksi | $\gamma$ :        | 63.186                 |
| $\lambda$ :       | 0.565       | $\beta$ :         | 3.359                  |
| $\rho$ :          | 1.000       | kd:               | 7.896                  |
| Effective Width:  | 3.320 in.   | kloc:             | 49.309                 |
|                   |             | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.510            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 1.510            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.320   | 0.110            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.510            | 2.079                           | 3.139                             | --                                |
| Bottom Corner                | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.110            | 2.183                           | 0.239                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.510            | 10.394                          | 15.694                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.325            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.872            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 50.093     |                  | 31.527                          | 34.254                            | 1.898                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.629 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.910 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.975 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.071 in.<sup>3</sup>  
**Mn = Se \* Fy = 64.28 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 18 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 33 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0474 in.                | Ag:                                      | 0.157 in. <sup>2</sup>    |
| Total Height:           | 1.527 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2117 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000543 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.622 in.

|                   |             |                   |                        |
|-------------------|-------------|-------------------|------------------------|
| Stress in Flange: | 22.701 ksi  | $\delta$ :        | 1.056                  |
| k:                | 16.607      | I <sub>sp</sub> : | 0.003 in. <sup>4</sup> |
| Fcr:              | 100.657 ksi | $\gamma$ :        | 99.481                 |
| $\lambda$ :       | 0.475       | $\beta$ :         | 3.760                  |
| $\rho$ :          | 1.000       | kd:               | 9.730                  |
| Effective Width:  | 3.320 in.   | kloc:             | 49.309                 |
|                   |             | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.504            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 1.504            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.320   | 0.103            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.504            | 2.070                           | 3.113                             | --                                |
| Bottom Corner                | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.103            | 2.054                           | 0.212                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.319            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.885            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.905     |                  | 31.066                          | 33.726                            | 1.897                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.622 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.905 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.772 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.853 in.<sup>3</sup>  
**Mn = Se \* Fy = 28.15 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 18 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 40 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0474 in.                | Ag:                                      | 0.157 in. <sup>2</sup>    |
| Total Height:           | 1.527 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2117 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000543 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.622 in.

|                   |             |                   |                        |
|-------------------|-------------|-------------------|------------------------|
| Stress in Flange: | 27.517 ksi  | $\delta$ :        | 1.056                  |
| k:                | 16.607      | I <sub>sp</sub> : | 0.003 in. <sup>4</sup> |
| Fcr:              | 100.657 ksi | $\gamma$ :        | 99.481                 |
| $\lambda$ :       | 0.523       | $\beta$ :         | 3.760                  |
| $\rho$ :          | 1.000       | kd:               | 9.730                  |
| Effective Width:  | 3.320 in.   | kloc:             | 49.309                 |
|                   |             | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.504            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 1.504            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.320   | 0.103            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.504            | 2.070                           | 3.113                             | --                                |
| Bottom Corner                | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.103            | 2.054                           | 0.212                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.319            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.885            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.905     |                  | 31.066                          | 33.726                            | 1.897                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.622 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.905 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.772 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.853 in.<sup>3</sup>  
**Mn = Se \* Fy = 34.12 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 18 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 50 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0474 in.                | Ag:                                      | 0.157 in. <sup>2</sup>    |
| Total Height:           | 1.527 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2117 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000543 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.622 in.

|                   |             |                   |                        |
|-------------------|-------------|-------------------|------------------------|
| Stress in Flange: | 34.396 ksi  | $\delta$ :        | 1.056                  |
| k:                | 16.607      | I <sub>sp</sub> : | 0.003 in. <sup>4</sup> |
| Fcr:              | 100.657 ksi | $\gamma$ :        | 99.481                 |
| $\lambda$ :       | 0.585       | $\beta$ :         | 3.760                  |
| $\rho$ :          | 1.000       | kd:               | 9.730                  |
| Effective Width:  | 3.320 in.   | kloc:             | 49.309                 |
|                   |             | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.504            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 1.504            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.320   | 0.103            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.504            | 2.070                           | 3.113                             | --                                |
| Bottom Corner                | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.103            | 2.054                           | 0.212                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.319            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.885            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.905     |                  | 31.066                          | 33.726                            | 1.897                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.622 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.905 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.772 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.853 in.<sup>3</sup>  
**Mn = Se \* Fy = 42.65 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 18 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 60 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0474 in.                | Ag:                                      | 0.157 in. <sup>2</sup>    |
| Total Height:           | 1.527 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2117 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000543 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.622 in.

|                   |             |                   |                        |
|-------------------|-------------|-------------------|------------------------|
| Stress in Flange: | 41.275 ksi  | $\delta$ :        | 1.056                  |
| k:                | 16.607      | I <sub>sp</sub> : | 0.003 in. <sup>4</sup> |
| Fcr:              | 100.657 ksi | $\gamma$ :        | 99.481                 |
| $\lambda$ :       | 0.640       | $\beta$ :         | 3.760                  |
| $\rho$ :          | 1.000       | kd:               | 9.730                  |
| Effective Width:  | 3.320 in.   | kloc:             | 49.309                 |
|                   |             | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.504            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 1.504            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.320   | 0.103            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.504            | 2.070                           | 3.113                             | --                                |
| Bottom Corner                | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Top Flange                   | 6        | 19.920     | 0.103            | 2.054                           | 0.212                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.504            | 10.351                          | 15.565                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.319            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.885            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.905     |                  | 31.066                          | 33.726                            | 1.897                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.622 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.905 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.772 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.853 in.<sup>3</sup>  
**Mn = Se \* Fy = 51.18 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 20 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 33 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0358 in.                | Ag:                                      | 0.119 in. <sup>2</sup>    |
| Total Height:           | 1.516 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2059 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000500 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.616 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 22.597 ksi | $\delta$ : | 1.056                  |
| k:                | 21.505     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 74.355 ksi | $\gamma$ : | 172.608                |
| $\lambda$ :       | 0.551      | $\beta$ :  | 4.314                  |
| $\rho$ :          | 1.000      | kd:        | 12.600                 |
| Effective Width:  | 3.320 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.498            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.377   | 1.498            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.320   | 0.097            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.498            | 2.062                           | 3.089                             | --                                |
| Bottom Corner                | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange                   | 6        | 19.920     | 0.097            | 1.932                           | 0.187                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.313            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.896            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.729     |                  | 30.637                          | 33.238                            | 1.896                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.616 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.900 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.582 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.647 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **21.35 k-in.**



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 20 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 40 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0358 in.                | Ag:                                      | 0.119 in. <sup>2</sup>    |
| Total Height:           | 1.516 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2059 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000500 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.616 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 27.390 ksi | $\delta$ : | 1.056                  |
| k:                | 21.505     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 74.355 ksi | $\gamma$ : | 172.608                |
| $\lambda$ :       | 0.607      | $\beta$ :  | 4.314                  |
| $\rho$ :          | 1.000      | kd:        | 12.600                 |
| Effective Width:  | 3.320 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.498            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.377   | 1.498            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.320   | 0.097            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.498            | 2.062                           | 3.089                             | --                                |
| Bottom Corner                | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange                   | 6        | 19.920     | 0.097            | 1.932                           | 0.187                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.313            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.896            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.729     |                  | 30.637                          | 33.238                            | 1.896                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.616 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.900 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] / t$  = 0.582 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.647 in.<sup>3</sup>  
**Mn = Se \* Fy = 25.88 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 20 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 50 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0358 in.                | Ag:                                      | 0.119 in. <sup>2</sup>    |
| Total Height:           | 1.516 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2059 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000500 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.617 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 34.332 ksi | $\delta$ : | 1.056                  |
| k:                | 21.505     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 74.355 ksi | $\gamma$ : | 172.608                |
| $\lambda$ :       | 0.680      | $\beta$ :  | 4.314                  |
| $\rho$ :          | 0.995      | kd:        | 12.600                 |
| Effective Width:  | 3.304 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.498            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.377   | 1.498            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.304   | 0.097            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.498            | 2.062                           | 3.089                             | --                                |
| Bottom Corner                | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange                   | 6        | 19.824     | 0.097            | 1.923                           | 0.187                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.313            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.896            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.633     |                  | 30.628                          | 33.237                            | 1.896                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.617 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.899 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.581 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.647 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **32.33 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 20 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 60 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0358 in.                | Ag:                                      | 0.119 in. <sup>2</sup>    |
| Total Height:           | 1.516 in.                 | n:                                       | 1                         |
| Radius:                 | 0.2059 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000500 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.630 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 42.617 ksi | $\delta$ : | 1.056                  |
| k:                | 21.505     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 74.355 ksi | $\gamma$ : | 172.608                |
| $\lambda$ :       | 0.757      | $\beta$ :  | 4.314                  |
| $\rho$ :          | 0.937      | kd:        | 12.600                 |
| Effective Width:  | 3.111 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.498            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.377   | 1.498            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.111   | 0.097            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.498            | 2.062                           | 3.089                             | --                                |
| Bottom Corner                | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Top Flange                   | 6        | 18.666     | 0.097            | 1.811                           | 0.176                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.498            | 10.311                          | 15.445                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.313            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.896            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 48.475     |                  | 30.516                          | 33.226                            | 1.896                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.630 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.886 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.570 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.643 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **38.56 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 22 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 33 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.098 in. <sup>2</sup>    |
| Total Height:           | 1.510 in.                 | n:                                       | 1                         |
| Radius:                 | 0.20275 in.               | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000477 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.613 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 22.539 ksi | $\delta$ : | 1.056                  |
| k:                | 25.794     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 60.558 ksi | $\gamma$ : | 253.018                |
| $\lambda$ :       | 0.610      | $\beta$ :  | 4.745                  |
| $\rho$ :          | 1.000      | kd:        | 15.113                 |
| Effective Width:  | 3.320 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.495            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.377   | 1.495            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.320   | 0.094            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.495            | 2.058                           | 3.076                             | --                                |
| Bottom Corner                | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange                   | 6        | 19.920     | 0.094            | 1.866                           | 0.175                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.310            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.902            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.633     |                  | 30.405                          | 32.975                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.613 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.897 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.479 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.534 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **17.63 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 22 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 40 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.098 in. <sup>2</sup>    |
| Total Height:           | 1.510 in.                 | n:                                       | 1                         |
| Radius:                 | 0.20275 in.               | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000477 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.613 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 27.320 ksi | $\delta$ : | 1.056                  |
| k:                | 25.794     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 60.558 ksi | $\gamma$ : | 253.018                |
| $\lambda$ :       | 0.672      | $\beta$ :  | 4.745                  |
| $\rho$ :          | 1.000      | kd:        | 15.113                 |
| Effective Width:  | 3.320 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.495            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.377   | 1.495            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.320   | 0.094            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.495            | 2.058                           | 3.076                             | --                                |
| Bottom Corner                | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange                   | 6        | 19.920     | 0.094            | 1.866                           | 0.175                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.310            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.902            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 49.633     |                  | 30.405                          | 32.975                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.613 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.897 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.479 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.534 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **21.37 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 22 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 50 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.098 in. <sup>2</sup>    |
| Total Height:           | 1.510 in.                 | n:                                       | 1                         |
| Radius:                 | 0.20275 in.               | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000477 in. <sup>3</sup> |  |                           |

**Guess  $\bar{y}$ :** 0.628 in.

|                   |            |                   |                        |
|-------------------|------------|-------------------|------------------------|
| Stress in Flange: | 35.578 ksi | $\delta$ :        | 1.056                  |
| k:                | 25.794     | I <sub>sp</sub> : | 0.002 in. <sup>4</sup> |
| Fcr:              | 60.558 ksi | $\gamma$ :        | 253.018                |
| $\lambda$ :       | 0.766      | $\beta$ :         | 4.745                  |
| $\rho$ :          | 0.930      | kd:               | 15.113                 |
| Effective Width:  | 3.088 in.  | kloc:             | 49.309                 |
|                   |            | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.495            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.377   | 1.495            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.088   | 0.094            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.495            | 2.058                           | 3.076                             | --                                |
| Bottom Corner                | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange                   | 6        | 18.529     | 0.094            | 1.736                           | 0.163                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.310            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.902            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 48.243     |                  | 30.275                          | 32.962                            | 1.895                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.628 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.882 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  0.468 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.530 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **26.52 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 22 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 60 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.098 in. <sup>2</sup>    |
| Total Height:           | 1.510 in.                 | n:                                       | 1                         |
| Radius:                 | 0.20275 in.               | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000477 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.642 in.

|                   |            |            |                        |
|-------------------|------------|------------|------------------------|
| Stress in Flange: | 44.356 ksi | $\delta$ : | 1.056                  |
| k:                | 25.794     | lsp:       | 0.002 in. <sup>4</sup> |
| Fcr:              | 60.558 ksi | $\gamma$ : | 253.018                |
| $\lambda$ :       | 0.856      | $\beta$ :  | 4.745                  |
| $\rho$ :          | 0.868      | kd:        | 15.113                 |
| Effective Width:  | 2.882 in.  | kloc:      | 49.309                 |
|                   |            | R:         | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.495            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.377   | 1.495            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 2.882   | 0.094            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.495            | 2.058                           | 3.076                             | --                                |
| Bottom Corner                | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Top Flange                   | 6        | 17.292     | 0.094            | 1.620                           | 0.152                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.495            | 10.289                          | 15.380                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.302            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.310            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.902            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 47.006     |                  | 30.159                          | 32.951                            | 1.895                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.642 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.868 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.457 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.527 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **31.60 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 24 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 33 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0238 in.                | Ag:                                      | 0.079 in. <sup>2</sup>    |
| Total Height:           | 1.504 in.                 | n:                                       | 1                         |
| Radius:                 | 0.1999 in.                |  |                           |
| θ:                      | 72.5 deg                  | θ <sub>Stiff</sub> :                     | 30.625 deg                |
| θ:                      | 1.265 rad                 | θ <sub>Stiff</sub> :                     | 0.535 rad                 |
| Curve I' <sub>x</sub> : | 0.000457 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000007 in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 0.610 in.

|                   |            |                   |                        |
|-------------------|------------|-------------------|------------------------|
| Stress in Flange: | 22.494 ksi | δ:                | 1.056                  |
| k:                | 32.413     | I <sub>sp</sub> : | 0.002 in. <sup>4</sup> |
| Fcr:              | 49.531 ksi | γ:                | 407.100                |
| λ:                | 0.674      | β:                | 5.343                  |
| ρ:                | 0.999      | kd:               | 18.991                 |
| Effective Width:  | 3.318 in.  | kloc:             | 49.309                 |
|                   |            | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.492            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 1.377   | 1.492            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 3.318   | 0.091            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 1.377  | 1.492            | 2.054                   | 3.064                                | --                                   |
| Bottom Corner                | 12       | 3.035  | 1.341            | 4.071                   | 5.460                                | 0.005                                |
| Web                          | 12       | 15.296 | 0.752            | 11.501                  | 8.647                                | 1.884                                |
| Top Corner                   | 12       | 3.035  | 0.163            | 0.493                   | 0.080                                | 0.005                                |
| Top Flange                   | 6        | 19.909 | 0.091            | 1.806                   | 0.164                                | --                                   |
| Bottom Flange                | 5        | 6.884  | 1.492            | 10.270                  | 15.322                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000  | 1.301            | 0.000                   | 0.000                                | 0.000                                |
| Web <sub>Stiff</sub>         | 0        | 0.000  | 1.307            | 0.000                   | 0.000                                | 0.000                                |
| High Corner <sub>Stiff</sub> | 0        | 0.000  | 0.908            | 0.000                   | 0.000                                | 0.000                                |
|                              | Σ        | 49.536 |                  | 30.195                  | 32.738                               | 1.895                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.610 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.894 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.386 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.432 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **14.25 k-in.**



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 24 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 40 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0238 in.                | Ag:                                      | 0.079 in. <sup>2</sup>    |
| Total Height:           | 1.504 in.                 | n:                                       | 1                         |
| Radius:                 | 0.1999 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000007 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000457 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.623 in.

|                   |            |                   |                        |
|-------------------|------------|-------------------|------------------------|
| Stress in Flange: | 28.265 ksi | $\delta$ :        | 1.056                  |
| k:                | 32.413     | I <sub>sp</sub> : | 0.002 in. <sup>4</sup> |
| Fcr:              | 49.531 ksi | $\gamma$ :        | 407.100                |
| $\lambda$ :       | 0.755      | $\beta$ :         | 5.343                  |
| $\rho$ :          | 0.938      | kd:               | 18.991                 |
| Effective Width:  | 3.115 in.  | kloc:             | 49.309                 |
|                   |            | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.492            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 1.377   | 1.492            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 3.115   | 0.091            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.492            | 2.054                           | 3.064                             | --                                |
| Bottom Corner                | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web                          | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner                   | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange                   | 6        | 18.690     | 0.091            | 1.695                           | 0.154                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.492            | 10.270                          | 15.322                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.301            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.307            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.908            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 48.317     |                  | 30.084                          | 32.728                            | 1.895                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.623 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.881 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.378 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.429 in.<sup>3</sup>  
**Mn = Se \* Fy = 17.17 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 24 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 50 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0238 in.                | Ag:                                      | 0.079 in. <sup>2</sup>    |
| Total Height:           | 1.504 in.                 | n:                                       | 1                         |
| Radius:                 | 0.1999 in.                |  |                           |
| θ:                      | 72.5 deg                  | θ <sub>Stiff</sub> :                     | 30.625 deg                |
| θ:                      | 1.265 rad                 | θ <sub>Stiff</sub> :                     | 0.535 rad                 |
| Curve I' <sub>x</sub> : | 0.000457 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000007 in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 0.640 in.

|                   |            |                   |                        |
|-------------------|------------|-------------------|------------------------|
| Stress in Flange: | 37.030 ksi | δ:                | 1.056                  |
| k:                | 32.413     | I <sub>sp</sub> : | 0.002 in. <sup>4</sup> |
| F <sub>cr</sub> : | 49.531 ksi | γ:                | 407.100                |
| λ:                | 0.865      | β:                | 5.343                  |
| ρ:                | 0.862      | kd:               | 18.991                 |
| Effective Width:  | 2.863 in.  | kloc:             | 49.309                 |
|                   |            | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.492            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 1.377   | 1.492            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 2.863   | 0.091            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 1.377  | 1.492            | 2.054                   | 3.064                                | --                                   |
| Bottom Corner                | 12       | 3.035  | 1.341            | 4.071                   | 5.460                                | 0.005                                |
| Web                          | 12       | 15.296 | 0.752            | 11.501                  | 8.647                                | 1.884                                |
| Top Corner                   | 12       | 3.035  | 0.163            | 0.493                   | 0.080                                | 0.005                                |
| Top Flange                   | 6        | 17.176 | 0.091            | 1.558                   | 0.141                                | --                                   |
| Bottom Flange                | 5        | 6.884  | 1.492            | 10.270                  | 15.322                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000  | 1.301            | 0.000                   | 0.000                                | 0.000                                |
| Web <sub>Stiff</sub>         | 0        | 0.000  | 1.307            | 0.000                   | 0.000                                | 0.000                                |
| High Corner <sub>Stiff</sub> | 0        | 0.000  | 0.908            | 0.000                   | 0.000                                | 0.000                                |
|                              | Σ        | 46.803 |                  | 29.947                  | 32.715                               | 1.895                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.640 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.864 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.368 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.426 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **21.28 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

|                         |                           |  |                           |
|-------------------------|---------------------------|--|---------------------------|
| Deck:                   | 1.5B (stiffeners)         | bo:                                      | 3.144 in.                 |
| Gage:                   | 24 GA                     | h:                                       | 1.275 in.                 |
| Strength:               | 60 ksi                    | bp:                                      | 0.895 in.                 |
| Thickness:              | 0.0238 in.                | Ag:                                      | 0.079 in. <sup>2</sup>    |
| Total Height:           | 1.504 in.                 | n:                                       | 1                         |
| Radius:                 | 0.1999 in.                | $\theta_{Stiff}$ :                       | 30.625 deg                |
| $\theta$ :              | 72.5 deg                  | $\theta_{Stiff}$ :                       | 0.535 rad                 |
| $\theta$ :              | 1.265 rad                 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000007 in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000457 in. <sup>3</sup> |  |                           |

Guess  $\bar{y}$ : 0.655 in.

|                   |            |                   |                        |
|-------------------|------------|-------------------|------------------------|
| Stress in Flange: | 46.309 ksi | $\delta$ :        | 1.056                  |
| k:                | 32.413     | I <sub>sp</sub> : | 0.002 in. <sup>4</sup> |
| Fcr:              | 49.531 ksi | $\gamma$ :        | 407.100                |
| $\lambda$ :       | 0.967      | $\beta$ :         | 5.343                  |
| $\rho$ :          | 0.799      | kd:               | 18.991                 |
| Effective Width:  | 2.652 in.  | kloc:             | 49.309                 |
|                   |            | R:                | 1.707                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 1.492            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 1.377   | 1.492            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 2.652   | 0.091            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 1.377      | 1.492            | 2.054                           | 3.064                             | --                                |
| Bottom Corner                | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Web                          | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner                   | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Top Flange                   | 6        | 15.914     | 0.091            | 1.443                           | 0.131                             | --                                |
| Bottom Flange                | 5        | 6.884      | 1.492            | 10.270                          | 15.322                            | --                                |
| Low Corner <sub>Stiff</sub>  | 0        | 0.000      | 1.301            | 0.000                           | 0.000                             | 0.000                             |
| Web <sub>Stiff</sub>         | 0        | 0.000      | 1.307            | 0.000                           | 0.000                             | 0.000                             |
| High Corner <sub>Stiff</sub> | 0        | 0.000      | 0.908            | 0.000                           | 0.000                             | 0.000                             |
| $\Sigma$                     |          | 45.541     |                  | 29.832                          | 32.705                            | 1.895                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.655 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.849 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.358 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.422 in.<sup>3</sup>  
**Mn = Se \* Fy = 25.33 k-in.**

## CHAPTER 7: ANALYSIS | 1.5B DECK (STIFFENED) | - BENDING



### 7.0 Executive Summary

The Direct Strength Method predicted higher strengths for each of the stiffened 1.5B Deck sections undergoing negative flexure. The compression flange is the lower unstiffened flange for this section and DSM is able to take advantage of the shorter compression flange width. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 1.037 and 1.157.

