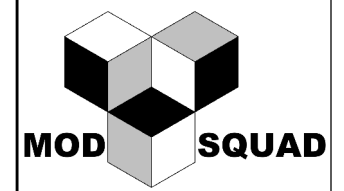




MODULAR HOUSE
SENIOR PROJECT



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STAMP:

DRAWN BY:

Chris Martinez

Date:

5/2/17

DRAWING TITLE:

Existing Conditions
Rendering

SCALE:

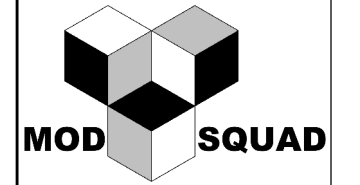
SHEET NUMBER:

T.0.01



Phase I Construction - June 2017

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Phase 1 Rendering

SCALE:

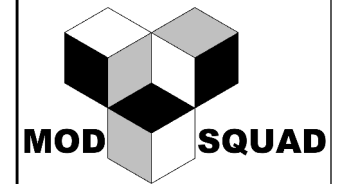
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T.0.02



Phase II Construction - December 2017

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Chris Martinez

Date:

5/2/17

DRAWING TITLE:

Phase II Rendering

SCALE:

SHEET NUMBER:

T.0.03

Modular House Project Narrative

Senior Project - Spring 2017

Completed by:

Kevin Chiang · Spencer Dilley · Sarah Douthwaite
Trevor Houghton · Ryan Lefebvre · Michele Leung
Cameron Lober · Chris Martinez · Katie Mayer

February 24, 2017

Project Summary

The Modular House, located in Poly Canyon, has seen extensive damage since the last caretaker left nearly ten years ago. To prevent further damage and improve the safety and appeal of the structure, we are proposing a renovation of the existing building that removes the existing cladding and partitions. By the end of Spring Quarter 2017, the Modular House will have a guardrail system replacing the wood paneling on the walls and a new steel composite deck to replace the current flooring system. The structural steel framing system will remain as is.

Purpose

The Modular House has been subject to the most damage due to vandalism in Poly Canyon. After the last caretaker left in 2010, steps were taken to preserve the structures. The Modular House used to be a symbol of livelihood in the area and was once used as housing for the caretaker of the canyon. Now, it is a boarded up house. We hope to revive this structure by improving its structural and aesthetic qualities, thereby creating a safe and welcoming space for the Cal Poly community to utilize and enjoy.

Our focus is a remodel of the Modular House which emphasizes the unique structural and architectural aspects of the house. In terms of architectural design, what makes the house unique are the road signs that act as the building's skin. In terms of structural design, the house was built using 8'0" cubes with a few forty-five degree offsets around the perimeter of the house. Our goal is to highlight the frames and utilize them in the design of a new guardrail system.

The new design will remove all of the walls from the structure, revealing the cubic modules, and will replace the perimeter walls with a guardrail that integrates the road signs into the design. This will effectively transform the structure from a closed off house into an open observation deck (overlooks a creek) to be used by the public.

Multi-Phase Project

***With this being such a large project to finish in 10 weeks, the construction will be split into two phases. We propose to complete Phase I, which will offer a new usable space, while Phase II will bring the addition of a 2nd level and the connecting stairs.*

Phase I: A complete demolition of the walls, roof, and floor will be performed. The new floor (LW concrete over steel decking) and guardrails for the first level will be installed.

Phase II: The second level guardrails and floor will be added, as well as the linking stairs and structural components necessary for the stairs (footings and columns). Since the design of the guardrails and floor will have been completed in Phase I, the design focus of Phase II will be the stairs.

Scope of Work (Phase I)

Design: This project will include the design of a new guardrail system, connections between the rails and the existing frame, and a new steel deck with concrete fill. The Modular House will have a new guardrail system surrounding every exterior side on both the lower and upper levels. We will be incorporating the existing road signs from the south wall of the structure into the design to maintain the unique charm they currently give to the Modular house. The guardrail will be made of steel for ease of connection to the frame through welds. These connections will be designed to ensure adequate strength. Additionally, a steel deck with concrete fill will be designed to replace the existing deck on both floors. A seismic analysis will be performed on the structure to ensure that the proposed solution will be adequate for the canyon. Analysis will also be performed on the existing structure to confirm that the structure is adequate for continuation of proposed design.

Demolition/Construction: For the repair and remodel for the Modular House, the following is a deconstruction and construction phase as proposed. The goal is to deconstruct the original modular house while maintaining the structural frame. For demolition, the interior and non-structural components (cabinets, furniture and other design aspects) are to be removed from the structure first. Following the removal of non-structural components will be the removal of the exterior walls whilst preserving the original signs. The signs will be reused for use of the handrail design. All waste will be disposed and removed from the premise to begin construction. The tentative construction phase proposal shall consist of the finalised design as described in the section above. All construction pertaining to the structural aspect of the building shall be completed first. Following the completion of the structural portion of construction will be the architectural finishes as proposed.