## CHAPTER 7: ANALYSIS | 1.5B DECK (STIFFENED) | - BENDING

### 7.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI

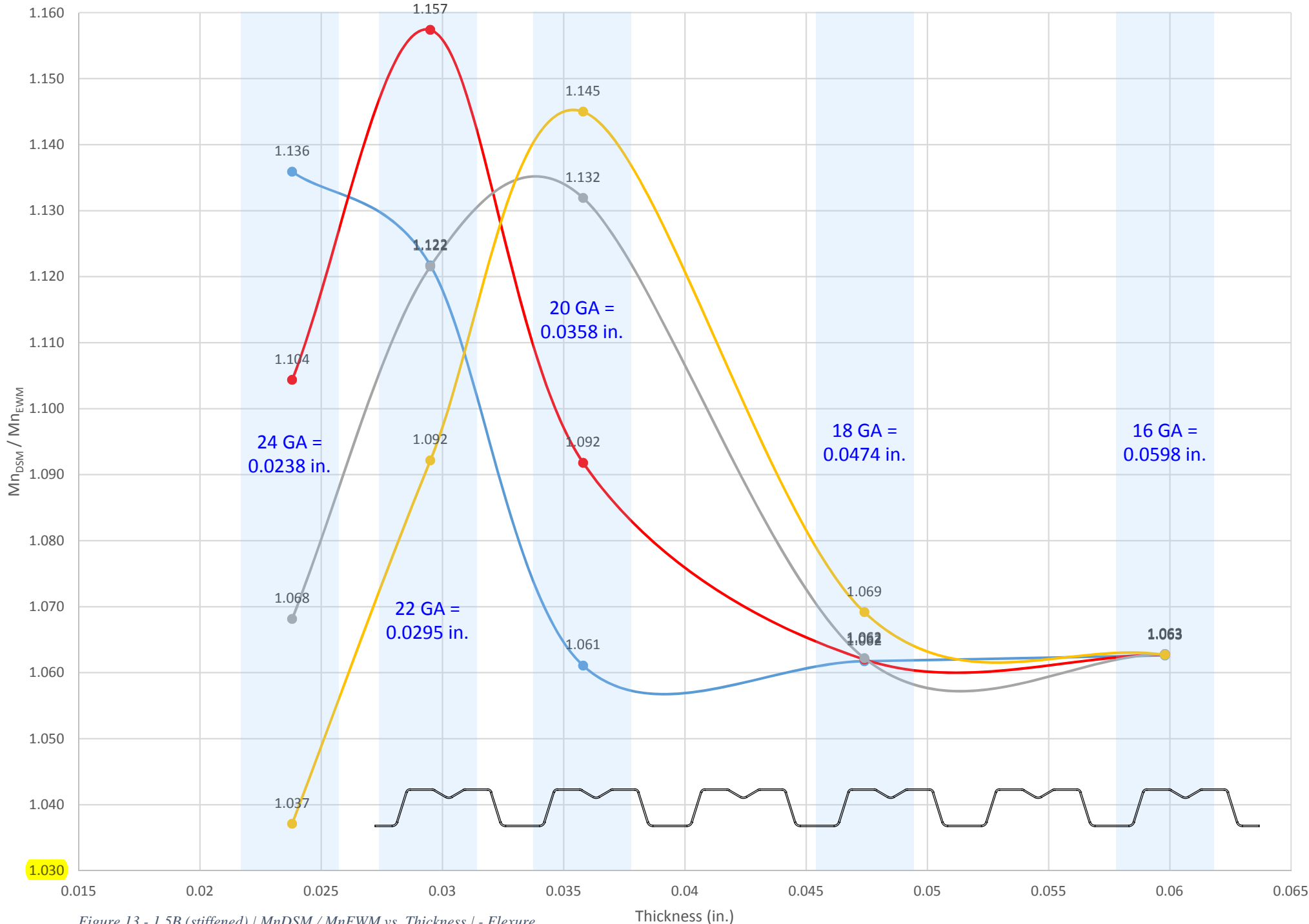


Figure 13 - 1.5B (stiffened) | Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness | - Flexure

1.5B Deck w/ Stiffeners Negative Bending

## 7.2 Analysis Results Summary

Table 7 - 1.5B (stiffened) | Analysis Results Summary | - Flexure

| 1.5B DECK (stiffeners) - 33 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_g$ (CUFSM)                   | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| $y$ -bar (CUFSM)                | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| $S_{xx}$                        | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| $M_y$                           | 15.07   | 18.71   | 22.76   | 30.09   | 37.84   |
| $Mn_{DSM}$                      | 14.21   | 18.71   | 22.76   | 30.09   | 37.84   |
| $Mn_{EWM}$                      | 12.51   | 16.68   | 21.45   | 28.34   | 35.61   |
| % ERROR                         | 11.963% | 10.850% | 5.756%  | 5.816%  | 5.893%  |

| 1.5B DECK (stiffeners) - 33 KSI |        |            |            |                       |
|---------------------------------|--------|------------|------------|-----------------------|
| Thickness                       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                              | 0.0238 | 14.21      | 12.51      | 1.136                 |
| 22                              | 0.0295 | 18.71      | 16.68      | 1.122                 |
| 20                              | 0.0358 | 22.76      | 21.45      | 1.061                 |
| 18                              | 0.0474 | 30.09      | 28.34      | 1.062                 |
| 16                              | 0.0598 | 37.84      | 35.61      | 1.063                 |

| 1.5B DECK (stiffeners) - 40 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_g$ (CUFSM)                   | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| $y$ -bar (CUFSM)                | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| $S_{xx}$                        | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| $M_y$                           | 18.27   | 22.68   | 27.59   | 36.48   | 45.87   |
| $Mn_{DSM}$                      | 16.19   | 22.65   | 27.59   | 36.48   | 45.87   |
| $Mn_{EWM}$                      | 14.66   | 19.57   | 25.27   | 34.35   | 43.16   |
| % ERROR                         | 9.450%  | 13.598% | 8.409%  | 5.839%  | 5.908%  |

| 1.5B DECK (stiffeners) - 40 KSI |        |            |            |                       |
|---------------------------------|--------|------------|------------|-----------------------|
| Thickness                       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                              | 0.0238 | 16.19      | 14.66      | 1.104                 |
| 22                              | 0.0295 | 22.65      | 19.57      | 1.157                 |
| 20                              | 0.0358 | 27.59      | 25.27      | 1.092                 |
| 18                              | 0.0474 | 36.48      | 34.35      | 1.062                 |
| 16                              | 0.0598 | 45.87      | 43.16      | 1.063                 |

| 1.5B DECK (stiffeners) - 50 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_g$ (CUFSM)                   | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| $y$ -bar (CUFSM)                | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| $S_{xx}$                        | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| $M_y$                           | 22.84   | 28.35   | 34.49   | 45.60   | 57.34   |
| $Mn_{DSM}$                      | 18.81   | 26.39   | 34.49   | 45.6    | 57.34   |
| $Mn_{EWM}$                      | 17.61   | 23.53   | 30.47   | 42.93   | 53.95   |
| % ERROR                         | 6.380%  | 10.837% | 11.656% | 5.855%  | 5.912%  |

| 1.5B DECK (stiffeners) - 50 KSI |        |            |            |                       |
|---------------------------------|--------|------------|------------|-----------------------|
| Thickness                       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                              | 0.0238 | 18.81      | 17.61      | 1.068                 |
| 22                              | 0.0295 | 26.39      | 23.53      | 1.122                 |
| 20                              | 0.0358 | 34.49      | 30.47      | 1.132                 |
| 18                              | 0.0474 | 45.60      | 42.93      | 1.062                 |
| 16                              | 0.0598 | 57.34      | 53.95      | 1.063                 |

| 1.5B DECK (stiffeners) - 60 KSI |         |         |         |         |         |
|---------------------------------|---------|---------|---------|---------|---------|
| Gage                            | 24      | 22      | 20      | 18      | 16      |
| Thickness                       | 0.0238  | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius                    | 0.1999  | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_g$ (CUFSM)                   | 0.407   | 0.505   | 0.616   | 0.815   | 1.025   |
| $y$ -bar (CUFSM)                | 0.89116 | 0.89128 | 0.89289 | 0.89359 | 0.89359 |
| $S_{xx}$                        | 0.457   | 0.567   | 0.690   | 0.912   | 1.147   |
| $M_y$                           | 27.40   | 34.02   | 41.38   | 54.72   | 68.80   |
| $Mn_{DSM}$                      | 21.23   | 29.86   | 40.59   | 54.72   | 68.8    |
| $Mn_{EWM}$                      | 20.47   | 27.34   | 35.45   | 51.18   | 64.74   |
| % ERROR                         | 3.580%  | 8.439%  | 12.663% | 6.469%  | 5.901%  |

| 1.5B DECK (stiffeners) - 60 KSI |        |            |            |                       |
|---------------------------------|--------|------------|------------|-----------------------|
| Thickness                       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 24                              | 0.0238 | 21.23      | 20.47      | 1.037                 |
| 22                              | 0.0295 | 29.86      | 27.34      | 1.092                 |
| 20                              | 0.0358 | 40.59      | 35.45      | 1.145                 |
| 18                              | 0.0474 | 54.72      | 51.18      | 1.069                 |
| 16                              | 0.0598 | 68.80      | 64.74      | 1.063                 |



### 7.3 Direct Strength Method Calculations

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 16       | GA                             |         |
|               | Strength:          | -33      | KSI                            |         |
|               | $M_y =$            | 37.84    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 7.43230  | $M_{cr\ell} = 281.2382$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 27.74000 | $M_{crd} = 1049.682$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1892$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 37.84$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.37$  (local-global slenderness)

**$M_{n\ell} = 37.84$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.19$  (distortional slenderness)

**$M_{nd} = 37.84$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 37.84$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 16       | GA                             |         |
|        | Strength:          | -40      | KSI                            |         |
|        | $M_y =$            | 45.87    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 6.13170  | $M_{cr\ell} = 281.2611$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 22.89000 | $M_{crd} = 1049.964$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2293.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 45.87$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.40$  (local-global slenderness)

**$M_{n\ell} = 45.87$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.21$  (distortional slenderness)

**$M_{nd} = 45.87$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 45.87$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 16       | GA                             |         |
|        | Strength:          | -50      | KSI                            |         |
|        | $M_y =$            | 57.34    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 4.90530  | $M_{cr\ell} = 281.2699$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 18.31000 | $M_{crd} = 1049.895$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2867$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 57.34$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.45$  (local-global slenderness)

**$M_{n\ell} = 57.34$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.23$  (distortional slenderness)

**$M_{nd} = 57.34$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 57.34$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 16       | GA                             |         |
|               | Strength:          | -60      | KSI                            |         |
|               | $M_y =$            | 68.80    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 4.08780  | $M_{cr\ell} = 281.2406$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 15.26000 | $M_{crd} = 1049.888$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 3440$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 68.80$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.49$  (local-global slenderness)

**$M_{n\ell} = 68.80$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.26$  (distortional slenderness)

**$M_{nd} = 68.80$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 68.80$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 18       | GA                             |         |
|               | Strength:          | -33      | KSI                            |         |
|               | $M_y =$            | 30.09    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 4.78110  | $M_{cr\ell} = 143.8633$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 22.85000 | $M_{crd} = 687.5565$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1504.5$ kip-in      | - in    |

### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 30.09$  kip-in**

### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.46$  (local-global slenderness)

**$M_{n\ell} = 30.09$  kip-in** (fully effective section for local buckling)

### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.21$  (distortional slenderness)

**$M_{nd} = 30.09$  kip-in** (fully effective section for distortional buckling)

### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 30.09$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |    |
|--------|--------------------|----------|--------------------------------|---------|----|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |    |
|        | Gage:              | 18       | GA                             |         |    |
|        | Strength:          | -40      | KSI                            |         |    |
|        | $M_y =$            | 36.48    | kip-in                         | Length: |    |
| local  | $M_{cr\ell}/M_y =$ | 3.94440  | $M_{cr\ell} =$ 143.8917 kip-in | 1       | in |
| dist.  | $M_{crd}/M_y =$    | 18.85000 | $M_{crd} =$ 687.648 kip-in     | 12      | in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 1824 kip-in        | -       | in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 36.48$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.50$  (local-global slenderness)

**$M_{n\ell} = 36.48$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.23$  (distortional slenderness)

**$M_{nd} = 36.48$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 36.48$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |    |
|--------|--------------------|----------|--------------------------------|---------|----|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |    |
|        | Gage:              | 18       | GA                             |         |    |
|        | Strength:          | -50      | KSI                            |         |    |
|        | $M_y =$            | 45.60    | kip-in                         | Length: |    |
| local  | $M_{cr\ell}/M_y =$ | 3.15560  | $M_{cr\ell} =$ 143.8954 kip-in | 1       | in |
| dist.  | $M_{crd}/M_y =$    | 15.08000 | $M_{crd} =$ 687.648 kip-in     | 12      | in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 2280 kip-in        | -       | in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 45.60$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.56$  (local-global slenderness)

**$M_{n\ell} = 45.60$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.26$  (distortional slenderness)

**$M_{nd} = 45.60$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 45.60$  kip-in (local-global controls)**



Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 18       | GA                             |         |
|        | Strength:          | -60      | KSI                            |         |
|        | $M_y =$            | 54.72    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 2.62960  | $M_{cr\ell} = 143.8917$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 12.57000 | $M_{crd} = 687.8304$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2736$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 54.72$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.62$  (local-global slenderness)

**$M_{n\ell} = 54.72$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.28$  (distortional slenderness)

**$M_{nd} = 54.72$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 54.72$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 20       | GA                             |         |
|        | Strength:          | -33      | KSI                            |         |
|        | $M_y =$            | 22.76    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 2.83930  | $M_{cr\ell} = 64.62247$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 19.26000 | $M_{crd} = 438.3576$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1138$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 22.76$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.59$  (local-global slenderness)

**$M_{n\ell} = 22.76$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.23$  (distortional slenderness)

**$M_{nd} = 22.76$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 22.76$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 20       | GA                             |         |
|               | Strength:          | -40      | KSI                            |         |
|               | $M_y =$            | 27.59    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 2.34250  | $M_{cr\ell} = 64.62958$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 15.89000 | $M_{crd} = 438.4051$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1379.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 27.59$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.65$  (local-global slenderness)

**$M_{n\ell} = 27.59$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.25$  (distortional slenderness)

**$M_{nd} = 27.59$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 27.59$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 20       | GA                             |         |
|               | Strength:          | -50      | KSI                            |         |
|               | $M_y =$            | 34.49    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 1.87400  | $M_{cr\ell} = 64.63426$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 12.71000 | $M_{crd} = 438.3679$ kip-in    | 12 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1724.5$ kip-in      | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 34.49$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.73$  (local-global slenderness)

**$M_{n\ell} = 34.49$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.28$  (distortional slenderness)

**$M_{nd} = 34.49$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 34.49$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 20       | GA                             |         |
|        | Strength:          | -60      | KSI                            |         |
|        | $M_y =$            | 41.38    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 1.56170  | $M_{cr\ell} = 64.62315$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 10.59000 | $M_{crd} = 438.2142$ kip-in    | 12 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 2069$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 41.38$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.80$  (local-global slenderness)

**$M_{n\ell} = 40.59$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.31$  (distortional slenderness)

**$M_{nd} = 41.38$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 40.59$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 22       | GA                             |         |
|               | Strength:          | -33      | KSI                            |         |
|               | $M_y =$            | 18.71    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 2.00510  | $M_{cr\ell} = 37.51542$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 16.27000 | $M_{crd} = 304.4117$ kip-in    | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 935.5$ kip-in       | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 18.71$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.71$  (local-global slenderness)

**$M_{n\ell} = 18.71$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.25$  (distortional slenderness)

**$M_{nd} = 18.71$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 18.71$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                                |         |
|--------|--------------------|----------|--------------------------------|---------|
| Given: | Deck:              | 1.5B     | (stiffeners)                   |         |
|        | Gage:              | 22       | GA                             |         |
|        | Strength:          | -40      | KSI                            |         |
|        | $M_y =$            | 22.68    | kip-in                         | Length: |
| local  | $M_{cr\ell}/M_y =$ | 1.65420  | $M_{cr\ell} = 37.51726$ kip-in | 1 in    |
| dist.  | $M_{crd}/M_y =$    | 13.43000 | $M_{crd} = 304.5924$ kip-in    | 24 in   |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1134$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 22.68$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.78$  (local-global slenderness)

**$M_{n\ell} = 22.65$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.27$  (distortional slenderness)

**$M_{nd} = 22.68$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 22.65$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 22       | GA                             |         |
|               | Strength:          | -50      | KSI                            |         |
|               | $M_y =$            | 28.35    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 1.32340  | $M_{cr\ell} = 37.51839$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 10.74000 | $M_{crd} = 304.479$ kip-in     | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1417.5$ kip-in      | - in    |

### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 28.35$  kip-in**

### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.87$  (local-global slenderness)

**$M_{n\ell} = 26.39$  kip-in** (local-global interaction reduction)

### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.31$  (distortional slenderness)

**$M_{nd} = 28.35$  kip-in** (fully effective section for distortional buckling)

### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 26.39$  kip-in (local-global controls)**



Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 22       | GA                             |         |
|               | Strength:          | -60      | KSI                            |         |
|               | $M_y =$            | 34.02    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 1.10280  | $M_{cr\ell} = 37.51726$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 8.95000  | $M_{crd} = 304.479$ kip-in     | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1701$ kip-in        | - in    |

### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 34.02$  kip-in**

### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.95$  (local-global slenderness)

**$M_{n\ell} = 29.86$  kip-in** (local-global interaction reduction)

### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.33$  (distortional slenderness)

**$M_{nd} = 34.02$  kip-in** (fully effective section for distortional buckling)

### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 29.86$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|        |                    |          |                               |         |       |
|--------|--------------------|----------|-------------------------------|---------|-------|
| Given: | Deck:              | 1.5B     | (stiffeners)                  |         |       |
|        | Gage:              | 24       | GA                            |         |       |
|        | Strength:          | -33      | KSI                           |         |       |
|        | $M_y =$            | 15.07    | kip-in                        | Length: |       |
| local  | $M_{cr\ell}/M_y =$ | 1.37710  | $M_{cr\ell} =$ 20.7529 kip-in |         | 1 in  |
| dist.  | $M_{crd}/M_y =$    | 12.01000 | $M_{crd} =$ 180.9907 kip-in   |         | 24 in |
| global | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} =$ 753.5 kip-in      |         | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 15.07$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.85$  (local-global slenderness)

**$M_{n\ell} = 14.21$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.29$  (distortional slenderness)

**$M_{nd} = 15.07$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 14.21$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 24       | GA                             |         |
|               | Strength:          | -40      | KSI                            |         |
|               | $M_y =$            | 18.27    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 1.13610  | $M_{cr\ell} = 20.75655$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 9.91000  | $M_{crd} = 181.0557$ kip-in    | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 913.5$ kip-in       | - in    |

### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 18.27$  kip-in**

### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.94$  (local-global slenderness)

**$M_{n\ell} = 16.19$  kip-in** (local-global interaction reduction)

### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.32$  (distortional slenderness)

**$M_{nd} = 18.27$  kip-in** (fully effective section for distortional buckling)

### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 16.19$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 24       | GA                             |         |
|               | Strength:          | -50      | KSI                            |         |
|               | $M_y =$            | 22.84    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 0.90890  | $M_{cr\ell} = 20.75928$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 7.92000  | $M_{crd} = 180.8928$ kip-in    | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1142$ kip-in        | - in    |

### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 22.84$  kip-in**

### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.05$  (local-global slenderness)

**$M_{n\ell} = 18.81$  kip-in** (local-global interaction reduction)

### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.36$  (distortional slenderness)

**$M_{nd} = 22.84$  kip-in** (fully effective section for distortional buckling)

### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 18.81$  kip-in (local-global controls)**

Date: 1/11/2015

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                    |          |                                |         |
|---------------|--------------------|----------|--------------------------------|---------|
| <b>Given:</b> | Deck:              | 1.5B     | (stiffeners)                   |         |
|               | Gage:              | 24       | GA                             |         |
|               | Strength:          | -60      | KSI                            |         |
|               | $M_y =$            | 27.40    | kip-in                         | Length: |
| local         | $M_{cr\ell}/M_y =$ | 0.75742  | $M_{cr\ell} = 20.75331$ kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$    | 6.60000  | $M_{crd} = 180.84$ kip-in      | 24 in   |
| global        | $M_{cre}/M_y =$    | 50.00000 | $M_{cre} = 1370$ kip-in        | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 27.40$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.15$  (local-global slenderness)

**$M_{n\ell} = 21.23$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.39$  (distortional slenderness)

**$M_{nd} = 27.40$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 21.23$  kip-in (local-global controls)**

## 7.4 Effective Width Method Calculations

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 16 GA  
 Strength: 33 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000010 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.898 in.

Stress in Flange: 33.000 ksi  
 k: 4.000  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.405  
 $\rho$ : 1.128  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.030            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 0.030            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 0.895   | 1.510            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.510            | 16.224                          | 24.496                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.030            | 0.247                           | 0.007                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.398      | 1.302            | 1.820                           | 2.370                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.325            | 8.959                           | 11.870                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.398      | 0.872            | 1.219                           | 1.064                             | 0.000                             |
| $\Sigma$                     |          | 50.475     |                  | 45.340                          | 54.989                            | 1.944                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.898 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.898 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.969 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.079 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **35.61** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 16 GA  
 Strength: 40 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000010 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.898 in.

Stress in Flange: 40.000 ksi  
 k: 4.000  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.446  
 $\rho$ : 1.136  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.030            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 0.030            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 0.895   | 1.510            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.510            | 16.224                          | 24.496                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.030            | 0.247                           | 0.007                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.398      | 1.302            | 1.820                           | 2.370                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.325            | 8.959                           | 11.870                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.398      | 0.872            | 1.219                           | 1.064                             | 0.000                             |
| $\Sigma$                     |          | 50.475     |                  | 45.340                          | 54.989                            | 1.944                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.898 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.898 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.969 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.079 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **43.16** k-in.



**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 16 GA  
 Strength: 50 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000010 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.898 in.

Stress in Flange: 50.000 ksi  
 k: 4.000  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.498  
 $\rho$ : 1.121  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.030            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 0.030            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 0.895   | 1.510            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.510            | 16.224                          | 24.496                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.030            | 0.247                           | 0.007                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.398      | 1.302            | 1.820                           | 2.370                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.325            | 8.959                           | 11.870                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.398      | 0.872            | 1.219                           | 1.064                             | 0.000                             |
| $\Sigma$                     |          | 50.475     |                  | 45.340                          | 54.989                            | 1.944                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.898 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.898 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.969 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.079 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **53.95** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 16 GA  
 Strength: 60 ksi  
 Thickness: 0.0598 in.  
 Total Height: 1.540 in.  
 Radius: 0.2179 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000592 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000010 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.898 in.

Stress in Flange: 60.000 ksi  
 k: 4.000  
 Fcr: 201.212 ksi  
 $\lambda$ : 0.546  
 $\rho$ : 1.093  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.030            |
| Corners                  | 0.276   | 0.194            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.377   | 0.030            |
| Web                      | 1.275   | 0.770            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 0.895   | 1.510            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.030            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.309      | 0.194            | 0.642                           | 0.125                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.770            | 11.776                          | 9.066                             | 1.884                             |
| Top Corner                   | 12       | 3.309      | 1.346            | 4.452                           | 5.991                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.510            | 16.224                          | 24.496                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.030            | 0.247                           | 0.007                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.398      | 1.302            | 1.820                           | 2.370                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.325            | 8.959                           | 11.870                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.398      | 0.872            | 1.219                           | 1.064                             | 0.000                             |
| $\Sigma$                     |          | 50.475     |                  | 45.340                          | 54.989                            | 1.944                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.898 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.898 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.969 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 1.079 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **64.74** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 18 GA  
 Strength: 33 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000009 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.893 in.

Stress in Flange: 33.000 ksi  
 k: 4.000  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.511  
 $\rho$ : 1.114  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.024            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 0.024            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 0.895   | 1.504            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.504            | 16.157                          | 24.295                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.024            | 0.196                           | 0.005                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.358      | 1.302            | 1.768                           | 2.302                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.319            | 8.917                           | 11.759                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.358      | 0.885            | 1.201                           | 1.062                             | 0.000                             |
| $\Sigma$                     |          | 50.208     |                  | 44.830                          | 54.259                            | 1.943                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  0.893 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  0.893 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.767 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.859 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **28.34** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 18 GA  
 Strength: 40 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000009 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.893 in.

Stress in Flange: 40.000 ksi  
 k: 4.000  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.563  
 $\rho$ : 1.082  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.024            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 0.024            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 0.895   | 1.504            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.504            | 16.157                          | 24.295                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.024            | 0.196                           | 0.005                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.358      | 1.302            | 1.768                           | 2.302                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.319            | 8.917                           | 11.759                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.358      | 0.885            | 1.201                           | 1.062                             | 0.000                             |
| $\Sigma$                     |          | 50.208     |                  | 44.830                          | 54.259                            | 1.943                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.893 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.893 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.767 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.859 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **34.35** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 18 GA  
 Strength: 50 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000009 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.893 in.

Stress in Flange: 50.000 ksi  
 k: 4.000  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.629  
 $\rho$ : 1.034  
 Effective Width: 1.377 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.024            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.377   | 0.024            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 0.895   | 1.504            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.504            | 16.157                          | 24.295                            | --                                |
| Bottom Flange                | 6        | 8.260      | 0.024            | 0.196                           | 0.005                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.358      | 1.302            | 1.768                           | 2.302                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.319            | 8.917                           | 11.759                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.358      | 0.885            | 1.201                           | 1.062                             | 0.000                             |
| $\Sigma$                     |          | 50.208     |                  | 44.830                          | 54.259                            | 1.943                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.893 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.893 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.767 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.859 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **42.93** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 18 GA  
 Strength: 60 ksi  
 Thickness: 0.0474 in.  
 Total Height: 1.527 in.  
 Radius: 0.2117 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000543 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000009 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.895 in.

Stress in Flange: 60.000 ksi  
 k: 4.000  
 Fcr: 126.418 ksi  
 $\lambda$ : 0.689  
 $\rho$ : 0.988  
 Effective Width: 1.360 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.024            |
| Corners                  | 0.268   | 0.183            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.360   | 0.024            |
| Web                      | 1.275   | 0.764            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 0.895   | 1.504            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.024            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.215      | 0.183            | 0.589                           | 0.108                             | 0.007                             |
| Web                          | 12       | 15.296     | 0.764            | 11.681                          | 8.921                             | 1.884                             |
| Top Corner                   | 12       | 3.215      | 1.344            | 4.321                           | 5.808                             | 0.007                             |
| Top Flange                   | 12       | 10.745     | 1.504            | 16.157                          | 24.295                            | --                                |
| Bottom Flange                | 6        | 8.161      | 0.024            | 0.193                           | 0.005                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.358      | 1.302            | 1.768                           | 2.302                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.319            | 8.917                           | 11.759                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.358      | 0.885            | 1.201                           | 1.062                             | 0.000                             |
| $\Sigma$                     |          | 50.108     |                  | 44.827                          | 54.259                            | 1.943                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.895 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.895 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t$  = 0.763 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.853 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **51.18** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 20 GA  
 Strength: 33 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.888 in.

Stress in Flange: 33.000 ksi  
 k: 4.000  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.676  
 $\rho$ : 0.998  
 Effective Width: 1.373 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.018            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.373   | 0.018            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 0.895   | 1.498            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.498            | 16.095                          | 24.108                            | --                                |
| Bottom Flange                | 6        | 8.240      | 0.018            | 0.147                           | 0.003                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.321      | 1.302            | 1.719                           | 2.238                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.313            | 8.878                           | 11.656                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.321      | 0.896            | 1.183                           | 1.060                             | 0.000                             |
| $\Sigma$                     |          | 49.936     |                  | 44.354                          | 53.580                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.888 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.888 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.577 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.650 in.<sup>3</sup>  
**Mn = Se \* Fy = 21.45 k-in.**

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 20 GA  
 Strength: 40 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.896 in.

Stress in Flange: 40.000 ksi  
 k: 4.000  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.745  
 $\rho$ : 0.946  
 Effective Width: 1.303 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.018            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.303   | 0.018            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 0.895   | 1.498            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.498            | 16.095                          | 24.108                            | --                                |
| Bottom Flange                | 6        | 7.815      | 0.018            | 0.140                           | 0.003                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.321      | 1.302            | 1.719                           | 2.238                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.313            | 8.878                           | 11.656                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.321      | 0.896            | 1.183                           | 1.060                             | 0.000                             |
| $\Sigma$                     |          | 49.512     |                  | 44.346                          | 53.580                            | 1.942                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 0.896 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.896 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.566 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.632 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **25.27** k-in.



**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 20 GA  
 Strength: 50 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.905 in.

Stress in Flange: 50.000 ksi  
 k: 4.000  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.833  
 $\rho$ : 0.884  
 Effective Width: 1.217 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.018            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.217   | 0.018            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 0.895   | 1.498            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.498            | 16.095                          | 24.108                            | --                                |
| Bottom Flange                | 6        | 7.299      | 0.018            | 0.131                           | 0.002                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.321      | 1.302            | 1.719                           | 2.238                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.313            | 8.878                           | 11.656                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.321      | 0.896            | 1.183                           | 1.060                             | 0.000                             |
| $\Sigma$                     |          | 48.996     |                  | 44.337                          | 53.580                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.905 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.905 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t$  = 0.551 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.609 in.<sup>3</sup>  
**Mn = Se \* Fy = 30.47 k-in.**

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 20 GA  
 Strength: 60 ksi  
 Thickness: 0.0358 in.  
 Total Height: 1.516 in.  
 Radius: 0.2059 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000500 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.913 in.

Stress in Flange: 60.000 ksi  
 k: 4.000  
 Fcr: 72.114 ksi  
 $\lambda$ : 0.912  
 $\rho$ : 0.832  
 Effective Width: 1.145 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.018            |
| Corners                  | 0.261   | 0.173            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.145   | 0.018            |
| Web                      | 1.275   | 0.758            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 0.895   | 1.498            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.018            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.126      | 0.173            | 0.541                           | 0.094                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.758            | 11.592                          | 8.786                             | 1.884                             |
| Top Corner                   | 12       | 3.126      | 1.343            | 4.198                           | 5.637                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.498            | 16.095                          | 24.108                            | --                                |
| Bottom Flange                | 6        | 6.872      | 0.018            | 0.123                           | 0.002                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.321      | 1.302            | 1.719                           | 2.238                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.313            | 8.878                           | 11.656                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.321      | 0.896            | 1.183                           | 1.060                             | 0.000                             |
| $\Sigma$                     |          | 48.568     |                  | 44.329                          | 53.580                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.913 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.913 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.539 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.591 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **35.45** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 22 GA  
 Strength: 33 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.901 in.

Stress in Flange: 33.000 ksi  
 k: 4.000  
 Fcr: 48.966 ksi  
 $\lambda$ : 0.821  
 $\rho$ : 0.892  
 Effective Width: 1.228 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.015            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.228   | 0.015            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 0.895   | 1.495            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.495            | 16.061                          | 24.007                            | --                                |
| Bottom Flange                | 6        | 7.366      | 0.015            | 0.109                           | 0.002                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.300      | 1.302            | 1.693                           | 2.203                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.310            | 8.857                           | 11.600                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.300      | 0.902            | 1.173                           | 1.058                             | 0.000                             |
| $\Sigma$                     |          | 48.926     |                  | 44.083                          | 53.213                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.901 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.901 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.455 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.505 in.<sup>3</sup>  
**Mn = Se \* Fy = 16.68 k-in.**

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 22 GA  
 Strength: 40 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.909 in.

Stress in Flange: 40.000 ksi  
 k: 4.000  
 Fcr: 48.966 ksi  
 $\lambda$ : 0.904  
 $\rho$ : 0.837  
 Effective Width: 1.152 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.015            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.152   | 0.015            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 0.895   | 1.495            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.495            | 16.061                          | 24.007                            | --                                |
| Bottom Flange                | 6        | 6.915      | 0.015            | 0.102                           | 0.002                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.300      | 1.302            | 1.693                           | 2.203                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.310            | 8.857                           | 11.600                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.300      | 0.902            | 1.173                           | 1.058                             | 0.000                             |
| $\Sigma$                     |          | 48.475     |                  | 44.076                          | 53.213                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.909 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.909 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t$  = 0.445 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.489 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **19.57** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 22 GA  
 Strength: 50 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.919 in.

Stress in Flange: 50.000 ksi  
 k: 4.000  
 Fcr: 48.966 ksi  
 $\lambda$ : 1.011  
 $\rho$ : 0.774  
 Effective Width: 1.066 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.015            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.066   | 0.015            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 0.895   | 1.495            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.495            | 16.061                          | 24.007                            | --                                |
| Bottom Flange                | 6        | 6.395      | 0.015            | 0.094                           | 0.001                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.300      | 1.302            | 1.693                           | 2.203                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.310            | 8.857                           | 11.600                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.300      | 0.902            | 1.173                           | 1.058                             | 0.000                             |
| $\Sigma$                     |          | 47.955     |                  | 44.069                          | 53.212                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.919 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.919 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.432 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.471 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **23.53** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 22 GA  
 Strength: 60 ksi  
 Thickness: 0.0295 in.  
 Total Height: 1.510 in.  
 Radius: 0.20275 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000477 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000008 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.927 in.

Stress in Flange: 60.000 ksi  
 k: 4.000  
 Fcr: 48.966 ksi  
 $\lambda$ : 1.107  
 $\rho$ : 0.724  
 Effective Width: 0.997 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.015            |
| Corners                  | 0.257   | 0.168            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 0.997   | 0.015            |
| Web                      | 1.275   | 0.755            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 0.895   | 1.495            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.015            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.079      | 0.168            | 0.516                           | 0.086                             | 0.006                             |
| Web                          | 12       | 15.296     | 0.755            | 11.544                          | 8.713                             | 1.884                             |
| Top Corner                   | 12       | 3.079      | 1.342            | 4.131                           | 5.544                             | 0.006                             |
| Top Flange                   | 12       | 10.745     | 1.495            | 16.061                          | 24.007                            | --                                |
| Bottom Flange                | 6        | 5.979      | 0.015            | 0.088                           | 0.001                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.300      | 1.302            | 1.693                           | 2.203                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.310            | 8.857                           | 11.600                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.300      | 0.902            | 1.173                           | 1.058                             | 0.000                             |
| $\Sigma$                     |          | 47.540     |                  | 44.063                          | 53.212                            | 1.942                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.927 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.927 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.422 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.456 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **27.34** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 24 GA  
 Strength: 33 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000007 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.917 in.

Stress in Flange: 33.000 ksi  
 k: 4.000  
 Fcr: 31.872 ksi  
 $\lambda$ : 1.018  
 $\rho$ : 0.770  
 Effective Width: 1.060 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.012            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 1.060   | 0.012            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 0.895   | 1.492            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Web                          | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner                   | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Top Flange                   | 12       | 10.745     | 1.492            | 16.030                          | 23.915                            | --                                |
| Bottom Flange                | 6        | 6.363      | 0.012            | 0.076                           | 0.001                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.282      | 1.301            | 1.669                           | 2.171                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.307            | 8.837                           | 11.549                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.282      | 0.908            | 1.164                           | 1.056                             | 0.000                             |
| $\Sigma$                     |          | 47.800     |                  | 43.841                          | 52.881                            | 1.941                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.917 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.917 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.348 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.379 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **12.51** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 24 GA  
 Strength: 40 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000007 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.926 in.

Stress in Flange: 40.000 ksi  
 k: 4.000  
 Fcr: 31.872 ksi  
 $\lambda$ : 1.120  
 $\rho$ : 0.717  
 Effective Width: 0.988 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.012            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 0.988   | 0.012            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 0.895   | 1.492            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Web                          | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner                   | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Top Flange                   | 12       | 10.745     | 1.492            | 16.030                          | 23.915                            | --                                |
| Bottom Flange                | 6        | 5.926      | 0.012            | 0.071                           | 0.001                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.282      | 1.301            | 1.669                           | 2.171                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.307            | 8.837                           | 11.549                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.282      | 0.908            | 1.164                           | 1.056                             | 0.000                             |
| $\Sigma$                     |          | 47.363     |                  | 43.835                          | 52.881                            | 1.941                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.926 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.926 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.339 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.366 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **14.66** k-in.



**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 24 GA  
 Strength: 50 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000007 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.935 in.

Stress in Flange: 50.000 ksi  
 k: 4.000  
 Fcr: 31.872 ksi  
 $\lambda$ : 1.253  
 $\rho$ : 0.658  
 Effective Width: 0.906 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.012            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 0.906   | 0.012            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 0.895   | 1.492            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Web                          | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner                   | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Top Flange                   | 12       | 10.745     | 1.492            | 16.030                          | 23.915                            | --                                |
| Bottom Flange                | 6        | 5.437      | 0.012            | 0.065                           | 0.001                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.282      | 1.301            | 1.669                           | 2.171                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.307            | 8.837                           | 11.549                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.282      | 0.908            | 1.164                           | 1.056                             | 0.000                             |
| $\Sigma$                     |          | 46.874     |                  | 43.830                          | 52.881                            | 1.941                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.935 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.935 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.329 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.352 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **17.61** k-in.

**EFFECTIVE WIDTH METHOD**  
**NEGATIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 1/12/2015  
 calc by: RKD  
 check by: TS

Deck: 1.5B (stiffeners)  
 Gage: 24 GA  
 Strength: 60 ksi  
 Thickness: 0.0238 in.  
 Total Height: 1.504 in.  
 Radius: 0.1999 in.  
 $\theta$ : 72.5 deg  
 $\theta$ : 1.265 rad  
 Curve  $I'_x$ : 0.000457 in.<sup>3</sup>

Comp Flange: 1.377 in  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000007 in.<sup>3</sup>

Guess  $\bar{y}$ : 0.943 in.

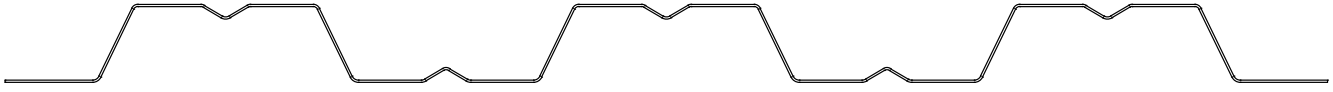
Stress in Flange: 60.000 ksi  
 k: 4.000  
 Fcr: 31.872 ksi  
 $\lambda$ : 1.372  
 $\rho$ : 0.612  
 Effective Width: 0.843 in.

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 0.688   | 0.012            |
| Corners                  | 0.253   | 0.163            |
| Corners <sub>Stiff</sub> | 0.107   | 0.202            |
| Bottom Flange            | 0.843   | 0.012            |
| Web                      | 1.275   | 0.752            |
| Web <sub>Stiff</sub>     | 0.564   | 0.197            |
| Top Flange               | 0.895   | 1.492            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 0        | 0.000      | 0.012            | 0.000                           | 0.000                             | --                                |
| Bottom Corner                | 12       | 3.035      | 0.163            | 0.493                           | 0.080                             | 0.005                             |
| Web                          | 12       | 15.296     | 0.752            | 11.501                          | 8.647                             | 1.884                             |
| Top Corner                   | 12       | 3.035      | 1.341            | 4.071                           | 5.460                             | 0.005                             |
| Top Flange                   | 12       | 10.745     | 1.492            | 16.030                          | 23.915                            | --                                |
| Bottom Flange                | 6        | 5.055      | 0.012            | 0.060                           | 0.001                             | --                                |
| High Corner <sub>Stiff</sub> | 12       | 1.282      | 1.301            | 1.669                           | 2.171                             | 0.000                             |
| Web <sub>Stiff</sub>         | 12       | 6.762      | 1.307            | 8.837                           | 11.549                            | 0.046                             |
| Low Corner <sub>Stiff</sub>  | 12       | 1.282      | 0.908            | 1.164                           | 1.056                             | 0.000                             |
| $\Sigma$                     |          | 46.493     |                  | 43.825                          | 52.881                            | 1.941                             |

Solved  $\bar{y}$  =  $\Sigma Ly / \Sigma L$  = 0.943 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 0.943 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 0.322 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.341 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **20.47** k-in.

## CHAPTER 8: ANALYSIS | 2 DECK (STIFFENED) | $\pm$ BENDING



### 8.0 Executive Summary

The Direct Strength Method predicted higher strengths for each of the 2C Deck sections undergoing positive and negative flexure. Similar to the stiffened 1.5B Deck, the 2C Deck is able to take advantage of the DSM with the compression flange stiffener breaking up and decreasing the flat width the compression element. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 1.108 and 1.295.

## CHAPTER 8: ANALYSIS | 2 DECK (STIFFENED) | $\pm$ BENDING

### 8.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

33 KSI 40 KSI 50 KSI 60 KSI

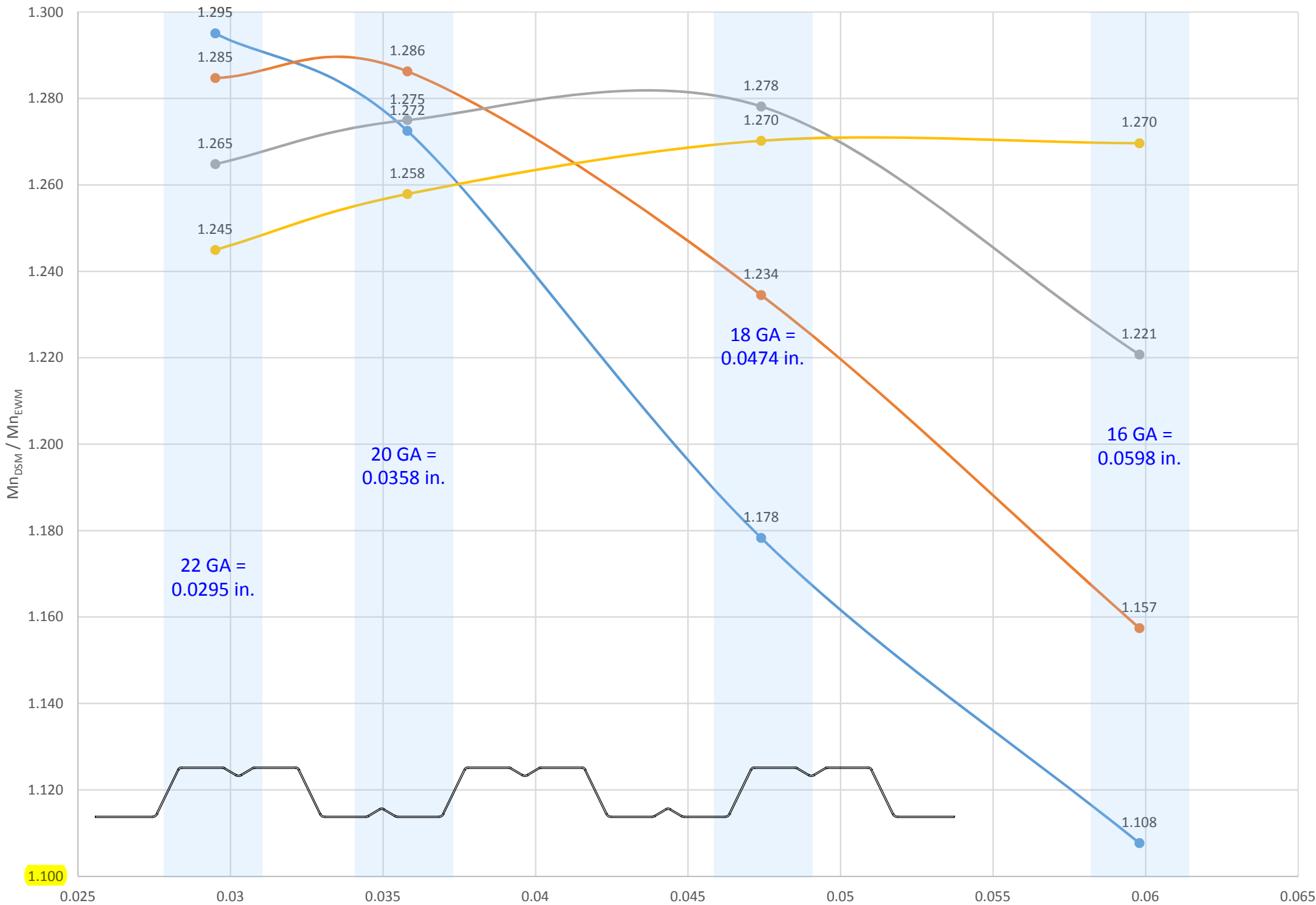


Figure 14 - 2C | Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness | +/- Flexure

2 Deck +/- Bending

## 8.2 Analysis Results Summary

Table 8 - 2C / Analysis Results Summary / +/- Flexure

| 2 DECK - 33 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 1.030   | 1.249   | 1.654   | 2.087   |
| $\bar{y}$ (CUFSM) | 1.04876 | 1.05239 | 1.05907 | 1.06621 |
| Sxx               | 0.982   | 1.187   | 1.562   | 1.958   |
| My                | 32.40   | 39.18   | 51.55   | 64.61   |
| $Mn_{DSM}$        | 31.25   | 39.18   | 51.55   | 64.61   |
| $Mn_{EWM}$        | 24.13   | 30.79   | 43.75   | 58.33   |
| % ERROR           | 22.784% | 21.414% | 15.131% | 9.720%  |

| 2 DECK - 33 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 31.25      | 24.13      | 1.295                 |
| 20              | 0.0358 | 39.18      | 30.79      | 1.272                 |
| 18              | 0.0474 | 51.55      | 43.75      | 1.178                 |
| 16              | 0.0598 | 64.61      | 58.33      | 1.108                 |

| 2 DECK - 40 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 1.030   | 1.249   | 1.654   | 2.087   |
| $\bar{y}$ (CUFSM) | 1.04876 | 1.05239 | 1.05907 | 1.06621 |
| Sxx               | 0.982   | 1.187   | 1.562   | 1.958   |
| My                | 39.27   | 47.49   | 62.49   | 78.31   |
| $Mn_{DSM}$        | 35.78   | 45.74   | 62.49   | 78.31   |
| $Mn_{EWM}$        | 27.85   | 35.56   | 50.62   | 67.66   |
| % ERROR           | 22.163% | 22.256% | 18.995% | 13.600% |

| 2 DECK - 40 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 35.78      | 27.85      | 1.285                 |
| 20              | 0.0358 | 45.74      | 35.56      | 1.286                 |
| 18              | 0.0474 | 62.49      | 50.62      | 1.234                 |
| 16              | 0.0598 | 78.31      | 67.66      | 1.157                 |

| 2 DECK - 50 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 1.030   | 1.249   | 1.654   | 2.087   |
| $\bar{y}$ (CUFSM) | 1.04876 | 1.05239 | 1.05907 | 1.06621 |
| Sxx               | 0.982   | 1.187   | 1.562   | 1.958   |
| My                | 49.08   | 59.36   | 78.11   | 97.89   |
| $Mn_{DSM}$        | 41.60   | 53.55   | 76.51   | 97.89   |
| $Mn_{EWM}$        | 32.89   | 42      | 59.86   | 80.19   |
| % ERROR           | 20.938% | 21.569% | 21.762% | 18.082% |

| 2 DECK - 50 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 41.60      | 32.89      | 1.265                 |
| 20              | 0.0358 | 53.55      | 42.00      | 1.275                 |
| 18              | 0.0474 | 76.51      | 59.86      | 1.278                 |
| 16              | 0.0598 | 97.89      | 80.19      | 1.221                 |

| 2 DECK - 60 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 1.030   | 1.249   | 1.654   | 2.087   |
| $\bar{y}$ (CUFSM) | 1.04876 | 1.05239 | 1.05907 | 1.06621 |
| Sxx               | 0.982   | 1.187   | 1.562   | 1.958   |
| My                | 58.90   | 71.23   | 93.73   | 117.47  |
| $Mn_{DSM}$        | 46.91   | 60.53   | 87.15   | 116.82  |
| $Mn_{EWM}$        | 37.68   | 48.12   | 68.61   | 92.01   |
| % ERROR           | 19.676% | 20.502% | 21.274% | 21.238% |

| 2 DECK - 60 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 46.91      | 37.68      | 1.245                 |
| 20              | 0.0358 | 60.53      | 48.12      | 1.258                 |
| 18              | 0.0474 | 87.15      | 68.61      | 1.270                 |
| 16              | 0.0598 | 116.82     | 92.01      | 1.270                 |

### 8.3 Direct Strength Method Calculations



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |          |             |                 |         |
|---------------|-----------------|----------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 2        |             |                 |         |
|               | Gage:           | 16       | GA          |                 |         |
|               | Strength:       | 33       | KSI         |                 |         |
|               | $M_y =$         | 64.61    | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 5.86000  | $M_{crf} =$ | 378.6146 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 3.93000  | $M_{crd} =$ | 253.9173 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 12.06000 | $M_{cre} =$ | 779.1966 kip-in | 120 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 64.61$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.41$  (local-global slenderness)  
 **$M_{n\ell} = 64.61$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.50$  (distortional slenderness)  
 **$M_{nd} = 64.61$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 64.61$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 2       |             |                 |         |
|               | Gage:           | 16      | GA          |                 |         |
|               | Strength:       | 40      | KSI         |                 |         |
|               | $M_y =$         | 78.31   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 4.84000 | $M_{crf} =$ | 379.0204 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 3.24000 | $M_{crd} =$ | 253.7244 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 9.95000 | $M_{cre} =$ | 779.1845 kip-in | 120 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 78.31$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.45$  (local-global slenderness)  
 **$M_{n\ell} = 78.31$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.56$  (distortional slenderness)  
 **$M_{nd} = 78.31$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 78.31$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 2       |             |                 |         |
|               | Gage:           | 16      | GA          |                 |         |
|               | Strength:       | 50      | KSI         |                 |         |
|               | $M_y =$         | 97.89   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 3.87000 | $M_{crf} =$ | 378.8343 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 2.60000 | $M_{crd} =$ | 254.514 kip-in  | 12 in   |
| global        | $M_{cre}/M_y =$ | 7.96000 | $M_{cre} =$ | 779.2044 kip-in | 120 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 97.89$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.51$  (local-global slenderness)  
 **$M_{n\ell} = 97.89$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.62$  (distortional slenderness)  
 **$M_{nd} = 97.89$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 97.89$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 2       |             |                 |         |
|               | Gage:           | 16      | GA          |                 |         |
|               | Strength:       | 50      | KSI         |                 |         |
|               | $M_y =$         | 117.47  | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 3.23000 | $M_{crf} =$ | 379.4281 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 2.16000 | $M_{crd} =$ | 253.7352 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 6.63000 | $M_{cre} =$ | 778.8261 kip-in | 120 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 117.47$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.56$  (local-global slenderness)  
 **$M_{n\ell} = 117.47$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.68$  (distortional slenderness)  
 **$M_{nd} = 116.82$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 116.82$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 2       |                       |        |         |
|               | Gage:           | 18      | GA                    |        |         |
|               | Strength:       | 33      | KSI                   |        |         |
|               | $M_y =$         | 51.55   | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 3.80940 | $M_{crf} = 196.37457$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 3.08000 | $M_{crd} = 158.774$   | kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 9.60000 | $M_{cre} = 494.88$    | kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 51.55$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.51$  (local-global slenderness)  
 **$M_{n\ell} = 51.55$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.57$  (distortional slenderness)  
 **$M_{nd} = 51.55$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 51.55$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                              |  |         |
|---------------|-----------------|---------|------------------------------|--|---------|
| <b>Given:</b> | Deck:           | 2       |                              |  |         |
|               | Gage:           | 18      | GA                           |  |         |
|               | Strength:       | 40      | KSI                          |  |         |
|               | $M_y =$         | 62.49   | kip-in                       |  | Length: |
| local         | $M_{crf}/M_y =$ | 3.14270 | $M_{crf} =$ 196.38732 kip-in |  | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 2.54000 | $M_{crd} =$ 158.7246 kip-in  |  | 12 in   |
| global        | $M_{cre}/M_y =$ | 7.93000 | $M_{cre} =$ 495.5457 kip-in  |  | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 62.49$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.56$  (local-global slenderness)  
 **$M_{n\ell} = 62.49$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.63$  (distortional slenderness)  
 **$M_{nd} = 62.49$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 62.49$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                              |  |         |
|---------------|-----------------|---------|------------------------------|--|---------|
| <b>Given:</b> | Deck:           | 2       |                              |  |         |
|               | Gage:           | 18      | GA                           |  |         |
|               | Strength:       | 50      | KSI                          |  |         |
|               | $M_y =$         | 78.11   | kip-in                       |  | Length: |
| local         | $M_{crf}/M_y =$ | 2.51420 | $M_{crf} =$ 196.38416 kip-in |  | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 2.04000 | $M_{crd} =$ 159.3444 kip-in  |  | 12 in   |
| global        | $M_{cre}/M_y =$ | 6.34000 | $M_{cre} =$ 495.2174 kip-in  |  | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 78.11$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.63$  (local-global slenderness)  
 **$M_{n\ell} = 78.11$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.70$  (distortional slenderness)  
 **$M_{nd} = 76.51$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 76.51$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                             |  |         |
|---------------|-----------------|---------|-----------------------------|--|---------|
| <b>Given:</b> | Deck:           | 2       |                             |  |         |
|               | Gage:           | 18      | GA                          |  |         |
|               | Strength:       | 60      | KSI                         |  |         |
|               | $M_y =$         | 93.73   | kip-in                      |  | Length: |
| local         | $M_{crf}/M_y =$ | 2.09520 | $M_{crf} =$ 196.3831 kip-in |  | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 1.70000 | $M_{crd} =$ 159.341 kip-in  |  | 12 in   |
| global        | $M_{cre}/M_y =$ | 5.28000 | $M_{cre} =$ 494.8944 kip-in |  | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 93.73$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.69$  (local-global slenderness)  
 **$M_{n\ell} = 93.73$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.77$  (distortional slenderness)  
 **$M_{nd} = 87.15$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 87.15$  kip-in (distortional controls)**