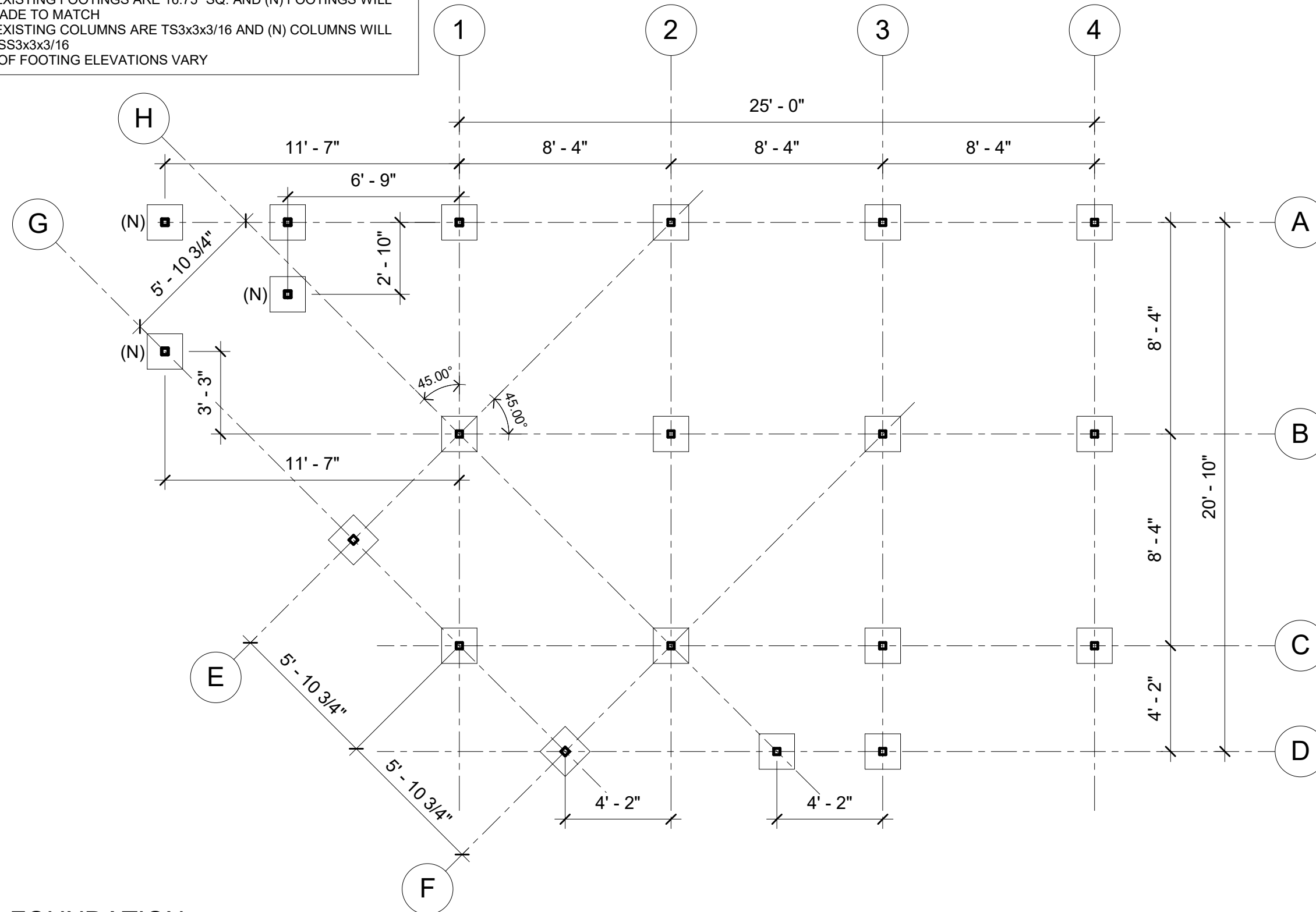
Existing Repairs: The floors will be removed and replaced with a new steel deck with concrete fill. Any decking that is damaged should also be replaced with new materials. For all other components of the Modular House, anything that is damaged, either by natural weathering or intentional mischief, shall be replaced and repaired. After all demolition is complete, a survey and analysis of the existing frame will be done, and then construction of the remodel will begin.

Timeline: The timeline below shows a tentative schedule of this project.