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |         |        |
|---------------|-----------------|---------|-----------------------|---------|--------|
| <b>Given:</b> | Deck:           | 2       |                       |         |        |
|               | Gage:           | 20      | GA                    |         |        |
|               | Strength:       | 33      | KSI                   |         |        |
|               | $M_y =$         | 39.18   | kip-in                | Length: |        |
| local         | $M_{crf}/M_y =$ | 2.21990 | $M_{crf} = 86.975682$ | kip-in  | 1 in   |
| dist.         | $M_{crd}/M_y =$ | 2.33000 | $M_{crd} = 91.2894$   | kip-in  | 12 in  |
| global        | $M_{cre}/M_y =$ | 6.83000 | $M_{cre} = 267.5994$  | kip-in  | 240 in |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 39.18$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.67$  (local-global slenderness)  
 **$M_{n\ell} = 39.18$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.66$  (distortional slenderness)  
 **$M_{nd} = 39.18$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 39.18$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 2       |                       |        |         |
|               | Gage:           | 20      | GA                    |        |         |
|               | Strength:       | 40      | KSI                   |        |         |
|               | $M_y =$         | 47.49   | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 1.83150 | $M_{crf} = 86.977935$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 1.92000 | $M_{crd} = 91.1808$   | kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 5.64000 | $M_{cre} = 267.8436$  | kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 47.49$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.74$  (local-global slenderness)  
 **$M_{n\ell} = 47.49$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.72$  (distortional slenderness)  
 **$M_{nd} = 45.74$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 45.74$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 2       |                       |        |         |
|               | Gage:           | 20      | GA                    |        |         |
|               | Strength:       | 50      | KSI                   |        |         |
|               | $M_v =$         | 59.36   | kip-in                |        | Length: |
| local         | $M_{crf}/M_v =$ | 1.46520 | $M_{crf} = 86.974272$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_v =$ | 1.54000 | $M_{crd} = 91.4144$   | kip-in | 12 in   |
| global        | $M_{cre}/M_v =$ | 4.51000 | $M_{cre} = 267.7136$  | kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 59.36$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.83$  (local-global slenderness)  
 **$M_{n\ell} = 57.07$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.81$  (distortional slenderness)  
 **$M_{nd} = 53.55$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 53.55$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 2       |             |                 |         |
|               | Gage:           | 20      | GA          |                 |         |
|               | Strength:       | 60      | KSI         |                 |         |
|               | $M_y =$         | 71.23   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.22100 | $M_{crf} =$ | 86.97183 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 1.28000 | $M_{crd} =$ | 91.1744 kip-in  | 12 in   |
| global        | $M_{cre}/M_y =$ | 3.76000 | $M_{cre} =$ | 267.8248 kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 71.23$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.90$  (local-global slenderness)  
 **$M_{n\ell} = 64.62$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.88$  (distortional slenderness)  
 **$M_{nd} = 60.53$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 60.53$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 2       |             |                 |         |
|               | Gage:           | 22      | GA          |                 |         |
|               | Strength:       | 33      | KSI         |                 |         |
|               | $M_y =$         | 32.40   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.52840 | $M_{crf} =$ | 49.52016 kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 1.93000 | $M_{crd} =$ | 62.532 kip-in   | 12 in   |
| global        | $M_{cre}/M_y =$ | 5.57000 | $M_{cre} =$ | 180.468 kip-in  | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 32.40$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.81$  (local-global slenderness)  
 **$M_{n\ell} = 31.57$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.72$  (distortional slenderness)  
 **$M_{nd} = 31.25$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 31.25$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 2       |                       |        |         |
|               | Gage:           | 22      | GA                    |        |         |
|               | Strength:       | 40      | KSI                   |        |         |
|               | $M_y =$         | 39.27   | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 1.26090 | $M_{crf} = 49.515543$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 1.59000 | $M_{crd} = 62.4393$   | kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.60000 | $M_{cre} = 180.642$   | kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 39.27$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.89$  (local-global slenderness)  
 **$M_{n\ell} = 35.99$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.79$  (distortional slenderness)  
 **$M_{nd} = 35.78$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 35.78$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 2       |                       |        |         |
|               | Gage:           | 22      | GA                    |        |         |
|               | Strength:       | 50      | KSI                   |        |         |
|               | $M_y =$         | 49.08   | kip-in                |        | Length: |
| local         | $M_{crf}/M_y =$ | 1.00870 | $M_{crf} = 49.506996$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_y =$ | 1.27000 | $M_{crd} = 62.3316$   | kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 3.68000 | $M_{cre} = 180.6144$  | kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 49.08$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.00$  (local-global slenderness)  
 **$M_{n\ell} = 41.84$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.89$  (distortional slenderness)  
 **$M_{nd} = 41.60$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 41.60$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |        |         |
|---------------|-----------------|---------|-----------------------|--------|---------|
| <b>Given:</b> | Deck:           | 2       |                       |        |         |
|               | Gage:           | 22      | GA                    |        |         |
|               | Strength:       | 60      | KSI                   |        |         |
|               | $M_v =$         | 58.90   | kip-in                |        | Length: |
| local         | $M_{crf}/M_v =$ | 0.84062 | $M_{crf} = 49.512518$ | kip-in | 1 in    |
| dist.         | $M_{crd}/M_v =$ | 1.06000 | $M_{crd} = 62.434$    | kip-in | 12 in   |
| global        | $M_{cre}/M_v =$ | 3.06000 | $M_{cre} = 180.234$   | kip-in | 240 in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 58.90$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.09$  (local-global slenderness)  
 **$M_{n\ell} = 47.26$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.97$  (distortional slenderness)  
 **$M_{nd} = 46.91$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 46.91$  kip-in (distortional controls)**



## 8.4 Effective Width Method Calculations

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 2        | bo:                                      | 4.765    | in.              |
| Gage:                   | 16       | h:                                       | 2.050    | in.              |
| Strength:               | 33       | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0598   | Ag:                                      | 0.295    | in. <sup>2</sup> |
| Total Height:           | 2.120    | n:                                       | 1        |                  |
| Radius:                 | 0.2179   |  |          |                  |
| θ:                      | 64.106   | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119    | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000337 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 | in. <sup>3</sup> |

Guess  $\bar{y}$ : 1.096 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 33.000 | ksi | δ:    | 1.037  |                  |
| k:                | 11.461 |     | lsp:  | 0.004  | in. <sup>4</sup> |
| Fcr:              | 48.128 | ksi | γ:    | 41.366 |                  |
| λ:                | 0.828  |     | β:    | 3.025  |                  |
| ρ:                | 0.887  |     | kd:   | 6.605  |                  |
| Effective Width:  | 4.381  | in. | kloc: | 31.205 |                  |
|                   |        |     | R:    | 1.735  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.090            |
| Corners                  | 0.244   | 0.205            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.706   | 2.090            |
| Web                      | 2.050   | 1.060            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 4.381   | 0.083            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.090            | 9.956                   | 20.808                               | --                                   |
| Bottom Corner                | 6        | 1.463  | 1.915            | 2.801                   | 5.363                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.060            | 13.037                  | 13.818                               | 3.486                                |
| Top Corner                   | 6        | 1.463  | 0.205            | 0.300                   | 0.062                                | 0.002                                |
| Top Flange                   | 3        | 13.142 | 0.083            | 1.097                   | 0.092                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.090            | 14.261                  | 29.805                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.466  | 1.882            | 0.877                   | 1.650                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.905            | 4.294                   | 8.179                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.466  | 1.452            | 0.677                   | 0.983                                | 0.000                                |
|                              | Σ        | 43.142 |                  | 47.299                  | 80.758                               | 3.506                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.096 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.096 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.938 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.768 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **58.33** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 2  
 Gage: 16 GA  
 Strength: 40 ksi  
 Thickness: 0.0598 in.  
 Total Height: 2.120 in.  
 Radius: 0.2179 in.  
 $\theta$ : 64.106 deg  
 $\theta$ : 1.119 rad  
 Curve  $I'_x$ : 0.000337 in.<sup>3</sup>

bo: 4.765 in.  
 h: 2.050 in.  
 bp: 1.706 in.  
 Ag: 0.295 in.<sup>2</sup>  
 n: 1  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000010 in.<sup>3</sup>

**Guess  $\bar{y}$ :** 1.116 in.

Stress in Flange: 40.000 ksi  
 k: 11.461  
 Fcr: 48.128 ksi  
 $\lambda$ : 0.912  
 $\rho$ : 0.832  
 Effective Width: 4.111 in.

$\delta$ : 1.037  
 $I_{sp}$ : 0.004 in.<sup>4</sup>  
 $\gamma$ : 41.366  
 $\beta$ : 3.025  
 kd: 6.605  
 kloc: 31.205  
 R: 1.735

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.090            |
| Corners                  | 0.244   | 0.205            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.706   | 2.090            |
| Web                      | 2.050   | 1.060            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 4.111   | 0.083            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.090            | 9.956                           | 20.808                            | --                                |
| Bottom Corner                | 6        | 1.463      | 1.915            | 2.801                           | 5.363                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.060            | 13.037                          | 13.818                            | 3.486                             |
| Top Corner                   | 6        | 1.463      | 0.205            | 0.300                           | 0.062                             | 0.002                             |
| Top Flange                   | 3        | 12.333     | 0.083            | 1.029                           | 0.086                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.090            | 14.261                          | 29.805                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.466      | 1.882            | 0.877                           | 1.650                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.905            | 4.294                           | 8.179                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.466      | 1.452            | 0.677                           | 0.983                             | 0.000                             |
| $\Sigma$                     |          | 42.333     |                  | 47.232                          | 80.753                            | 3.506                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.116 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.116 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.887 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.692 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** 67.66 k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 16       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 50       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0598   | in.              | Ag:                                      | 0.295    | in. <sup>2</sup> |
| Total Height:           | 2.120    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2179   | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000337 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.139 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 50.000 | ksi | $\delta$ :        | 1.037  |                  |
| k:                | 11.461 |     | I <sub>sp</sub> : | 0.004  | in. <sup>4</sup> |
| Fcr:              | 48.128 | ksi | $\gamma$ :        | 41.366 |                  |
| $\lambda$ :       | 1.019  |     | $\beta$ :         | 3.025  |                  |
| $\rho$ :          | 0.769  |     | kd:               | 6.605  |                  |
| Effective Width:  | 3.801  | in. | kloc:             | 31.205 |                  |
|                   |        |     | R:                | 1.735  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.090            |
| Corners                  | 0.244   | 0.205            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.706   | 2.090            |
| Web                      | 2.050   | 1.060            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.801   | 0.083            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.090            | 9.956                           | 20.808                            | --                                |
| Bottom Corner                | 6        | 1.463      | 1.915            | 2.801                           | 5.363                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.060            | 13.037                          | 13.818                            | 3.486                             |
| Top Corner                   | 6        | 1.463      | 0.205            | 0.300                           | 0.062                             | 0.002                             |
| Top Flange                   | 3        | 11.402     | 0.083            | 0.952                           | 0.079                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.090            | 14.261                          | 29.805                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.466      | 1.882            | 0.877                           | 1.650                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.905            | 4.294                           | 8.179                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.466      | 1.452            | 0.677                           | 0.983                             | 0.000                             |
| $\Sigma$                     |          | 41.401     |                  | 47.154                          | 80.746                            | 3.506                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.139 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.139 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  1.827 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.604 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **80.19** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 2        | bo:                                      | 4.765    | in.              |
| Gage:                   | 16       | h:                                       | 2.050    | in.              |
| Strength:               | 60       | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0598   | Ag:                                      | 0.295    | in. <sup>2</sup> |
| Total Height:           | 2.120    | n:                                       | 1        |                  |
| Radius:                 | 0.2179   |  |          |                  |
| θ:                      | 64.106   | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119    | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000337 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000010 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.158 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 60.000 | ksi | δ:                | 1.037  |                  |
| k:                | 11.461 |     | I <sub>sp</sub> : | 0.004  | in. <sup>4</sup> |
| F <sub>cr</sub> : | 48.128 | ksi | γ:                | 41.366 |                  |
| λ:                | 1.117  |     | β:                | 3.025  |                  |
| ρ:                | 0.719  |     | kd:               | 6.605  |                  |
| Effective Width:  | 3.553  | in. | kloc:             | 31.205 |                  |
|                   |        |     | R:                | 1.735  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.090            |
| Corners                  | 0.244   | 0.205            |
| Corners <sub>Stiff</sub> | 0.116   | 0.238            |
| Bottom Flange            | 1.706   | 2.090            |
| Web                      | 2.050   | 1.060            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.553   | 0.083            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.090            | 9.956                   | 20.808                               | --                                   |
| Bottom Corner                | 6        | 1.463  | 1.915            | 2.801                   | 5.363                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.060            | 13.037                  | 13.818                               | 3.486                                |
| Top Corner                   | 6        | 1.463  | 0.205            | 0.300                   | 0.062                                | 0.002                                |
| Top Flange                   | 3        | 10.658 | 0.083            | 0.889                   | 0.074                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.090            | 14.261                  | 29.805                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.466  | 1.882            | 0.877                   | 1.650                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.905            | 4.294                   | 8.179                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.466  | 1.452            | 0.677                   | 0.983                                | 0.000                                |
|                              | Σ        | 40.657 |                  | 47.092                  | 80.741                               | 3.506                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.158 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.158 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.776 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.533 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **92.01** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 2        | bo:                                      | 4.765    | in.              |
| Gage:                   | 18       | h:                                       | 2.050    | in.              |
| Strength:               | 33       | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0474   | Ag:                                      | 0.234    | in. <sup>2</sup> |
| Total Height:           | 2.107    | n:                                       | 1        |                  |
| Radius:                 | 0.2117   |  |          |                  |
| θ:                      | 64.106   | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119    | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000309 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.116 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 33.000 | ksi | δ:                | 1.037  |                  |
| k:                | 14.072 |     | l <sub>sp</sub> : | 0.003  | in. <sup>4</sup> |
| F <sub>cr</sub> : | 37.127 | ksi | γ:                | 65.203 |                  |
| λ:                | 0.943  |     | β:                | 3.386  |                  |
| ρ:                | 0.813  |     | kd:               | 8.110  |                  |
| Effective Width:  | 4.017  | in. | kloc:             | 31.205 |                  |
|                   |        |     | R:                | 1.735  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.084            |
| Corners                  | 0.237   | 0.194            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.706   | 2.084            |
| Web                      | 2.050   | 1.054            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 4.017   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.084            | 9.927                   | 20.684                               | --                                   |
| Bottom Corner                | 6        | 1.421  | 1.913            | 2.719                   | 5.204                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.054            | 12.961                  | 13.656                               | 3.486                                |
| Top Corner                   | 6        | 1.421  | 0.194            | 0.276                   | 0.053                                | 0.002                                |
| Top Flange                   | 3        | 12.051 | 0.077            | 0.928                   | 0.072                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.084            | 14.219                  | 29.628                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.453  | 1.882            | 0.852                   | 1.603                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.899            | 4.280                   | 8.126                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.453  | 1.465            | 0.663                   | 0.971                                | 0.000                                |
|                              | Σ        | 41.941 |                  | 46.824                  | 79.997                               | 3.505                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.116 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.116 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.480 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.326 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **43.75** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 2        | bo:                                      | 4.765    | in.              |
| Gage:                   | 18       | h:                                       | 2.050    | in.              |
| Strength:               | 40       | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0474   | Ag:                                      | 0.234    | in. <sup>2</sup> |
| Total Height:           | 2.107    | n:                                       | 1        |                  |
| Radius:                 | 0.2117   |  |          |                  |
| θ:                      | 64.106   | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119    | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000309 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.137 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 40.000 | ksi | δ:    | 1.037  |                  |
| k:                | 14.072 |     | lsp:  | 0.003  | in. <sup>4</sup> |
| Fcr:              | 37.127 | ksi | γ:    | 65.203 |                  |
| λ:                | 1.038  |     | β:    | 3.386  |                  |
| ρ:                | 0.759  |     | kd:   | 8.110  |                  |
| Effective Width:  | 3.751  | in. | kloc: | 31.205 |                  |
|                   |        |     | R:    | 1.735  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.084            |
| Corners                  | 0.237   | 0.194            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.706   | 2.084            |
| Web                      | 2.050   | 1.054            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.751   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.084            | 9.927                   | 20.684                               | --                                   |
| Bottom Corner                | 6        | 1.421  | 1.913            | 2.719                   | 5.204                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.054            | 12.961                  | 13.656                               | 3.486                                |
| Top Corner                   | 6        | 1.421  | 0.194            | 0.276                   | 0.053                                | 0.002                                |
| Top Flange                   | 3        | 11.252 | 0.077            | 0.867                   | 0.067                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.084            | 14.219                  | 29.628                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.453  | 1.882            | 0.852                   | 1.603                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.899            | 4.280                   | 8.126                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.453  | 1.465            | 0.663                   | 0.971                                | 0.000                                |
|                              | Σ        | 41.141 |                  | 46.763                  | 79.993                               | 3.505                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.137 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.137 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  1.438 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.265 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **50.62** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 2        | bo:                                      | 4.765    | in.              |
| Gage:                   | 18       | h:                                       | 2.050    | in.              |
| Strength:               | 50       | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0474   | Ag:                                      | 0.234    | in. <sup>2</sup> |
| Total Height:           | 2.107    | n:                                       | 1        |                  |
| Radius:                 | 0.2117   |  |          |                  |
| θ:                      | 64.106   | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119    | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000309 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000009 | in. <sup>3</sup> |

Guess  $\bar{y}$ : 1.160 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 50.000 | ksi | δ:                | 1.037  |                  |
| k:                | 14.072 |     | l <sub>sp</sub> : | 0.003  | in. <sup>4</sup> |
| F <sub>cr</sub> : | 37.127 | ksi | γ:                | 65.203 |                  |
| λ:                | 1.160  |     | β:                | 3.386  |                  |
| ρ:                | 0.698  |     | kd:               | 8.110  |                  |
| Effective Width:  | 3.450  | in. | kloc:             | 31.205 |                  |
|                   |        |     | R:                | 1.735  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.084            |
| Corners                  | 0.237   | 0.194            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.706   | 2.084            |
| Web                      | 2.050   | 1.054            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.450   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.084            | 9.927                   | 20.684                               | --                                   |
| Bottom Corner                | 6        | 1.421  | 1.913            | 2.719                   | 5.204                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.054            | 12.961                  | 13.656                               | 3.486                                |
| Top Corner                   | 6        | 1.421  | 0.194            | 0.276                   | 0.053                                | 0.002                                |
| Top Flange                   | 3        | 10.350 | 0.077            | 0.797                   | 0.061                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.084            | 14.219                  | 29.628                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.453  | 1.882            | 0.852                   | 1.603                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.899            | 4.280                   | 8.126                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.453  | 1.465            | 0.663                   | 0.971                                | 0.000                                |
|                              | Σ        | 40.239 |                  | 46.693                  | 79.987                               | 3.505                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.160 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.160 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.389 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.197 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **59.86** k-in.



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 2  
 Gage: 18 GA  
 Strength: 60 ksi  
 Thickness: 0.0474 in.  
 Total Height: 2.107 in.  
 Radius: 0.2117 in.  
 $\theta$ : 64.106 deg  
 $\theta$ : 1.119 rad  
 Curve  $I'_x$ : 0.000309 in.<sup>3</sup>

bo: 4.765 in.  
 h: 2.050 in.  
 bp: 1.706 in.  
 Ag: 0.234 in.<sup>2</sup>  
 n: 1  
 $\theta_{Stiff}$ : 30.625 deg  
 $\theta_{Stiff}$ : 0.535 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000009 in.<sup>3</sup>

**Guess  $\bar{y}$ :** 1.180 in.

Stress in Flange: 60.000 ksi  
 k: 14.072  
 Fcr: 37.127 ksi  
 $\lambda$ : 1.271  
 $\rho$ : 0.650  
 Effective Width: 3.213 in.

$\delta$ : 1.037  
 $I_{sp}$ : 0.003 in.<sup>4</sup>  
 $\gamma$ : 65.203  
 $\beta$ : 3.386  
 kd: 8.110  
 kloc: 31.205  
 R: 1.735

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.084            |
| Corners                  | 0.237   | 0.194            |
| Corners <sub>Stiff</sub> | 0.113   | 0.225            |
| Bottom Flange            | 1.706   | 2.084            |
| Web                      | 2.050   | 1.054            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.213   | 0.077            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.084            | 9.927                           | 20.684                            | --                                |
| Bottom Corner                | 6        | 1.421      | 1.913            | 2.719                           | 5.204                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.054            | 12.961                          | 13.656                            | 3.486                             |
| Top Corner                   | 6        | 1.421      | 0.194            | 0.276                           | 0.053                             | 0.002                             |
| Top Flange                   | 3        | 9.640      | 0.077            | 0.743                           | 0.057                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.084            | 14.219                          | 29.628                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.453      | 1.882            | 0.852                           | 1.603                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.899            | 4.280                           | 8.126                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.453      | 1.465            | 0.663                           | 0.971                             | 0.000                             |
| $\Sigma$                     |          | 39.530     |                  | 46.638                          | 79.983                            | 3.505                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.180 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.180 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  1.349 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.144 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **68.61** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 33       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.177    | in. <sup>2</sup> |
| Total Height:           | 2.096    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              |  |          |                  |
| θ:                      | 64.106   | deg              | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119    | rad              | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000284 | in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.143 in.

|                   |        |     |                   |         |                  |
|-------------------|--------|-----|-------------------|---------|------------------|
| Stress in Flange: | 33.000 | ksi | δ:                | 1.037   |                  |
| k:                | 18.169 |     | I <sub>sp</sub> : | 0.002   | in. <sup>4</sup> |
| F <sub>cr</sub> : | 27.345 | ksi | γ:                | 113.380 |                  |
| λ:                | 1.099  |     | β:                | 3.885   |                  |
| ρ:                | 0.728  |     | kd:               | 10.471  |                  |
| Effective Width:  | 3.596  | in. | kloc:             | 31.205  |                  |
|                   |        |     | R:                | 1.735   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.078            |
| Corners                  | 0.230   | 0.183            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.706   | 2.078            |
| Web                      | 2.050   | 1.048            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.596   | 0.071            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.078            | 9.899                   | 20.569                               | --                                   |
| Bottom Corner                | 6        | 1.382  | 1.912            | 2.643                   | 5.055                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.048            | 12.889                  | 13.507                               | 3.486                                |
| Top Corner                   | 6        | 1.382  | 0.183            | 0.254                   | 0.047                                | 0.002                                |
| Top Flange                   | 3        | 10.789 | 0.071            | 0.767                   | 0.054                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.078            | 14.180                  | 29.464                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.440  | 1.882            | 0.828                   | 1.559                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.893            | 4.267                   | 8.076                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.440  | 1.476            | 0.650                   | 0.959                                | 0.000                                |
|                              | Σ        | 40.576 |                  | 46.376                  | 79.289                               | 3.505                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.143 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.143 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  1.066 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.933 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **30.79** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 40       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.177    | in. <sup>2</sup> |
| Total Height:           | 2.096    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000284 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.164 in.

|                   |        |            |            |                  |
|-------------------|--------|------------|------------|------------------|
| Stress in Flange: | 40.000 | ksi        | $\delta$ : | 1.037            |
| k:                | 18.169 | $I_{sp}$ : | 0.002      | in. <sup>4</sup> |
| Fcr:              | 27.345 | ksi        | $\gamma$ : | 113.380          |
| $\lambda$ :       | 1.209  | $\beta$ :  | 3.885      |                  |
| $\rho$ :          | 0.676  | kd:        | 10.471     |                  |
| Effective Width:  | 3.342  | in.        | kloc:      | 31.205           |
|                   |        | R:         | 1.735      |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.078            |
| Corners                  | 0.230   | 0.183            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.706   | 2.078            |
| Web                      | 2.050   | 1.048            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.342   | 0.071            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.078            | 9.899                           | 20.569                            | --                                |
| Bottom Corner                | 6        | 1.382      | 1.912            | 2.643                           | 5.055                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.048            | 12.889                          | 13.507                            | 3.486                             |
| Top Corner                   | 6        | 1.382      | 0.183            | 0.254                           | 0.047                             | 0.002                             |
| Top Flange                   | 3        | 10.025     | 0.071            | 0.712                           | 0.051                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.078            | 14.180                          | 29.464                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.440      | 1.882            | 0.828                           | 1.559                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.893            | 4.267                           | 8.076                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.440      | 1.476            | 0.650                           | 0.959                             | 0.000                             |
| $\Sigma$                     |          | 39.811     |                  | 46.322                          | 79.286                            | 3.505                             |

**Solved  $\bar{y}$**  =  $\Sigma Ly / \Sigma L$  = 1.164 in.  
 $\bar{Y}_{EXTREME FIBER}$  =  $\max(\bar{y}, h - \bar{y})$  = 1.164 in.  
 $I_x$  =  $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t$  = 1.034 in.<sup>4</sup>  
 $S_e$  =  $I_x / \bar{y}$  = 0.889 in.<sup>3</sup>  
**Mn** = **Se \* Fy** = **35.56** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 50       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.177    | in. <sup>2</sup> |
| Total Height:           | 2.096    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000284 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.187 in.

|                   |        |     |                   |         |                  |
|-------------------|--------|-----|-------------------|---------|------------------|
| Stress in Flange: | 50.000 | ksi | $\delta$ :        | 1.037   |                  |
| k:                | 18.169 |     | I <sub>sp</sub> : | 0.002   | in. <sup>4</sup> |
| Fcr:              | 27.345 | ksi | $\gamma$ :        | 113.380 |                  |
| $\lambda$ :       | 1.352  |     | $\beta$ :         | 3.885   |                  |
| $\rho$ :          | 0.619  |     | kd:               | 10.471  |                  |
| Effective Width:  | 3.059  | in. | kloc:             | 31.205  |                  |
|                   |        |     | R:                | 1.735   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.078            |
| Corners                  | 0.230   | 0.183            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.706   | 2.078            |
| Web                      | 2.050   | 1.048            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.059   | 0.071            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.078            | 9.899                           | 20.569                            | --                                |
| Bottom Corner                | 6        | 1.382      | 1.912            | 2.643                           | 5.055                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.048            | 12.889                          | 13.507                            | 3.486                             |
| Top Corner                   | 6        | 1.382      | 0.183            | 0.254                           | 0.047                             | 0.002                             |
| Top Flange                   | 3        | 9.177      | 0.071            | 0.652                           | 0.046                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.078            | 14.180                          | 29.464                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.440      | 1.882            | 0.828                           | 1.559                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.893            | 4.267                           | 8.076                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.440      | 1.476            | 0.650                           | 0.959                             | 0.000                             |
| $\Sigma$                     |          | 38.964     |                  | 46.261                          | 79.281                            | 3.505                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.187 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.187 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.997 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.840 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **42.00** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 60       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.177    | in. <sup>2</sup> |
| Total Height:           | 2.096    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000284 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.206 in.

|                   |        |            |            |                  |
|-------------------|--------|------------|------------|------------------|
| Stress in Flange: | 60.000 | ksi        | $\delta$ : | 1.037            |
| k:                | 18.169 | $I_{sp}$ : | 0.002      | in. <sup>4</sup> |
| Fcr:              | 27.345 | ksi        | $\gamma$ : | 113.380          |
| $\lambda$ :       | 1.481  | $\beta$ :  | 3.885      |                  |
| $\rho$ :          | 0.575  | kd:        | 10.471     |                  |
| Effective Width:  | 2.840  | in.        | kloc:      | 31.205           |
|                   |        | R:         | 1.735      |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.078            |
| Corners                  | 0.230   | 0.183            |
| Corners <sub>Stiff</sub> | 0.110   | 0.214            |
| Bottom Flange            | 1.706   | 2.078            |
| Web                      | 2.050   | 1.048            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 2.840   | 0.071            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.078            | 9.899                           | 20.569                            | --                                |
| Bottom Corner                | 6        | 1.382      | 1.912            | 2.643                           | 5.055                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.048            | 12.889                          | 13.507                            | 3.486                             |
| Top Corner                   | 6        | 1.382      | 0.183            | 0.254                           | 0.047                             | 0.002                             |
| Top Flange                   | 3        | 8.519      | 0.071            | 0.605                           | 0.043                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.078            | 14.180                          | 29.464                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.440      | 1.882            | 0.828                           | 1.559                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.893            | 4.267                           | 8.076                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.440      | 1.476            | 0.650                           | 0.959                             | 0.000                             |
| $\Sigma$                     |          | 38.306     |                  | 46.215                          | 79.278                            | 3.505                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.206 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.206 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.968 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.802 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **48.12** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 22       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 33       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0295   | in.              | Ag:                                      | 0.146    | in. <sup>2</sup> |
| Total Height:           | 2.090    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.20275  | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000271 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.162 in.

|                   |        |     |                   |         |                  |
|-------------------|--------|-----|-------------------|---------|------------------|
| Stress in Flange: | 33.000 | ksi | $\delta$ :        | 1.037   |                  |
| k:                | 21.736 |     | I <sub>sp</sub> : | 0.002   | in. <sup>4</sup> |
| F <sub>cr</sub> : | 22.212 | ksi | $\gamma$ :        | 166.038 |                  |
| $\lambda$ :       | 1.219  |     | $\beta$ :         | 4.272   |                  |
| $\rho$ :          | 0.672  |     | kd:               | 12.527  |                  |
| Effective Width:  | 3.321  | in. | kloc:             | 31.205  |                  |
|                   |        |     | R:                | 1.735   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.075            |
| Corners                  | 0.227   | 0.178            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.706   | 2.075            |
| Web                      | 2.050   | 1.045            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.321   | 0.068            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.075            | 9.884                           | 20.507                            | --                                |
| Bottom Corner                | 6        | 1.361      | 1.912            | 2.602                           | 4.974                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.045            | 12.850                          | 13.425                            | 3.486                             |
| Top Corner                   | 6        | 1.361      | 0.178            | 0.242                           | 0.043                             | 0.002                             |
| Top Flange                   | 3        | 9.964      | 0.068            | 0.675                           | 0.046                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.075            | 14.158                          | 29.375                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.433      | 1.882            | 0.816                           | 1.535                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.890            | 4.259                           | 8.049                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.433      | 1.482            | 0.642                           | 0.952                             | 0.000                             |
| $\Sigma$                     |          | 39.695     |                  | 46.130                          | 78.906                            | 3.505                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.162 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.162 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.850 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.731 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **24.13** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 22       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 40       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0295   | in.              | Ag:                                      | 0.146    | in. <sup>2</sup> |
| Total Height:           | 2.090    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.20275  | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000271 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.183 in.

|                   |        |     |                   |         |                  |
|-------------------|--------|-----|-------------------|---------|------------------|
| Stress in Flange: | 40.000 | ksi | $\delta$ :        | 1.037   |                  |
| k:                | 21.736 |     | I <sub>sp</sub> : | 0.002   | in. <sup>4</sup> |
| F <sub>cr</sub> : | 22.212 | ksi | $\gamma$ :        | 166.038 |                  |
| $\lambda$ :       | 1.342  |     | $\beta$ :         | 4.272   |                  |
| $\rho$ :          | 0.623  |     | kd:               | 12.527  |                  |
| Effective Width:  | 3.078  | in. | kloc:             | 31.205  |                  |
|                   |        |     | R:                | 1.735   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.075            |
| Corners                  | 0.227   | 0.178            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.706   | 2.075            |
| Web                      | 2.050   | 1.045            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.078   | 0.068            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.075            | 9.884                           | 20.507                            | --                                |
| Bottom Corner                | 6        | 1.361      | 1.912            | 2.602                           | 4.974                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.045            | 12.850                          | 13.425                            | 3.486                             |
| Top Corner                   | 6        | 1.361      | 0.178            | 0.242                           | 0.043                             | 0.002                             |
| Top Flange                   | 3        | 9.233      | 0.068            | 0.626                           | 0.042                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.075            | 14.158                          | 29.375                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.433      | 1.882            | 0.816                           | 1.535                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.890            | 4.259                           | 8.049                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.433      | 1.482            | 0.642                           | 0.952                             | 0.000                             |
| $\Sigma$                     |          | 38.964     |                  | 46.080                          | 78.903                            | 3.505                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.183 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.183 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.823 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.696 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **27.85** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |                           |  |          |                  |
|-------------------------|---------------------------|--|----------|------------------|
| Deck:                   | 2                         | bo:                                      | 4.765    | in.              |
| Gage:                   | 22 GA                     | h:                                       | 2.050    | in.              |
| Strength:               | 50 ksi                    | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.146    | in. <sup>2</sup> |
| Total Height:           | 2.090 in.                 | n:                                       | 1        |                  |
| Radius:                 | 0.20275 in.               |  |          |                  |
| θ:                      | 64.106 deg                | θ <sub>Stiff</sub> :                     | 30.625   | deg              |
| θ:                      | 1.119 rad                 | θ <sub>Stiff</sub> :                     | 0.535    | rad              |
| Curve I' <sub>x</sub> : | 0.000271 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.206 in.

|                   |            |                   |                        |
|-------------------|------------|-------------------|------------------------|
| Stress in Flange: | 50.000 ksi | δ:                | 1.037                  |
| k:                | 21.736     | I <sub>sp</sub> : | 0.002 in. <sup>4</sup> |
| F <sub>cr</sub> : | 22.212 ksi | γ:                | 166.038                |
| λ:                | 1.500      | β:                | 4.272                  |
| ρ:                | 0.569      | kd:               | 12.527                 |
| Effective Width:  | 2.810 in.  | kloc:             | 31.205                 |
|                   |            | R:                | 1.735                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.075            |
| Corners                  | 0.227   | 0.178            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.706   | 2.075            |
| Web                      | 2.050   | 1.045            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 2.810   | 0.068            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.764  | 2.075            | 9.884                   | 20.507                               | --                                   |
| Bottom Corner                | 6        | 1.361  | 1.912            | 2.602                   | 4.974                                | 0.002                                |
| Web                          | 6        | 12.300 | 1.045            | 12.850                  | 13.425                               | 3.486                                |
| Top Corner                   | 6        | 1.361  | 0.178            | 0.242                   | 0.043                                | 0.002                                |
| Top Flange                   | 3        | 8.429  | 0.068            | 0.571                   | 0.039                                | --                                   |
| Bottom Flange                | 4        | 6.824  | 2.075            | 14.158                  | 29.375                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.433  | 1.882            | 0.816                   | 1.535                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 1.890            | 4.259                   | 8.049                                | 0.015                                |
| High Corner <sub>Stiff</sub> | 4        | 0.433  | 1.482            | 0.642                   | 0.952                                | 0.000                                |
|                              | Σ        | 38.161 |                  | 46.026                  | 78.899                               | 3.505                                |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.206 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.206 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.793 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.658 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **32.89 k-in.**



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 2        | bo:              | 4.765                                    | in.      |                  |
| Gage:                   | 22       | GA               | h:                                       | 2.050    | in.              |
| Strength:               | 60       | ksi              | bp:                                      | 1.706    | in.              |
| Thickness:              | 0.0295   | in.              | Ag:                                      | 0.146    | in. <sup>2</sup> |
| Total Height:           | 2.090    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.20275  | in.              | $\theta_{Stiff}$ :                       | 30.625   | deg              |
| $\theta$ :              | 64.106   | deg              | $\theta_{Stiff}$ :                       | 0.535    | rad              |
| $\theta$ :              | 1.119    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000008 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000271 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.225 in.

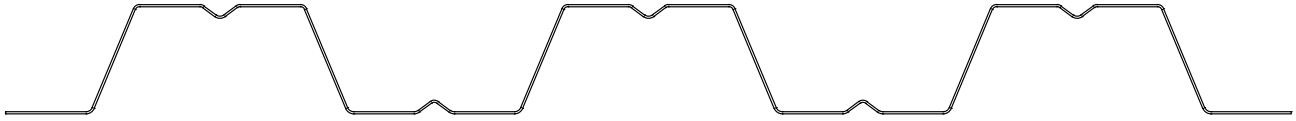
|                   |        |     |            |         |                  |
|-------------------|--------|-----|------------|---------|------------------|
| Stress in Flange: | 60.000 | ksi | $\delta$ : | 1.037   |                  |
| k:                | 21.736 |     | lsp:       | 0.002   | in. <sup>4</sup> |
| Fcr:              | 22.212 | ksi | $\gamma$ : | 166.038 |                  |
| $\lambda$ :       | 1.644  |     | $\beta$ :  | 4.272   |                  |
| $\rho$ :          | 0.527  |     | kd:        | 12.527  |                  |
| Effective Width:  | 2.603  | in. | kloc:      | 31.205  |                  |
|                   |        |     | R:         | 1.735   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.382   | 2.075            |
| Corners                  | 0.227   | 0.178            |
| Corners <sub>Stiff</sub> | 0.108   | 0.208            |
| Bottom Flange            | 1.706   | 2.075            |
| Web                      | 2.050   | 1.045            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 2.603   | 0.068            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.764      | 2.075            | 9.884                           | 20.507                            | --                                |
| Bottom Corner                | 6        | 1.361      | 1.912            | 2.602                           | 4.974                             | 0.002                             |
| Web                          | 6        | 12.300     | 1.045            | 12.850                          | 13.425                            | 3.486                             |
| Top Corner                   | 6        | 1.361      | 0.178            | 0.242                           | 0.043                             | 0.002                             |
| Top Flange                   | 3        | 7.810      | 0.068            | 0.529                           | 0.036                             | --                                |
| Bottom Flange                | 4        | 6.824      | 2.075            | 14.158                          | 29.375                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.433      | 1.882            | 0.816                           | 1.535                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 1.890            | 4.259                           | 8.049                             | 0.015                             |
| High Corner <sub>Stiff</sub> | 4        | 0.433      | 1.482            | 0.642                           | 0.952                             | 0.000                             |
| $\Sigma$                     |          | 37.541     |                  | 45.984                          | 78.896                            | 3.505                             |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.225 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.225 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  0.769 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  0.628 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **37.68** k-in.

## CHAPTER 9: ANALYSIS | 3 DECK (STIFFENED) | $\pm$ BENDING



### 9.0 Executive Summary

The Direct Strength Method predicted higher strengths for each of the 3C Deck sections undergoing positive and negative flexure. Similar to the stiffened 1.5B Deck, the 3C Deck is able to take advantage of the DSM with the compression flange stiffener breaking up and decreasing the flat width the compression element. The nominal moment capacity ratio ( $M_{nDSM}/M_{nEWM}$ ) ranged between 1.056 and 1.192.

## CHAPTER 9: ANALYSIS | 3 DECK (STIFFENED) | $\pm$ BENDING

### 9.1 $M_{nDSM} / M_{nEWM}$ vs. Thickness Plot

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness

● 33 KSI ● 40 KSI ● 50 KSI ● 60 KSI

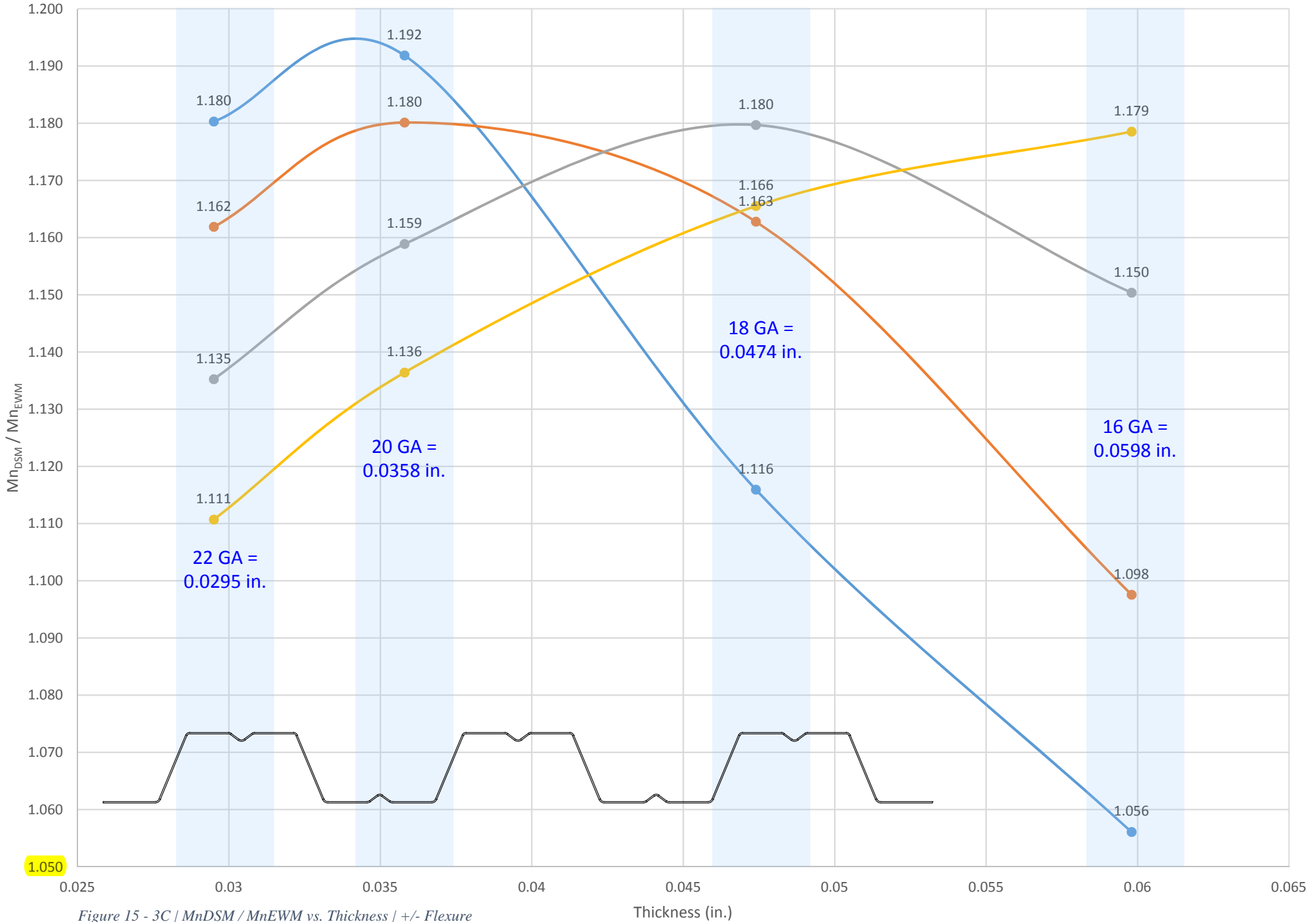


Figure 15 - 3C / Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Thickness / +/- Flexure

3 Deck +/- Bending

## 9.2 Analysis Results Summary

Table 9 - 3C / Analysis Results Summary / +/- Flexure

| 3 DECK - 33 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 2.276   | 2.762   | 3.657   | 4.613   |
| $\bar{y}$ (CUFSM) | 1.51607 | 1.51986 | 1.52684 | 1.53430 |
| Sxx               | 1.501   | 1.817   | 2.395   | 3.007   |
| My                | 49.53   | 59.96   | 79.03   | 99.23   |
| $Mn_{DSM}$        | 46.61   | 59.77   | 79.03   | 99.23   |
| $Mn_{EWM}$        | 39.49   | 50.15   | 70.82   | 93.96   |
| % ERROR           | 15.276% | 16.095% | 10.388% | 5.311%  |

| 3 DECK - 33 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 46.61      | 39.49      | 1.180                 |
| 20              | 0.0358 | 59.77      | 50.15      | 1.192                 |
| 18              | 0.0474 | 79.03      | 70.82      | 1.116                 |
| 16              | 0.0598 | 99.23      | 93.96      | 1.056                 |

| 3 DECK - 40 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 2.276   | 2.762   | 3.657   | 4.613   |
| $\bar{y}$ (CUFSM) | 1.51607 | 1.51986 | 1.52684 | 1.53430 |
| Sxx               | 1.501   | 1.817   | 2.395   | 3.007   |
| My                | 60.04   | 72.68   | 95.80   | 120.27  |
| $Mn_{DSM}$        | 53.26   | 68.73   | 95.80   | 120.27  |
| $Mn_{EWM}$        | 45.84   | 58.24   | 82.39   | 109.58  |
| % ERROR           | 13.932% | 15.263% | 13.998% | 8.888%  |

| 3 DECK - 40 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 53.26      | 45.84      | 1.162                 |
| 20              | 0.0358 | 68.73      | 58.24      | 1.180                 |
| 18              | 0.0474 | 95.80      | 82.39      | 1.163                 |
| 16              | 0.0598 | 120.27     | 109.58     | 1.098                 |

| 3 DECK - 50 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 2.276   | 2.762   | 3.657   | 4.613   |
| $\bar{y}$ (CUFSM) | 1.51607 | 1.51986 | 1.52684 | 1.53430 |
| Sxx               | 1.501   | 1.817   | 2.395   | 3.007   |
| My                | 75.05   | 90.85   | 119.75  | 150.34  |
| $Mn_{DSM}$        | 61.86   | 80.24   | 115.68  | 150.34  |
| $Mn_{EWM}$        | 54.49   | 69.24   | 98.06   | 130.69  |
| % ERROR           | 11.914% | 13.709% | 15.232% | 13.070% |

| 3 DECK - 50 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 61.86      | 54.49      | 1.135                 |
| 20              | 0.0358 | 80.24      | 69.24      | 1.159                 |
| 18              | 0.0474 | 115.68     | 98.06      | 1.180                 |
| 16              | 0.0598 | 150.34     | 130.69     | 1.150                 |

| 3 DECK - 60 KSI   |         |         |         |         |
|-------------------|---------|---------|---------|---------|
| Gage              | 22      | 20      | 18      | 16      |
| Thickness         | 0.0295  | 0.0358  | 0.0474  | 0.0598  |
| Curve Radius      | 0.2028  | 0.2059  | 0.2117  | 0.2179  |
| $I_G$ (CUFSM)     | 2.276   | 2.762   | 3.657   | 4.613   |
| $\bar{y}$ (CUFSM) | 1.51607 | 1.51986 | 1.52684 | 1.53430 |
| Sxx               | 1.501   | 1.817   | 2.395   | 3.007   |
| My                | 90.06   | 109.02  | 143.69  | 180.41  |
| $Mn_{DSM}$        | 69.74   | 90.64   | 131.68  | 177.64  |
| $Mn_{EWM}$        | 62.79   | 79.76   | 112.98  | 150.73  |
| % ERROR           | 9.966%  | 12.004% | 14.201% | 15.149% |

| 3 DECK - 60 KSI |        |            |            |                       |
|-----------------|--------|------------|------------|-----------------------|
| Thickness       |        | $Mn_{DSM}$ | $Mn_{EWM}$ | $Mn_{DSM} / Mn_{EWM}$ |
| 22              | 0.0295 | 69.74      | 62.79      | 1.111                 |
| 20              | 0.0358 | 90.64      | 79.76      | 1.136                 |
| 18              | 0.0474 | 131.68     | 112.98     | 1.166                 |
| 16              | 0.0598 | 177.64     | 150.73     | 1.179                 |

### 9.3 Direct Strength Method Calculations

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                 |         |
|               | Gage:           | 16      | GA          |                 |         |
|               | Strength:       | 33      | KSI         |                 |         |
|               | $M_y =$         | 99.23   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 5.58000 | $M_{crf} =$ | 553.7034 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 3.79000 | $M_{crd} =$ | 376.0817 kip-in | 10 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 396.92 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 99.23$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.42$  (local-global slenderness)  
 **$M_{n\ell} = 99.23$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.51$  (distortional slenderness)  
 **$M_{nd} = 99.23$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 99.23$  kip-in (local-global controls)**



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                             |         |       |
|---------------|-----------------|---------|-----------------------------|---------|-------|
| <b>Given:</b> | Deck:           | 3       |                             |         |       |
|               | Gage:           | 16      | GA                          |         |       |
|               | Strength:       | 40      | KSI                         |         |       |
|               | $M_v =$         | 120.27  | kip-in                      | Length: |       |
| local         | $M_{crf}/M_v =$ | 4.61000 | $M_{crf} =$ 554.4447 kip-in |         | 2 in  |
| dist.         | $M_{crd}/M_v =$ | 3.12000 | $M_{crd} =$ 375.2424 kip-in |         | 10 in |
| global        | $M_{cre}/M_v =$ | 4.00000 | $M_{cre} =$ 481.08 kip-in   |         | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 120.27$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.47$  (local-global slenderness)  
 **$M_{n\ell} = 120.27$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.57$  (distortional slenderness)  
 **$M_{nd} = 120.27$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 120.27$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                             |         |       |
|---------------|-----------------|---------|-----------------------------|---------|-------|
| <b>Given:</b> | Deck:           | 3       |                             |         |       |
|               | Gage:           | 16      | GA                          |         |       |
|               | Strength:       | 50      | KSI                         |         |       |
|               | $M_y =$         | 150.34  | kip-in                      | Length: |       |
| local         | $M_{crf}/M_y =$ | 3.68000 | $M_{crf} =$ 553.2512 kip-in |         | 2 in  |
| dist.         | $M_{crd}/M_y =$ | 2.50000 | $M_{crd} =$ 375.85 kip-in   |         | 10 in |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ 601.36 kip-in   |         | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 150.34$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.52$  (local-global slenderness)  
 **$M_{n\ell} = 150.34$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.63$  (distortional slenderness)  
 **$M_{nd} = 150.34$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 150.34$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                 |         |
|               | Gage:           | 16      | GA          |                 |         |
|               | Strength:       | 60      | KSI         |                 |         |
|               | $M_v =$         | 180.41  | kip-in      |                 | Length: |
| local         | $M_{crf}/M_v =$ | 3.07000 | $M_{crf} =$ | 553.8587 kip-in | 2 in    |
| dist.         | $M_{crd}/M_v =$ | 2.08000 | $M_{crd} =$ | 375.2528 kip-in | 10 in   |
| global        | $M_{cre}/M_v =$ | 4.00000 | $M_{cre} =$ | 721.64 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 180.41$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.57$  (local-global slenderness)  
 **$M_{n\ell} = 180.41$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.69$  (distortional slenderness)  
 **$M_{nd} = 177.64$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 177.64$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                 |         |
|               | Gage:           | 18      | GA          |                 |         |
|               | Strength:       | 33      | KSI         |                 |         |
|               | $M_y =$         | 79.03   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 3.62000 | $M_{crf} =$ | 286.0886 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 2.95000 | $M_{crd} =$ | 233.1385 kip-in | 10 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 316.12 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 79.03$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.53$  (local-global slenderness)  
 **$M_{n\ell} = 79.03$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.58$  (distortional slenderness)  
 **$M_{nd} = 79.03$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 79.03$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                |       |
|---------------|-----------------|---------|-------------|----------------|-------|
| <b>Given:</b> | Deck:           | 3       |             |                |       |
|               | Gage:           | 18      | GA          |                |       |
|               | Strength:       | 40      | KSI         |                |       |
|               | $M_y =$         | 95.80   | kip-in      | Length:        |       |
| local         | $M_{crf}/M_y =$ | 2.99000 | $M_{crf} =$ | 286.442 kip-in | 2 in  |
| dist.         | $M_{crd}/M_y =$ | 2.43000 | $M_{crd} =$ | 232.794 kip-in | 10 in |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 383.2 kip-in   | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 95.80$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.58$  (local-global slenderness)  
 **$M_{n\ell} = 95.80$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.64$  (distortional slenderness)  
 **$M_{nd} = 95.80$  kip-in** (fully effective section for distortional buckling)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 95.80$  kip-in (local-global controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                      |         |       |
|---------------|-----------------|---------|----------------------|---------|-------|
| <b>Given:</b> | Deck:           | 3       |                      |         |       |
|               | Gage:           | 18      | GA                   |         |       |
|               | Strength:       | 50      | KSI                  |         |       |
|               | $M_v =$         | 119.75  | kip-in               | Length: |       |
| local         | $M_{crf}/M_v =$ | 2.39000 | $M_{crf} = 286.2025$ | kip-in  | 2 in  |
| dist.         | $M_{crd}/M_v =$ | 1.94000 | $M_{crd} = 232.315$  | kip-in  | 10 in |
| global        | $M_{cre}/M_v =$ | 4.00000 | $M_{cre} = 479$      | kip-in  | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 119.75$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.65$  (local-global slenderness)  
 **$M_{n\ell} = 119.75$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.72$  (distortional slenderness)  
 **$M_{nd} = 115.68$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 115.68$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                      |         |       |
|---------------|-----------------|---------|----------------------|---------|-------|
| <b>Given:</b> | Deck:           | 3       |                      |         |       |
|               | Gage:           | 18      | GA                   |         |       |
|               | Strength:       | 60      | KSI                  |         |       |
|               | $M_v =$         | 143.69  | kip-in               | Length: |       |
| local         | $M_{crf}/M_v =$ | 1.99000 | $M_{crf} = 285.9431$ | kip-in  | 2 in  |
| dist.         | $M_{crd}/M_v =$ | 1.62000 | $M_{crd} = 232.7778$ | kip-in  | 10 in |
| global        | $M_{cre}/M_v =$ | 4.00000 | $M_{cre} = 574.76$   | kip-in  | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 143.69$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.71$  (local-global slenderness)  
 **$M_{n\ell} = 143.69$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.79$  (distortional slenderness)  
 **$M_{nd} = 131.68$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 131.68$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                 |         |
|               | Gage:           | 20      | GA          |                 |         |
|               | Strength:       | 33      | KSI         |                 |         |
|               | $M_y =$         | 59.96   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 2.13000 | $M_{crf} =$ | 127.7148 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 2.18000 | $M_{crd} =$ | 130.7128 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 239.84 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 59.96$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.69$  (local-global slenderness)  
 **$M_{n\ell} = 59.96$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.68$  (distortional slenderness)  
 **$M_{nd} = 59.77$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 59.77$  kip-in (distortional controls)**



Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                 |         |
|               | Gage:           | 20      | GA          |                 |         |
|               | Strength:       | 40      | KSI         |                 |         |
|               | $M_y =$         | 72.68   | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.76000 | $M_{crf} =$ | 127.9168 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 1.80000 | $M_{crd} =$ | 130.824 kip-in  | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 290.72 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 72.68$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.75$  (local-global slenderness)  
 **$M_{n\ell} = 72.68$  kip-in** (fully effective section for local buckling)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.75$  (distortional slenderness)  
 **$M_{nd} = 68.73$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 68.73$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                |         |
|---------------|-----------------|---------|-------------|----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                |         |
|               | Gage:           | 20      | GA          |                |         |
|               | Strength:       | 50      | KSI         |                |         |
|               | $M_y =$         | 90.85   | kip-in      |                | Length: |
| local         | $M_{crf}/M_y =$ | 1.40000 | $M_{crf} =$ | 127.19 kip-in  | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 1.44000 | $M_{crd} =$ | 130.824 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 363.4 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 90.85$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.85$  (local-global slenderness)  
 **$M_{n\ell} = 86.10$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.83$  (distortional slenderness)  
 **$M_{nd} = 80.24$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 80.24$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                 |         |
|---------------|-----------------|---------|-------------|-----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                 |         |
|               | Gage:           | 20      | GA          |                 |         |
|               | Strength:       | 60      | KSI         |                 |         |
|               | $M_y =$         | 109.02  | kip-in      |                 | Length: |
| local         | $M_{crf}/M_y =$ | 1.17000 | $M_{crf} =$ | 127.5534 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 1.20000 | $M_{crd} =$ | 130.824 kip-in  | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 436.08 kip-in   | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 109.02$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.92$  (local-global slenderness)  
 **$M_{n\ell} = 97.54$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.91$  (distortional slenderness)  
 **$M_{nd} = 90.64$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 90.64$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                |         |
|---------------|-----------------|---------|-------------|----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                |         |
|               | Gage:           | 22      | GA          |                |         |
|               | Strength:       | 33      | KSI         |                |         |
|               | $M_y =$         | 49.53   | kip-in      |                | Length: |
| local         | $M_{crf}/M_y =$ | 1.47000 | $M_{crf} =$ | 72.8091 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 1.77000 | $M_{crd} =$ | 87.6681 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 198.12 kip-in  | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 49.53$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.82$  (local-global slenderness)  
 **$M_{n\ell} = 47.67$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.75$  (distortional slenderness)  
 **$M_{nd} = 46.61$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 46.61$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                |         |
|---------------|-----------------|---------|-------------|----------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                |         |
|               | Gage:           | 22      | GA          |                |         |
|               | Strength:       | 40      | KSI         |                |         |
|               | $M_y =$         | 60.04   | kip-in      |                | Length: |
| local         | $M_{crf}/M_y =$ | 1.22000 | $M_{crf} =$ | 73.2488 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 1.46000 | $M_{crd} =$ | 87.6584 kip-in | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 240.16 kip-in  | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 60.04$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 0.91$  (local-global slenderness)  
 **$M_{n\ell} = 54.45$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.83$  (distortional slenderness)  
 **$M_{nd} = 53.26$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 53.26$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |             |                  |         |
|---------------|-----------------|---------|-------------|------------------|---------|
| <b>Given:</b> | Deck:           | 3       |             |                  |         |
|               | Gage:           | 22      | GA          |                  |         |
|               | Strength:       | 50      | KSI         |                  |         |
|               | $M_y =$         | 75.05   | kip-in      |                  | Length: |
| local         | $M_{crf}/M_y =$ | 0.97344 | $M_{crf} =$ | 73.056672 kip-in | 2 in    |
| dist.         | $M_{crd}/M_y =$ | 1.17000 | $M_{crd} =$ | 87.8085 kip-in   | 12 in   |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} =$ | 300.2 kip-in     | - in    |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 75.05$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.01$  (local-global slenderness)  
 **$M_{n\ell} = 63.23$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 0.92$  (distortional slenderness)  
 **$M_{nd} = 61.86$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 61.86$  kip-in (distortional controls)**

Date: 11/26/14

calc by: RKD  
check by: TS

### Deck Strength Calculations using the Direct Strength Method of Appendix 1

|               |                 |         |                       |         |       |
|---------------|-----------------|---------|-----------------------|---------|-------|
| <b>Given:</b> | Deck:           | 3       |                       |         |       |
|               | Gage:           | 22      | GA                    |         |       |
|               | Strength:       | 60      | KSI                   |         |       |
|               | $M_y =$         | 90.06   | kip-in                | Length: |       |
| local         | $M_{crf}/M_y =$ | 0.81120 | $M_{crf} = 73.056672$ | kip-in  | 2 in  |
| dist.         | $M_{crd}/M_y =$ | 0.98000 | $M_{crd} = 88.2588$   | kip-in  | 12 in |
| global        | $M_{cre}/M_y =$ | 4.00000 | $M_{cre} = 360.24$    | kip-in  | - in  |

#### Lateral-torsional buckling nominal flexural strength per DSM 1.2.2.1

for  $M_{cre} < 0.56M_y$   
 $M_{ne} = M_{cre}$  (Eq. 1.2.2-1)

for  $2.78M_y \geq M_{cre} \geq 0.56M_y$   
 $M_{ne} = \frac{10}{9} M_y \left( 1 - \frac{10M_y}{36M_{cre}} \right)$  (Eq. 1.2.2-2)

for  $M_{cre} > 2.78M_y$   
 $M_{ne} = M_y$  (Eq. 1.2.2-3)

**$M_{ne} = 90.06$  kip-in**

#### Local buckling nominal flexural strength per DSM 1.2.2.2

for  $\lambda_\ell \leq 0.776$   
 $M_{n\ell} = M_{ne}$  (Eq. 1.2.2-5)

for  $\lambda_\ell > 0.776$   
 $M_{n\ell} = \left( 1 - 0.15 \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left( \frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$  (Eq. 1.2.2-6)

where  $\lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}}$  (Eq. 1.2.2-7)

$\lambda_\ell = 1.11$  (local-global slenderness)  
 **$M_{n\ell} = 71.40$  kip-in** (local-global interaction reduction)

#### Distortional buckling nominal flexural strength per DSM 1.2.2.3

for  $\lambda_d \leq 0.673$   
 $M_{nd} = M_y$  (Eq. 1.2.2-8)

for  $\lambda_d > 0.673$   
 $M_{nd} = \left( 1 - 0.22 \left( \frac{M_{crd}}{M_y} \right)^{0.5} \right) \left( \frac{M_{crd}}{M_y} \right)^{0.5} M_y$  (Eq. 1.2.2-9)

where  $\lambda_d = \sqrt{M_y/M_{crd}}$  (Eq. 1.2.2-10)

$\lambda_d = 1.01$  (distortional slenderness)  
 **$M_{nd} = 69.74$  kip-in** (distortional reduction)

#### Nominal flexural strength of the beam per DSM 1.2.2

**$M_n = 69.74$  kip-in (distortional controls)**

## 9.4 Effective Width Method Calculations



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 3        | bo:                                      | 4.499    | in.              |
| Gage:                   | 16       | h:                                       | 3.000    | in.              |
| Strength:               | 33       | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0598   | Ag:                                      | 0.281    | in. <sup>2</sup> |
| Total Height:           | 3.060    | n:                                       | 1        |                  |
| Radius:                 | 0.2179   |  |          |                  |
| θ:                      | 67.38    | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000424 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000023 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.573 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 33.000 | ksi | δ:    | 1.044  |                  |
| k:                | 11.662 |     | lsp:  | 0.003  | in. <sup>4</sup> |
| Fcr:              | 54.932 | ksi | γ:    | 35.413 |                  |
| λ:                | 0.775  |     | β:    | 2.911  |                  |
| ρ:                | 0.924  |     | kd:   | 6.137  |                  |
| Effective Width:  | 4.339  | in. | kloc: | 28.449 |                  |
|                   |        |     | R:    | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.030            |
| Corners                  | 0.256   | 0.201            |
| Corners <sub>Stiff</sub> | 0.139   | 0.233            |
| Bottom Flange            | 1.687   | 3.030            |
| Web                      | 3.000   | 1.530            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 4.339   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.030            | 13.635                  | 41.311                               | --                                   |
| Bottom Corner                | 6        | 1.538  | 2.859            | 4.396                   | 12.566                               | 0.003                                |
| Web                          | 6        | 18.000 | 1.530            | 27.538                  | 42.131                               | 11.503                               |
| Top Corner                   | 6        | 1.538  | 0.201            | 0.309                   | 0.062                                | 0.003                                |
| Top Flange                   | 3        | 13.017 | 0.077            | 0.998                   | 0.076                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.030            | 20.446                  | 61.949                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.555  | 2.826            | 1.569                   | 4.436                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.845            | 6.412                   | 18.243                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.555  | 2.397            | 1.331                   | 3.189                                | 0.000                                |
|                              | Σ        | 48.705 |                  | 76.633                  | 183.963                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.573 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.573 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  4.480 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  2.847 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **93.96** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 3        | bo:                                      | 4.499    | in.              |
| Gage:                   | 16       | h:                                       | 3.000    | in.              |
| Strength:               | 40       | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0598   | Ag:                                      | 0.281    | in. <sup>2</sup> |
| Total Height:           | 3.060    | n:                                       | 1        |                  |
| Radius:                 | 0.2179   |  |          |                  |
| θ:                      | 67.38    | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000424 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000023 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.597 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 40.000 | ksi | δ:                | 1.044  |                  |
| k:                | 11.662 |     | I <sub>sp</sub> : | 0.003  | in. <sup>4</sup> |
| F <sub>cr</sub> : | 54.932 | ksi | γ:                | 35.413 |                  |
| λ:                | 0.853  |     | β:                | 2.911  |                  |
| ρ:                | 0.870  |     | kd:               | 6.137  |                  |
| Effective Width:  | 4.084  | in. | kloc:             | 28.449 |                  |
|                   |        |     | R:                | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.030            |
| Corners                  | 0.256   | 0.201            |
| Corners <sub>Stiff</sub> | 0.139   | 0.233            |
| Bottom Flange            | 1.687   | 3.030            |
| Web                      | 3.000   | 1.530            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 4.084   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.030            | 13.635                  | 41.311                               | --                                   |
| Bottom Corner                | 6        | 1.538  | 2.859            | 4.396                   | 12.566                               | 0.003                                |
| Web                          | 6        | 18.000 | 1.530            | 27.538                  | 42.131                               | 11.503                               |
| Top Corner                   | 6        | 1.538  | 0.201            | 0.309                   | 0.062                                | 0.003                                |
| Top Flange                   | 3        | 12.253 | 0.077            | 0.939                   | 0.072                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.030            | 20.446                  | 61.949                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.555  | 2.826            | 1.569                   | 4.436                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.845            | 6.412                   | 18.243                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.555  | 2.397            | 1.331                   | 3.189                                | 0.000                                |
|                              | Σ        | 47.941 |                  | 76.575                  | 183.959                              | 11.529                               |

**Solved  $\bar{y}$  =** ΣLy/ΣL = 1.597 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  = max( $\bar{y}$ , h -  $\bar{y}$ ) = 1.597 in.  
 $I_x$  = [ΣI'<sub>x</sub> + ΣLy<sup>2</sup> -  $\bar{y}^2$ ΣL]t = 4.376 in.<sup>4</sup>  
 $S_e$  =  $I_x/\bar{y}$  = 2.740 in.<sup>3</sup>  
**Mn = Se\*Fy = 109.58 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 3        | bo:                                      | 4.499    | in.              |
| Gage:                   | 16       | h:                                       | 3.000    | in.              |
| Strength:               | 50       | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0598   | Ag:                                      | 0.281    | in. <sup>2</sup> |
| Total Height:           | 3.060    | n:                                       | 1        |                  |
| Radius:                 | 0.2179   |  |          |                  |
| θ:                      | 67.38    | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000424 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000023 | in. <sup>3</sup> |

Guess  $\bar{y}$ : 1.626 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 50.000 | ksi | δ:    | 1.044  |                  |
| k:                | 11.662 |     | lsp:  | 0.003  | in. <sup>4</sup> |
| Fcr:              | 54.932 | ksi | γ:    | 35.413 |                  |
| λ:                | 0.954  |     | β:    | 2.911  |                  |
| ρ:                | 0.806  |     | kd:   | 6.137  |                  |
| Effective Width:  | 3.787  | in. | kloc: | 28.449 |                  |
|                   |        |     | R:    | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.030            |
| Corners                  | 0.256   | 0.201            |
| Corners <sub>Stiff</sub> | 0.139   | 0.233            |
| Bottom Flange            | 1.687   | 3.030            |
| Web                      | 3.000   | 1.530            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.787   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.030            | 13.635                  | 41.311                               | --                                   |
| Bottom Corner                | 6        | 1.538  | 2.859            | 4.396                   | 12.566                               | 0.003                                |
| Web                          | 6        | 18.000 | 1.530            | 27.538                  | 42.131                               | 11.503                               |
| Top Corner                   | 6        | 1.538  | 0.201            | 0.309                   | 0.062                                | 0.003                                |
| Top Flange                   | 3        | 11.361 | 0.077            | 0.871                   | 0.067                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.030            | 20.446                  | 61.949                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.555  | 2.826            | 1.569                   | 4.436                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.845            | 6.412                   | 18.243                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.555  | 2.397            | 1.331                   | 3.189                                | 0.000                                |
|                              | Σ        | 47.049 |                  | 76.507                  | 183.954                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.626 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.626 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  4.250 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  2.614 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **130.69** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 3        | bo:                                      | 4.499    | in.              |
| Gage:                   | 16       | h:                                       | 3.000    | in.              |
| Strength:               | 60       | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0598   | Ag:                                      | 0.281    | in. <sup>2</sup> |
| Total Height:           | 3.060    | n:                                       | 1        |                  |
| Radius:                 | 0.2179   |  |          |                  |
| θ:                      | 67.38    | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000424 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000023 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.650 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 60.000 | ksi | δ:    | 1.044  |                  |
| k:                | 11.662 |     | lsp:  | 0.003  | in. <sup>4</sup> |
| Fcr:              | 54.932 | ksi | γ:    | 35.413 |                  |
| λ:                | 1.045  |     | β:    | 2.911  |                  |
| ρ:                | 0.755  |     | kd:   | 6.137  |                  |
| Effective Width:  | 3.547  | in. | kloc: | 28.449 |                  |
|                   |        |     | R:    | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.030            |
| Corners                  | 0.256   | 0.201            |
| Corners <sub>Stiff</sub> | 0.139   | 0.233            |
| Bottom Flange            | 1.687   | 3.030            |
| Web                      | 3.000   | 1.530            |
| Web <sub>Stiff</sub>     | 0.564   | 0.215            |
| Top Flange               | 3.547   | 0.077            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.030            | 13.635                  | 41.311                               | --                                   |
| Bottom Corner                | 6        | 1.538  | 2.859            | 4.396                   | 12.566                               | 0.003                                |
| Web                          | 6        | 18.000 | 1.530            | 27.538                  | 42.131                               | 11.503                               |
| Top Corner                   | 6        | 1.538  | 0.201            | 0.309                   | 0.062                                | 0.003                                |
| Top Flange                   | 3        | 10.642 | 0.077            | 0.816                   | 0.063                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.030            | 20.446                  | 61.949                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.555  | 2.826            | 1.569                   | 4.436                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.845            | 6.412                   | 18.243                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.555  | 2.397            | 1.331                   | 3.189                                | 0.000                                |
|                              | Σ        | 46.330 |                  | 76.451                  | 183.949                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.650 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.650 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  4.145 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  2.512 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **150.73** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 3        | bo:              | 4.499                                    | in.      |                  |
| Gage:                   | 18       | GA               | h:                                       | 3.000    | in.              |
| Strength:               | 33       | ksi              | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0474   | in.              | Ag:                                      | 0.223    | in. <sup>2</sup> |
| Total Height:           | 3.047    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2117   | in.              |  |          |                  |
| θ:                      | 67.38    | deg              | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | rad              | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000389 | in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000021 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.600 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 33.000 | ksi | δ:    | 1.044  |                  |
| k:                | 14.296 |     | lsp:  | 0.002  | in. <sup>4</sup> |
| Fcr:              | 42.308 | ksi | γ:    | 55.839 |                  |
| λ:                | 0.883  |     | β:    | 3.258  |                  |
| ρ:                | 0.850  |     | kd:   | 7.524  |                  |
| Effective Width:  | 3.993  | in. | kloc: | 28.449 |                  |
|                   |        |     | R:    | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.024            |
| Corners                  | 0.249   | 0.190            |
| Corners <sub>Stiff</sub> | 0.135   | 0.221            |
| Bottom Flange            | 1.687   | 3.024            |
| Web                      | 3.000   | 1.524            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.993   | 0.070            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.024            | 13.607                  | 41.142                               | --                                   |
| Bottom Corner                | 6        | 1.494  | 2.858            | 4.268                   | 12.197                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.524            | 27.427                  | 41.790                               | 11.503                               |
| Top Corner                   | 6        | 1.494  | 0.190            | 0.284                   | 0.054                                | 0.002                                |
| Top Flange                   | 3        | 11.978 | 0.070            | 0.841                   | 0.059                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.024            | 20.404                  | 61.695                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.539  | 2.826            | 1.525                   | 4.308                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.839            | 6.398                   | 18.163                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.539  | 2.409            | 1.299                   | 3.130                                | 0.000                                |
| Σ                            |          | 47.546 |                  | 76.053                  | 182.539                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.600 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.600 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  3.433 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  2.146 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **70.82** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |                           |  |          |                  |
|-------------------------|---------------------------|--|----------|------------------|
| Deck:                   | 3                         | bo:                                      | 4.499    | in.              |
| Gage:                   | 18 GA                     | h:                                       | 3.000    | in.              |
| Strength:               | 40 ksi                    | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0474 in.                | Ag:                                      | 0.223    | in. <sup>2</sup> |
| Total Height:           | 3.047 in.                 | n:                                       | 1        |                  |
| Radius:                 | 0.2117 in.                |  |          |                  |
| θ:                      | 67.38 deg                 | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176 rad                 | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000389 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000021 | in. <sup>3</sup> |

Guess  $\bar{y}$ : 1.625 in.

|                   |        |     |       |        |
|-------------------|--------|-----|-------|--------|
| Stress in Flange: | 40.000 | ksi | δ:    | 1.044  |
| k:                | 14.296 |     | lsp:  | 0.002  |
| Fcr:              | 42.308 | ksi | γ:    | 55.839 |
| λ:                | 0.972  |     | β:    | 3.258  |
| ρ:                | 0.796  |     | kd:   | 7.524  |
| Effective Width:  | 3.737  | in. | kloc: | 28.449 |
|                   |        |     | R:    | 1.900  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.024            |
| Corners                  | 0.249   | 0.190            |
| Corners <sub>Stiff</sub> | 0.135   | 0.221            |
| Bottom Flange            | 1.687   | 3.024            |
| Web                      | 3.000   | 1.524            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.737   | 0.070            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.024            | 13.607                  | 41.142                               | --                                   |
| Bottom Corner                | 6        | 1.494  | 2.858            | 4.268                   | 12.197                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.524            | 27.427                  | 41.790                               | 11.503                               |
| Top Corner                   | 6        | 1.494  | 0.190            | 0.284                   | 0.054                                | 0.002                                |
| Top Flange                   | 3        | 11.211 | 0.070            | 0.787                   | 0.055                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.024            | 20.404                  | 61.695                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.539  | 2.826            | 1.525                   | 4.308                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.839            | 6.398                   | 18.163                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.539  | 2.409            | 1.299                   | 3.130                                | 0.000                                |
|                              | Σ        | 46.779 |                  | 75.999                  | 182.535                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.625 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.625 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  3.346 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  2.060 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **82.39** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 3        | bo:                                      | 4.499    | in.              |
| Gage:                   | 18       | h:                                       | 3.000    | in.              |
| Strength:               | 50       | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0474   | Ag:                                      | 0.223    | in. <sup>2</sup> |
| Total Height:           | 3.047    | n:                                       | 1        |                  |
| Radius:                 | 0.2117   |  |          |                  |
| θ:                      | 67.38    | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000389 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000021 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.654 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 50.000 | ksi | δ:    | 1.044  |                  |
| k:                | 14.296 |     | lsp:  | 0.002  | in. <sup>4</sup> |
| Fcr:              | 42.308 | ksi | γ:    | 55.839 |                  |
| λ:                | 1.087  |     | β:    | 3.258  |                  |
| ρ:                | 0.734  |     | kd:   | 7.524  |                  |
| Effective Width:  | 3.446  | in. | kloc: | 28.449 |                  |
|                   |        |     | R:    | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.024            |
| Corners                  | 0.249   | 0.190            |
| Corners <sub>Stiff</sub> | 0.135   | 0.221            |
| Bottom Flange            | 1.687   | 3.024            |
| Web                      | 3.000   | 1.524            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.446   | 0.070            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.024            | 13.607                  | 41.142                               | --                                   |
| Bottom Corner                | 6        | 1.494  | 2.858            | 4.268                   | 12.197                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.524            | 27.427                  | 41.790                               | 11.503                               |
| Top Corner                   | 6        | 1.494  | 0.190            | 0.284                   | 0.054                                | 0.002                                |
| Top Flange                   | 3        | 10.337 | 0.070            | 0.726                   | 0.051                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.024            | 20.404                  | 61.695                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.539  | 2.826            | 1.525                   | 4.308                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.839            | 6.398                   | 18.163                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.539  | 2.409            | 1.299                   | 3.130                                | 0.000                                |
|                              | Σ        | 45.905 |                  | 75.937                  | 182.531                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.654 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.654 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  3.244 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.961 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **98.06** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |  |          |                  |
|-------------------------|----------|--|----------|------------------|
| Deck:                   | 3        | bo:                                      | 4.499    | in.              |
| Gage:                   | 18       | h:                                       | 3.000    | in.              |
| Strength:               | 60       | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0474   | Ag:                                      | 0.223    | in. <sup>2</sup> |
| Total Height:           | 3.047    | n:                                       | 1        |                  |
| Radius:                 | 0.2117   |  |          |                  |
| θ:                      | 67.38    | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000389 | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000021 | in. <sup>3</sup> |

Guess  $\bar{y}$ : 1.678 in.

|                   |        |     |       |        |                  |
|-------------------|--------|-----|-------|--------|------------------|
| Stress in Flange: | 60.000 | ksi | δ:    | 1.044  |                  |
| k:                | 14.296 |     | lsp:  | 0.002  | in. <sup>4</sup> |
| Fcr:              | 42.308 | ksi | γ:    | 55.839 |                  |
| λ:                | 1.191  |     | β:    | 3.258  |                  |
| ρ:                | 0.685  |     | kd:   | 7.524  |                  |
| Effective Width:  | 3.215  | in. | kloc: | 28.449 |                  |
|                   |        |     | R:    | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.024            |
| Corners                  | 0.249   | 0.190            |
| Corners <sub>Stiff</sub> | 0.135   | 0.221            |
| Bottom Flange            | 1.687   | 3.024            |
| Web                      | 3.000   | 1.524            |
| Web <sub>Stiff</sub>     | 0.564   | 0.209            |
| Top Flange               | 3.215   | 0.070            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.024            | 13.607                  | 41.142                               | --                                   |
| Bottom Corner                | 6        | 1.494  | 2.858            | 4.268                   | 12.197                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.524            | 27.427                  | 41.790                               | 11.503                               |
| Top Corner                   | 6        | 1.494  | 0.190            | 0.284                   | 0.054                                | 0.002                                |
| Top Flange                   | 3        | 9.645  | 0.070            | 0.677                   | 0.048                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.024            | 20.404                  | 61.695                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.539  | 2.826            | 1.525                   | 4.308                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.839            | 6.398                   | 18.163                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.539  | 2.409            | 1.299                   | 3.130                                | 0.000                                |
|                              | Σ        | 45.213 |                  | 75.889                  | 182.528                              | 11.529                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.678 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.678 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  3.161 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.883 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **112.98** k-in.



**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 3        | bo:              | 4.499                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 3.000    | in.              |
| Strength:               | 33       | ksi              | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.168    | in. <sup>2</sup> |
| Total Height:           | 3.036    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              | $\theta_{Stiff}$ :                       | 36.501   | deg              |
| $\theta$ :              | 67.38    | deg              | $\theta_{Stiff}$ :                       | 0.637    | rad              |
| $\theta$ :              | 1.176    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000019 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000358 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.634 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 33.000 | ksi | $\delta$ :        | 1.044  |                  |
| k:                | 18.401 |     | I <sub>sp</sub> : | 0.002  | in. <sup>4</sup> |
| F <sub>cr</sub> : | 31.065 | ksi | $\gamma$ :        | 96.807 |                  |
| $\lambda$ :       | 1.031  |     | $\beta$ :         | 3.735  |                  |
| $\rho$ :          | 0.763  |     | kd:               | 9.684  |                  |
| Effective Width:  | 3.584  | in. | kloc:             | 28.449 |                  |
|                   |        |     | R:                | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.018            |
| Corners                  | 0.242   | 0.180            |
| Corners <sub>Stiff</sub> | 0.131   | 0.210            |
| Bottom Flange            | 1.687   | 3.018            |
| Web                      | 3.000   | 1.518            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.584   | 0.064            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.500      | 3.018            | 13.581                          | 40.985                            | --                                |
| Bottom Corner                | 6        | 1.453      | 2.856            | 4.150                           | 11.853                            | 0.002                             |
| Web                          | 6        | 18.000     | 1.518            | 27.322                          | 41.472                            | 11.503                            |
| Top Corner                   | 6        | 1.453      | 0.180            | 0.261                           | 0.047                             | 0.002                             |
| Top Flange                   | 3        | 10.751     | 0.064            | 0.690                           | 0.044                             | --                                |
| Bottom Flange                | 4        | 6.748      | 3.018            | 20.365                          | 61.459                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.525      | 2.826            | 1.483                           | 4.189                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 2.833            | 6.385                           | 18.089                            | 0.021                             |
| High Corner <sub>Stiff</sub> | 4        | 0.525      | 2.420            | 1.270                           | 3.072                             | 0.000                             |
| $\Sigma$                     |          | 46.208     |                  | 75.506                          | 181.211                           | 11.528                            |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.634 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.634 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  2.483 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.520 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **50.15** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 3  
 Gage: 20 GA  
 Strength: 40 ksi  
 Thickness: 0.0358 in.  
 Total Height: 3.036 in.  
 Radius: 0.2059 in.  
 $\theta$ : 67.38 deg  
 $\theta$ : 1.176 rad  
 Curve  $I'_x$ : 0.000358 in.<sup>3</sup>

b<sub>o</sub>: 4.499 in.  
 h: 3.000 in.  
 b<sub>p</sub>: 1.687 in.  
 A<sub>g</sub>: 0.168 in.<sup>2</sup>  
 n: 1  
 $\theta_{Stiff}$ : 36.501 deg  
 $\theta_{Stiff}$ : 0.637 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000019 in.<sup>3</sup>

**Guess  $\bar{y}$ :** 1.660 in.

Stress in Flange: 40.000 ksi  
 k: 18.401  
 F<sub>cr</sub>: 31.065 ksi  
 $\lambda$ : 1.135  
 $\rho$ : 0.710  
 Effective Width: 3.336 in.

$\delta$ : 1.044  
 I<sub>sp</sub>: 0.002 in.<sup>4</sup>  
 $\gamma$ : 96.807  
 $\beta$ : 3.735  
 k<sub>d</sub>: 9.684  
 k<sub>loc</sub>: 28.449  
 R: 1.900

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.018            |
| Corners                  | 0.242   | 0.180            |
| Corners <sub>Stiff</sub> | 0.131   | 0.210            |
| Bottom Flange            | 1.687   | 3.018            |
| Web                      | 3.000   | 1.518            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.336   | 0.064            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.500      | 3.018            | 13.581                          | 40.985                            | --                                |
| Bottom Corner                | 6        | 1.453      | 2.856            | 4.150                           | 11.853                            | 0.002                             |
| Web                          | 6        | 18.000     | 1.518            | 27.322                          | 41.472                            | 11.503                            |
| Top Corner                   | 6        | 1.453      | 0.180            | 0.261                           | 0.047                             | 0.002                             |
| Top Flange                   | 3        | 10.008     | 0.064            | 0.642                           | 0.041                             | --                                |
| Bottom Flange                | 4        | 6.748      | 3.018            | 20.365                          | 61.459                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.525      | 2.826            | 1.483                           | 4.189                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 2.833            | 6.385                           | 18.089                            | 0.021                             |
| High Corner <sub>Stiff</sub> | 4        | 0.525      | 2.420            | 1.270                           | 3.072                             | 0.000                             |
| $\Sigma$                     |          | 45.465     |                  | 75.458                          | 181.207                           | 11.528                            |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.660 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.660 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  2.416 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.456 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **58.24** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 3        | bo:              | 4.499                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 3.000    | in.              |
| Strength:               | 50       | ksi              | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.168    | in. <sup>2</sup> |
| Total Height:           | 3.036    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              |  |          |                  |
| θ:                      | 67.38    | deg              | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176    | rad              | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000358 | in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000019 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.689 in.

|                   |        |     |                   |        |                  |
|-------------------|--------|-----|-------------------|--------|------------------|
| Stress in Flange: | 50.000 | ksi | δ:                | 1.044  |                  |
| k:                | 18.401 |     | I <sub>sp</sub> : | 0.002  | in. <sup>4</sup> |
| F <sub>cr</sub> : | 31.065 | ksi | γ:                | 96.807 |                  |
| λ:                | 1.269  |     | β:                | 3.735  |                  |
| ρ:                | 0.652  |     | kd:               | 9.684  |                  |
| Effective Width:  | 3.060  | in. | kloc:             | 28.449 |                  |
|                   |        |     | R:                | 1.900  |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.018            |
| Corners                  | 0.242   | 0.180            |
| Corners <sub>Stiff</sub> | 0.131   | 0.210            |
| Bottom Flange            | 1.687   | 3.018            |
| Web                      | 3.000   | 1.518            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 3.060   | 0.064            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.018            | 13.581                  | 40.985                               | --                                   |
| Bottom Corner                | 6        | 1.453  | 2.856            | 4.150                   | 11.853                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.518            | 27.322                  | 41.472                               | 11.503                               |
| Top Corner                   | 6        | 1.453  | 0.180            | 0.261                   | 0.047                                | 0.002                                |
| Top Flange                   | 3        | 9.179  | 0.064            | 0.589                   | 0.038                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.018            | 20.365                  | 61.459                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.525  | 2.826            | 1.483                   | 4.189                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.833            | 6.385                   | 18.089                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.525  | 2.420            | 1.270                   | 3.072                                | 0.000                                |
|                              | Σ        | 44.636 |                  | 75.405                  | 181.204                              | 11.528                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.689 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.689 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  2.339 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.385 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **69.24** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |          |                  |  |          |                  |
|-------------------------|----------|------------------|--|----------|------------------|
| Deck:                   | 3        | bo:              | 4.499                                    | in.      |                  |
| Gage:                   | 20       | GA               | h:                                       | 3.000    | in.              |
| Strength:               | 60       | ksi              | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0358   | in.              | Ag:                                      | 0.168    | in. <sup>2</sup> |
| Total Height:           | 3.036    | in.              | n:                                       | 1        |                  |
| Radius:                 | 0.2059   | in.              | $\theta_{Stiff}$ :                       | 36.501   | deg              |
| $\theta$ :              | 67.38    | deg              | $\theta_{Stiff}$ :                       | 0.637    | rad              |
| $\theta$ :              | 1.176    | rad              | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000019 | in. <sup>3</sup> |
| Curve I' <sub>x</sub> : | 0.000358 | in. <sup>3</sup> |  |          |                  |

**Guess  $\bar{y}$ :** 1.713 in.

|                   |        |            |            |                  |
|-------------------|--------|------------|------------|------------------|
| Stress in Flange: | 60.000 | ksi        | $\delta$ : | 1.044            |
| k:                | 18.401 | $I_{sp}$ : | 0.002      | in. <sup>4</sup> |
| Fcr:              | 31.065 | ksi        | $\gamma$ : | 96.807           |
| $\lambda$ :       | 1.390  | $\beta$ :  | 3.735      |                  |
| $\rho$ :          | 0.606  | kd:        | 9.684      |                  |
| Effective Width:  | 2.844  | in.        | kloc:      | 28.449           |
|                   |        | R:         | 1.900      |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.018            |
| Corners                  | 0.242   | 0.180            |
| Corners <sub>Stiff</sub> | 0.131   | 0.210            |
| Bottom Flange            | 1.687   | 3.018            |
| Web                      | 3.000   | 1.518            |
| Web <sub>Stiff</sub>     | 0.564   | 0.203            |
| Top Flange               | 2.844   | 0.064            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.500      | 3.018            | 13.581                          | 40.985                            | --                                |
| Bottom Corner                | 6        | 1.453      | 2.856            | 4.150                           | 11.853                            | 0.002                             |
| Web                          | 6        | 18.000     | 1.518            | 27.322                          | 41.472                            | 11.503                            |
| Top Corner                   | 6        | 1.453      | 0.180            | 0.261                           | 0.047                             | 0.002                             |
| Top Flange                   | 3        | 8.532      | 0.064            | 0.548                           | 0.035                             | --                                |
| Bottom Flange                | 4        | 6.748      | 3.018            | 20.365                          | 61.459                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.525      | 2.826            | 1.483                           | 4.189                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 2.833            | 6.385                           | 18.089                            | 0.021                             |
| High Corner <sub>Stiff</sub> | 4        | 0.525      | 2.420            | 1.270                           | 3.072                             | 0.000                             |
| $\Sigma$                     |          | 43.989     |                  | 75.363                          | 181.201                           | 11.528                            |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.713 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.713 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  2.277 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.329 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **79.76** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |                           |  |          |                  |
|-------------------------|---------------------------|--|----------|------------------|
| Deck:                   | 3                         | bo:                                      | 4.499    | in.              |
| Gage:                   | 22 GA                     | h:                                       | 3.000    | in.              |
| Strength:               | 33 ksi                    | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.139    | in. <sup>2</sup> |
| Total Height:           | 3.030 in.                 | n:                                       | 1        |                  |
| Radius:                 | 0.20275 in.               |  |          |                  |
| θ:                      | 67.38 deg                 | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176 rad                 | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000341 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000018 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.659 in.

|                   |        |     |                   |         |                  |
|-------------------|--------|-----|-------------------|---------|------------------|
| Stress in Flange: | 33.000 | ksi | δ:                | 1.044   |                  |
| k:                | 21.996 |     | l <sub>sp</sub> : | 0.002   | in. <sup>4</sup> |
| F <sub>cr</sub> : | 25.214 | ksi | γ:                | 141.818 |                  |
| λ:                | 1.144  |     | β:                | 4.107   |                  |
| ρ:                | 0.706  |     | kd:               | 11.576  |                  |
| Effective Width:  | 3.315  | in. | kloc:             | 28.449  |                  |
|                   |        |     | R:                | 1.900   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.015            |
| Corners                  | 0.238   | 0.174            |
| Corners <sub>Stiff</sub> | 0.129   | 0.204            |
| Bottom Flange            | 1.687   | 3.015            |
| Web                      | 3.000   | 1.515            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.315   | 0.061            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.015            | 13.566                  | 40.899                               | --                                   |
| Bottom Corner                | 6        | 1.431  | 2.856            | 4.085                   | 11.666                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.515            | 27.266                  | 41.300                               | 11.503                               |
| Top Corner                   | 6        | 1.431  | 0.174            | 0.249                   | 0.043                                | 0.002                                |
| Top Flange                   | 3        | 9.946  | 0.061            | 0.606                   | 0.037                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.015            | 20.344                  | 61.331                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.517  | 2.825            | 1.460                   | 4.125                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.830            | 6.378                   | 18.049                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.517  | 2.426            | 1.253                   | 3.041                                | 0.000                                |
|                              | Σ        | 45.343 |                  | 75.207                  | 180.490                              | 11.528                               |

**Solved  $\bar{y}$  =** ΣLy/ΣL = 1.659 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  = max( $\bar{y}$ , h -  $\bar{y}$ ) = 1.659 in.  
 $I_x$  = [ΣI'<sub>x</sub> + ΣLy<sup>2</sup> -  $\bar{y}$ <sup>2</sup>ΣL]t = 1.985 in.<sup>4</sup>  
 $S_e$  =  $I_x/\bar{y}$  = 1.197 in.<sup>3</sup>  
**Mn = Se\*Fy = 39.49 k-in.**

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |                           |  |          |                  |
|-------------------------|---------------------------|--|----------|------------------|
| Deck:                   | 3                         | bo:                                      | 4.499    | in.              |
| Gage:                   | 22 GA                     | h:                                       | 3.000    | in.              |
| Strength:               | 40 ksi                    | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.139    | in. <sup>2</sup> |
| Total Height:           | 3.030 in.                 | n:                                       | 1        |                  |
| Radius:                 | 0.20275 in.               |  |          |                  |
| θ:                      | 67.38 deg                 | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176 rad                 | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000341 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000018 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.684 in.

|                   |        |     |       |         |                  |
|-------------------|--------|-----|-------|---------|------------------|
| Stress in Flange: | 40.000 | ksi | δ:    | 1.044   |                  |
| k:                | 21.996 |     | lsp:  | 0.002   | in. <sup>4</sup> |
| Fcr:              | 25.214 | ksi | γ:    | 141.818 |                  |
| λ:                | 1.260  |     | β:    | 4.107   |                  |
| ρ:                | 0.655  |     | kd:   | 11.576  |                  |
| Effective Width:  | 3.077  | in. | kloc: | 28.449  |                  |
|                   |        |     | R:    | 1.900   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.015            |
| Corners                  | 0.238   | 0.174            |
| Corners <sub>Stiff</sub> | 0.129   | 0.204            |
| Bottom Flange            | 1.687   | 3.015            |
| Web                      | 3.000   | 1.515            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 3.077   | 0.061            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.015            | 13.566                  | 40.899                               | --                                   |
| Bottom Corner                | 6        | 1.431  | 2.856            | 4.085                   | 11.666                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.515            | 27.266                  | 41.300                               | 11.503                               |
| Top Corner                   | 6        | 1.431  | 0.174            | 0.249                   | 0.043                                | 0.002                                |
| Top Flange                   | 3        | 9.231  | 0.061            | 0.562                   | 0.034                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.015            | 20.344                  | 61.331                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.517  | 2.825            | 1.460                   | 4.125                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.830            | 6.378                   | 18.049                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.517  | 2.426            | 1.253                   | 3.041                                | 0.000                                |
|                              | Σ        | 44.628 |                  | 75.163                  | 180.488                              | 11.528                               |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.684 in.  
 $\bar{Y}_{\text{EXTREME FIBER}} =$   $\max(\bar{y}, h - \bar{y}) =$  1.684 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L] t =$  1.930 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.146 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **45.84** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

Deck: 3  
 Gage: 22 GA  
 Strength: 50 ksi  
 Thickness: 0.0295 in.  
 Total Height: 3.030 in.  
 Radius: 0.20275 in.  
 $\theta$ : 67.38 deg  
 $\theta$ : 1.176 rad  
 Curve  $I'_x$ : 0.000341 in.<sup>3</sup>

bo: 4.499 in.  
 h: 3.000 in.  
 bp: 1.687 in.  
 Ag: 0.139 in.<sup>2</sup>  
 n: 1  
 $\theta_{Stiff}$ : 36.501 deg  
 $\theta_{Stiff}$ : 0.637 rad  
 Curve<sub>Stiff</sub>  $I'_x$ : 0.000018 in.<sup>3</sup>

**Guess  $\bar{y}$ :** 1.713 in.

Stress in Flange: 50.000 ksi  
 k: 21.996  
 Fcr: 25.214 ksi  
 $\lambda$ : 1.408  
 $\rho$ : 0.599  
 Effective Width: 2.814 in.

$\delta$ : 1.044  
 $I_{sp}$ : 0.002 in.<sup>4</sup>  
 $\gamma$ : 141.818  
 $\beta$ : 4.107  
 kd: 11.576  
 kloc: 28.449  
 R: 1.900

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.015            |
| Corners                  | 0.238   | 0.174            |
| Corners <sub>Stiff</sub> | 0.129   | 0.204            |
| Bottom Flange            | 1.687   | 3.015            |
| Web                      | 3.000   | 1.515            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 2.814   | 0.061            |

| Element                      | Quantity | $\Sigma L$ | y from top fiber | $\Sigma Ly$ (in. <sup>2</sup> ) | $\Sigma Ly^2$ (in. <sup>3</sup> ) | $\Sigma I'_x$ (in. <sup>3</sup> ) |
|------------------------------|----------|------------|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| Lip                          | 2        | 4.500      | 3.015            | 13.566                          | 40.899                            | --                                |
| Bottom Corner                | 6        | 1.431      | 2.856            | 4.085                           | 11.666                            | 0.002                             |
| Web                          | 6        | 18.000     | 1.515            | 27.266                          | 41.300                            | 11.503                            |
| Top Corner                   | 6        | 1.431      | 0.174            | 0.249                           | 0.043                             | 0.002                             |
| Top Flange                   | 3        | 8.441      | 0.061            | 0.514                           | 0.031                             | --                                |
| Bottom Flange                | 4        | 6.748      | 3.015            | 20.344                          | 61.331                            | --                                |
| Low Corner <sub>Stiff</sub>  | 4        | 0.517      | 2.825            | 1.460                           | 4.125                             | 0.000                             |
| Web <sub>Stiff</sub>         | 4        | 2.254      | 2.830            | 6.378                           | 18.049                            | 0.021                             |
| High Corner <sub>Stiff</sub> | 4        | 0.517      | 2.426            | 1.253                           | 3.041                             | 0.000                             |
| $\Sigma$                     |          | 43.838     |                  | 75.115                          | 180.485                           | 11.528                            |

**Solved  $\bar{y}$  =**  $\Sigma Ly / \Sigma L =$  1.713 in.  
 $\bar{Y}_{EXTREME FIBER} =$   $\max(\bar{y}, h - \bar{y}) =$  1.713 in.  
 $I_x =$   $[\Sigma I'_x + \Sigma Ly^2 - \bar{y}^2 \Sigma L]t =$  1.868 in.<sup>4</sup>  
 $S_e =$   $I_x / \bar{y} =$  1.090 in.<sup>3</sup>  
**Mn =** **Se \* Fy =** **54.49** k-in.

**EFFECTIVE WIDTH METHOD**  
**POSITIVE BENDING**  
**CFS Floor & Roof Deck Sections**

date: 12/11/2014  
 calc by: RKD  
 check by: TS

|                         |                           |  |          |                  |
|-------------------------|---------------------------|--|----------|------------------|
| Deck:                   | 3                         | bo:                                      | 4.499    | in.              |
| Gage:                   | 22 GA                     | h:                                       | 3.000    | in.              |
| Strength:               | 60 ksi                    | bp:                                      | 1.687    | in.              |
| Thickness:              | 0.0295 in.                | Ag:                                      | 0.139    | in. <sup>2</sup> |
| Total Height:           | 3.030 in.                 | n:                                       | 1        |                  |
| Radius:                 | 0.20275 in.               |  |          |                  |
| θ:                      | 67.38 deg                 | θ <sub>Stiff</sub> :                     | 36.501   | deg              |
| θ:                      | 1.176 rad                 | θ <sub>Stiff</sub> :                     | 0.637    | rad              |
| Curve I' <sub>x</sub> : | 0.000341 in. <sup>3</sup> | Curve <sub>Stiff</sub> I' <sub>x</sub> : | 0.000018 | in. <sup>3</sup> |

**Guess  $\bar{y}$ :** 1.737 in.

|                   |        |     |       |         |                  |
|-------------------|--------|-----|-------|---------|------------------|
| Stress in Flange: | 60.000 | ksi | δ:    | 1.044   |                  |
| k:                | 21.996 |     | lsp:  | 0.002   | in. <sup>4</sup> |
| Fcr:              | 25.214 | ksi | γ:    | 141.818 |                  |
| λ:                | 1.543  |     | β:    | 4.107   |                  |
| ρ:                | 0.556  |     | kd:   | 11.576  |                  |
| Effective Width:  | 2.610  | in. | kloc: | 28.449  |                  |
|                   |        |     | R:    | 1.900   |                  |

| Element                  | L (in.) | y from top (in.) |
|--------------------------|---------|------------------|
| Lip                      | 2.250   | 3.015            |
| Corners                  | 0.238   | 0.174            |
| Corners <sub>Stiff</sub> | 0.129   | 0.204            |
| Bottom Flange            | 1.687   | 3.015            |
| Web                      | 3.000   | 1.515            |
| Web <sub>Stiff</sub>     | 0.564   | 0.200            |
| Top Flange               | 2.610   | 0.061            |

| Element                      | Quantity | ΣL     | y from top fiber | ΣLy (in. <sup>2</sup> ) | ΣLy <sup>2</sup> (in. <sup>3</sup> ) | ΣI' <sub>x</sub> (in. <sup>3</sup> ) |
|------------------------------|----------|--------|------------------|-------------------------|--------------------------------------|--------------------------------------|
| Lip                          | 2        | 4.500  | 3.015            | 13.566                  | 40.899                               | --                                   |
| Bottom Corner                | 6        | 1.431  | 2.856            | 4.085                   | 11.666                               | 0.002                                |
| Web                          | 6        | 18.000 | 1.515            | 27.266                  | 41.300                               | 11.503                               |
| Top Corner                   | 6        | 1.431  | 0.174            | 0.249                   | 0.043                                | 0.002                                |
| Top Flange                   | 3        | 7.830  | 0.061            | 0.477                   | 0.029                                | --                                   |
| Bottom Flange                | 4        | 6.748  | 3.015            | 20.344                  | 61.331                               | --                                   |
| Low Corner <sub>Stiff</sub>  | 4        | 0.517  | 2.825            | 1.460                   | 4.125                                | 0.000                                |
| Web <sub>Stiff</sub>         | 4        | 2.254  | 2.830            | 6.378                   | 18.049                               | 0.021                                |
| High Corner <sub>Stiff</sub> | 4        | 0.517  | 2.426            | 1.253                   | 3.041                                | 0.000                                |
|                              | Σ        | 43.227 |                  | 75.078                  | 180.483                              | 11.528                               |

**Solved  $\bar{y}$  =** ΣLy/ΣL = 1.737 in.  
 $\bar{Y}_{\text{EXTREME FIBER}}$  = max( $\bar{y}$ , h -  $\bar{y}$ ) = 1.737 in.  
 $I_x$  = [ΣI'<sub>x</sub> + ΣLy<sup>2</sup> -  $\bar{y}$ <sup>2</sup>ΣL]t = 1.818 in.<sup>4</sup>  
 $S_e$  =  $I_x/\bar{y}$  = 1.046 in.<sup>3</sup>  
**Mn = Se\*Fy = 62.79 k-in.**



## CHAPTER 10: RESULTS

### 10.0 Comparison of Data

After running the DSM and EWM analyses, we have compared a couple of sets of data to observe trends between the various deck sections. The first data comparison plot shows the nominal moment capacity ratio of DSM to EWM,  $M_{nDSM} / M_{nEWM}$ , vs. the flat width of the compression flange over the thickness,  $b/t$ . The second data comparison plot shows the same relationship but now normalizing the nominal moment capacity ratio by the yield stress,  $(M_{nDSM} / M_{nEWM}) / F_y$ .

### 10.1 Comments on Results

From the first data comparison, we can see that DSM starts to predict lower strengths than EWM when  $b/t$  ratios exceed the 40-70 range for unstiffened deck sections. For the stiffened deck sections we see that the  $b/t$  ratio tops out around 55. DSM is able to take advantage of the lower range of  $b/t$  ratios and predict higher strengths than EWM. In the second data comparison with the normalized nominal moment capacity ratio, we can see the same decrease in DSM strength around the 40-70  $b/t$  range. We can gather that DSM performs well for lower  $b/t$  ratios. We also saw that for certain cases, DSM predicted fully effective sections where the EWM did not.

### 10.2 Recommendations

To take advantage of the slight increase in strength with the DSM, consider using compression element stiffeners. By adding the stiffener to the compression element, the  $b/t$  ratio

is reduced and as we have seen in this study, DSM predicts higher strengths than EWM for lower b/t ratios.

### 10.3 Future Work

The next step would be to conduct laboratory testing to verify the DSM strength results. Once our results are backed up with physical testing, potential enhancements to new deck profiles that may take advantage of DSM can be developed.

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Compression Flange Width / Thickness

- 1F (33 KSI)
- 1F (40 KSI)
- 1F (50 KSI)
- 1F (60 KSI)
- 1.5B (33 KSI)
- 1.5B (40 KSI)
- 1.5B (50 KSI)
- 1.5B (60 KSI)
- 1.5B (-33 KSI)
- 1.5B (-40 KSI)
- 1.5B (-50 KSI)
- 1.5B (-60 KSI)

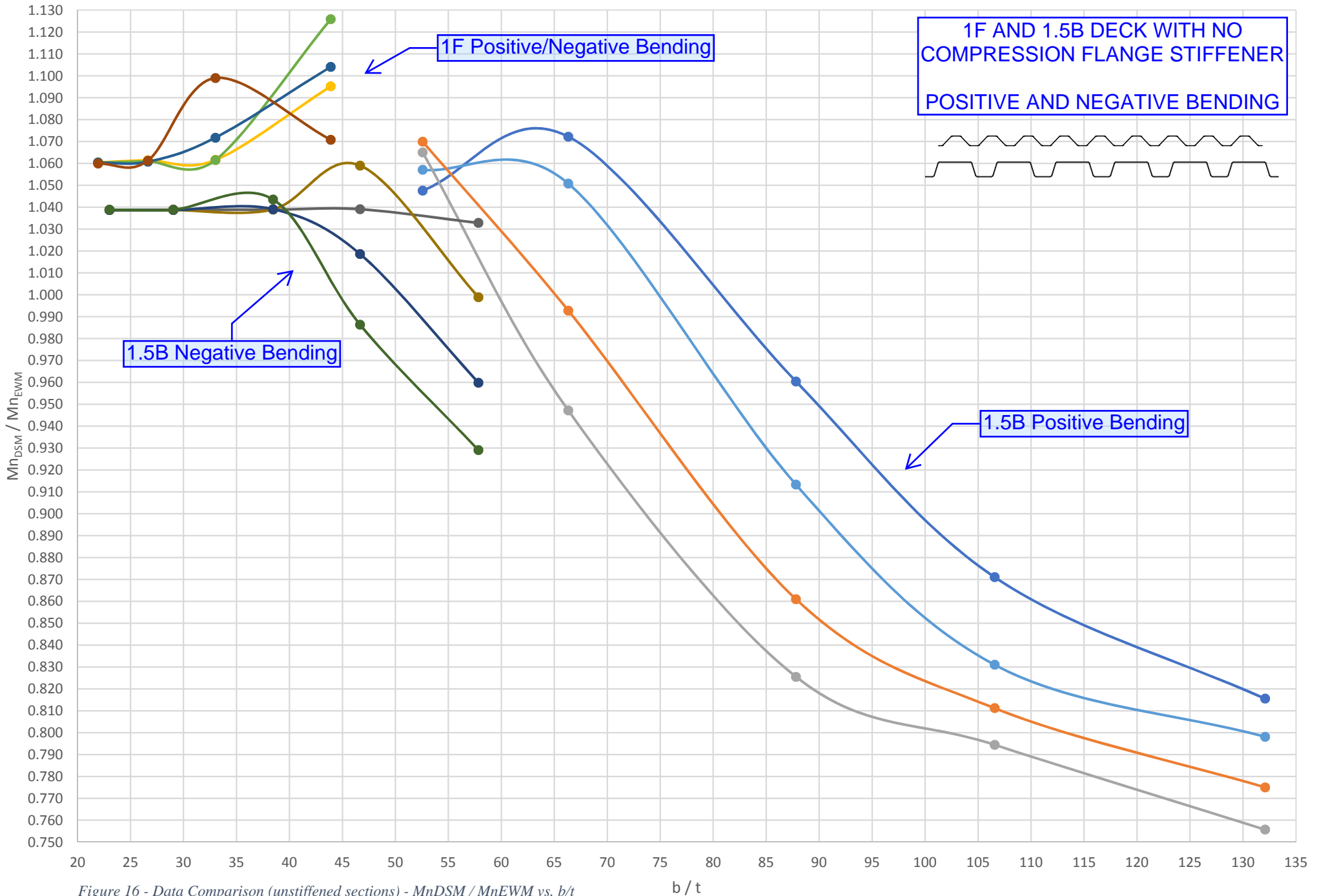


Figure 16 - Data Comparison (unstiffened sections) -  $Mn_{DSM} / Mn_{EWM}$  vs.  $b/t$

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Compression Flange Width / Thickness [POSITIVE BENDING]

- 1.5B (33 KSI)
- 1.5B (40 KSI)
- 1.5B (50 KSI)
- 1.5B (60 KSI)
- 2 (33 KSI)
- 2 (40 KSI)
- 2 (50 KSI)
- 2 (60 KSI)
- 3 (33 KSI)
- 3 (40 KSI)
- 3 (50 KSI)
- 3 (60 KSI)

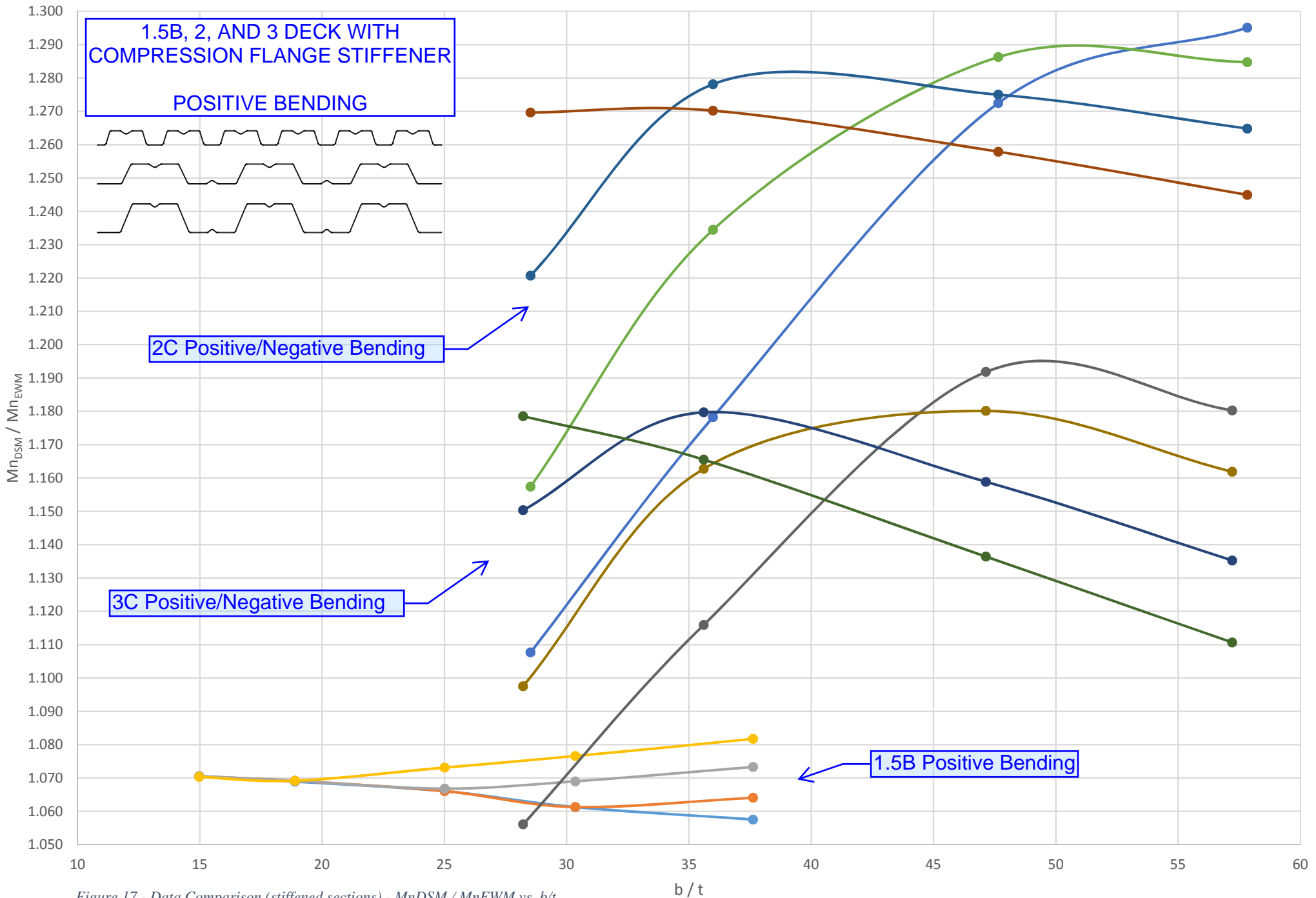


Figure 17 - Data Comparison (stiffened sections) - Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. b/t

### Mn<sub>DSM</sub> / Mn<sub>EWM</sub> / Fy vs. b/t

- 1C (33 KSI)
- 1C (40 KSI)
- 1C (50 KSI)
- 1C (60 KSI)
- 1.5B (33 KSI)
- 1.5B (40 KSI)
- 1.5B (50 KSI)
- 1.5B (60 KSI)
- 1.5B (-33 KSI)
- 1.5B (-40 KSI)
- 1.5B (-50 KSI)
- 1.5B (-60 KSI)

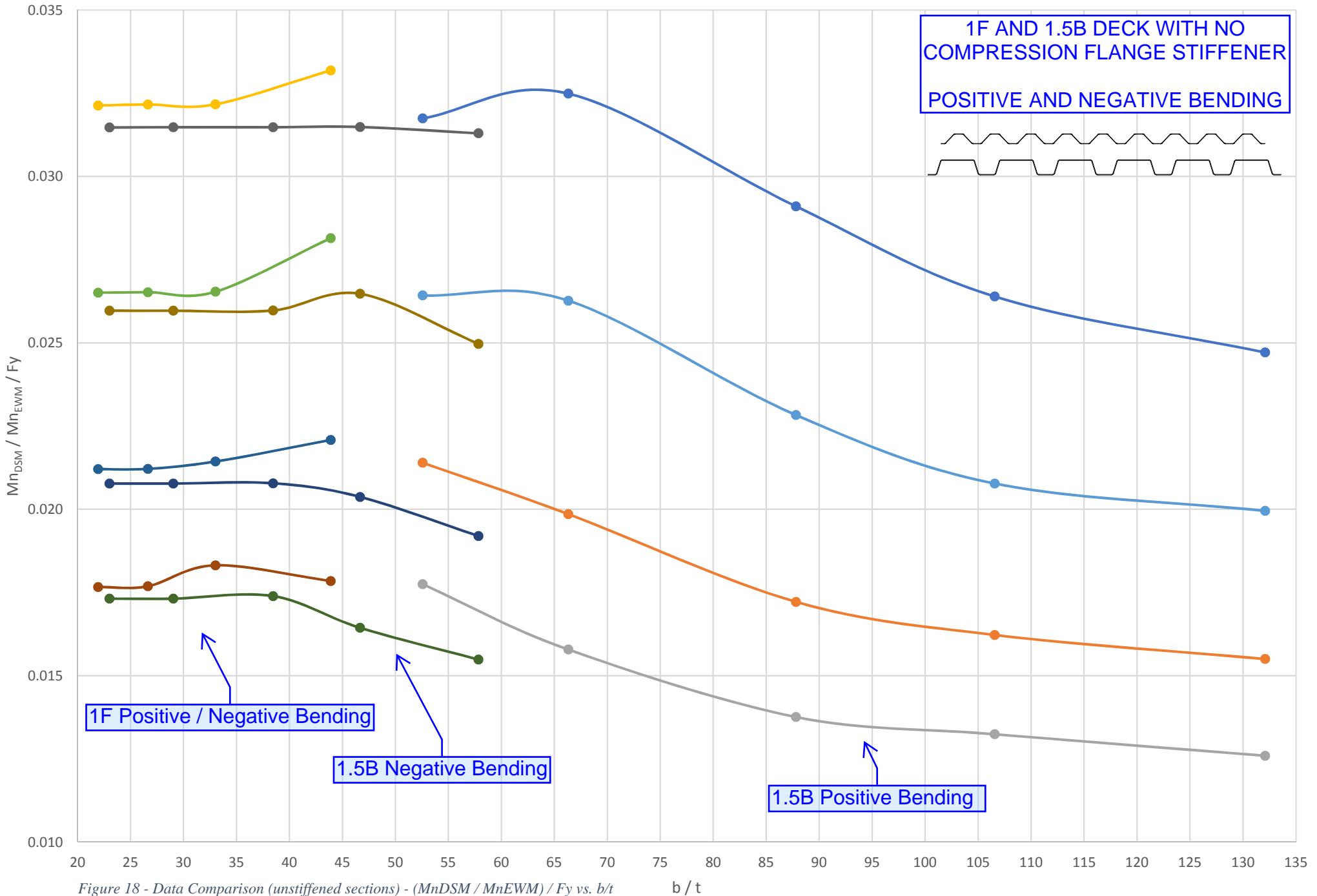


Figure 18 - Data Comparison (unstiffened sections) - (Mn<sub>DSM</sub> / Mn<sub>EWM</sub>) / Fy vs. b/t

# Mn<sub>DSM</sub> / Mn<sub>EWM</sub> vs. Compression Flange Width / Thickness [POSITIVE BENDING]

- 1.5B (33 KSI)
- 1.5B (40 KSI)
- 1.5B (50 KSI)
- 1.5B (60 KSI)
- 2 (33 KSI)
- 2 (40 KSI)
- 2 (50 KSI)
- 2 (60 KSI)
- 3 (33 KSI)
- 3 (40 KSI)
- 3 (50 KSI)
- 3 (60 KSI)

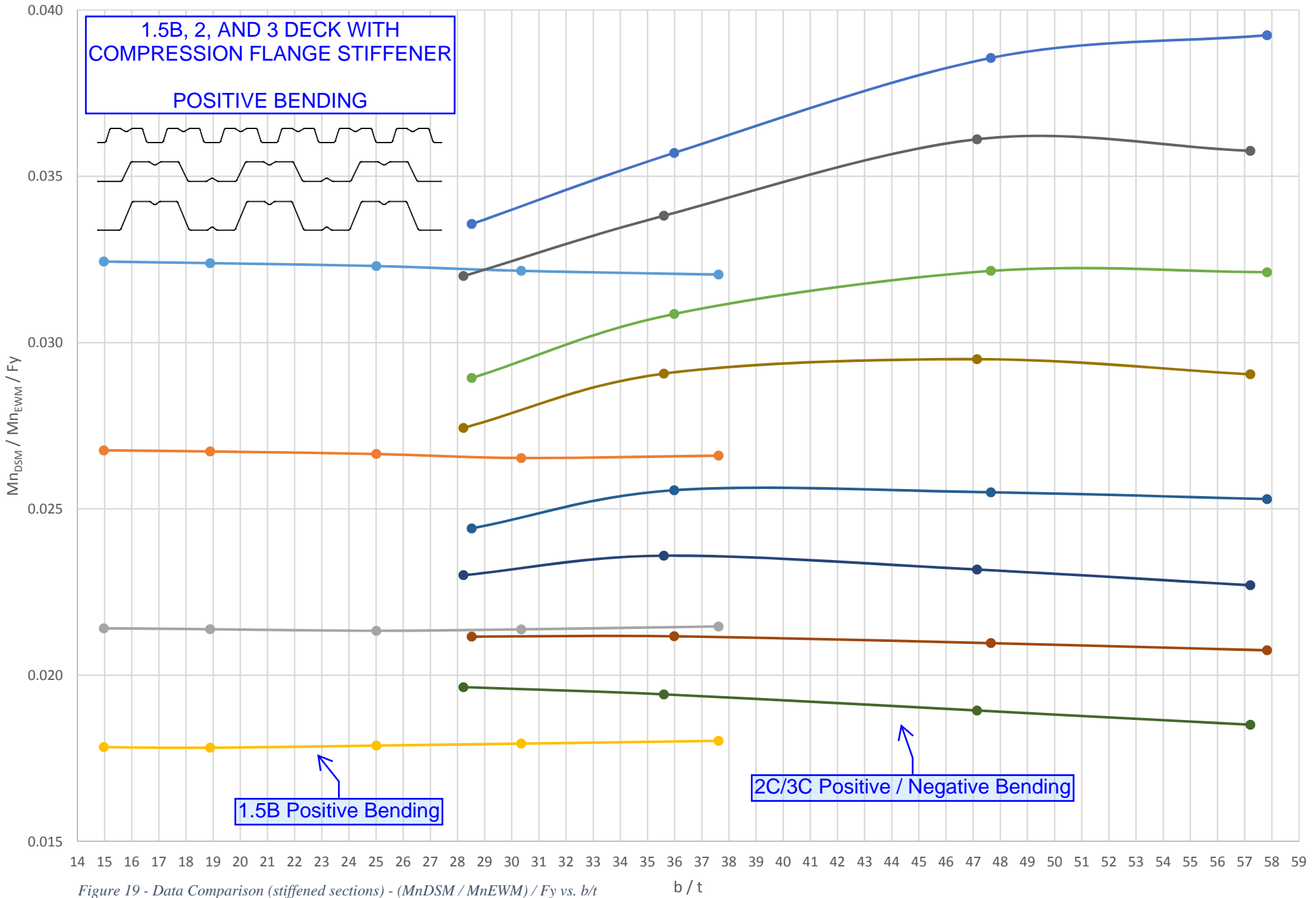


Figure 19 - Data Comparison (stiffened sections) - (Mn<sub>DSM</sub> / Mn<sub>EWM</sub>) / Fy vs. b/t



**American Iron and Steel Institute**

25 Massachusetts Avenue, NW  
Suite 800  
Washington, DC 20001

[www.steel.org](http://www.steel.org)