Date	Objective
Late February 2017	Conduct Site Investigation
Mid March 2017	Complete Structural Analysis and Design
Late April 2017	Complete Permit to Send Off for Approval
Early May 2017	Begin Demolition
Late May 2017	Begin Panel Prefabrication
Early June 2017	Complete Phase I

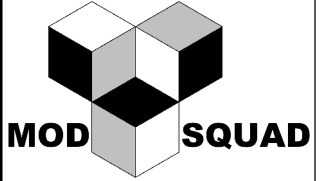
NOTES:

1. ALL FOOTINGS AND COLUMNS CURRENTLY EXIST UNLESS LABELED (N)
2. (N) COLUMNS AND FOOTINGS ARE PART OF PHASE 2
3. ALL EXISTING FOOTINGS ARE 16.75" SQ. AND (N) FOOTINGS WILL BE MADE TO MATCH
4. ALL EXISTING COLUMNS ARE TS3x3x3/16 AND (N) COLUMNS WILL BE HSS3x3x3/16
5. TOP OF FOOTING ELEVATIONS VARY



1 FOUNDATION
1/4" = 1'-0"

MODULAR HOUSE
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RYAN LEFEBVRE

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DRAWING TITLE:

FOUNDATION
PLAN

SCALE:

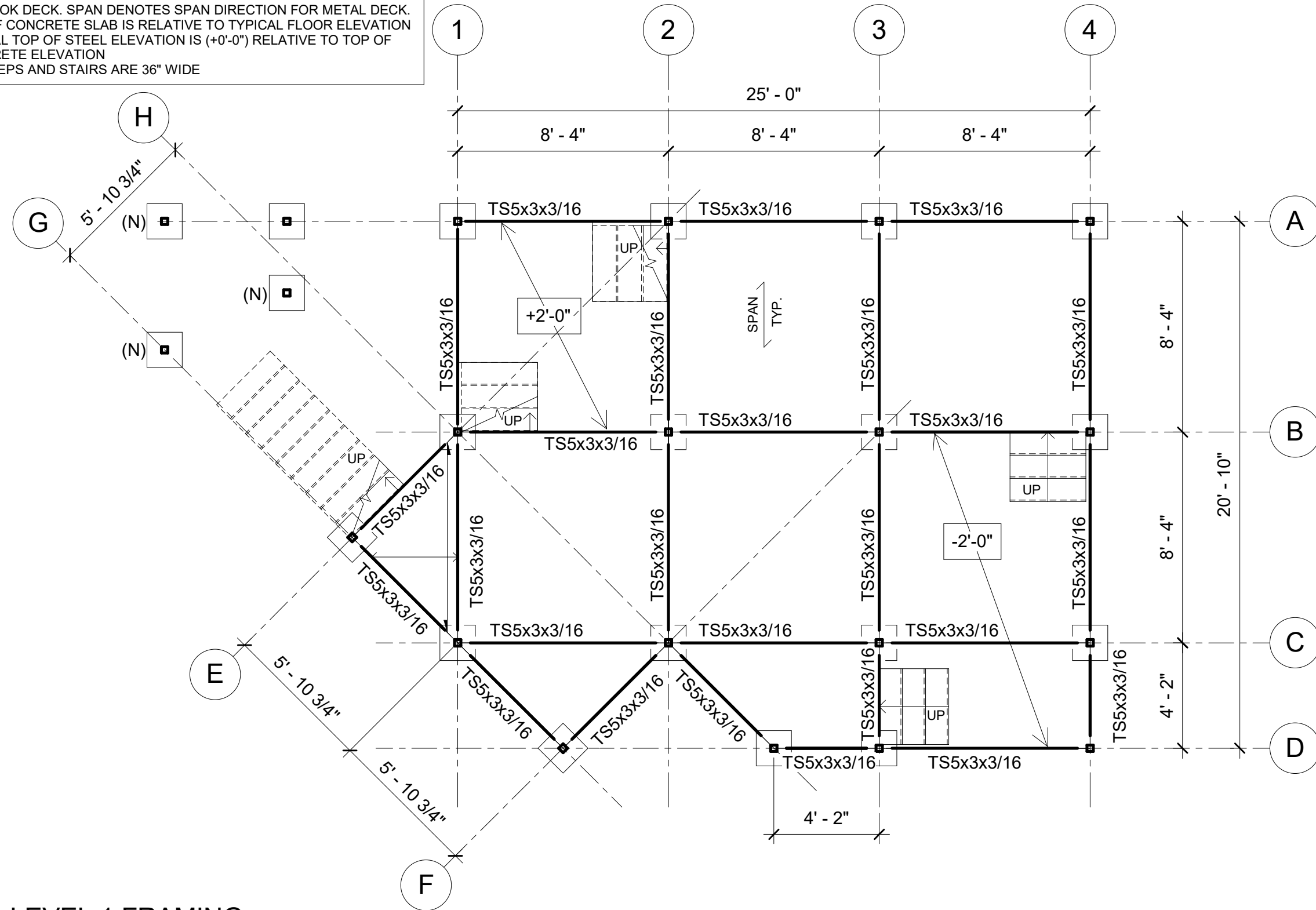
1/4" = 1'-0"

SHEET NUMBER:

S.3.1

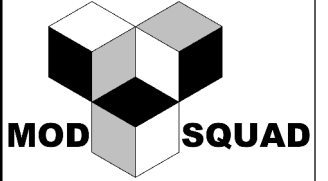
NOTES:

1. TYP. ELEVATION: 0'-0" (ELEVATION DATUM IS TOP OF FIRST FLOOR)
2. ALL BEAMS & COLUMNS ARE EXISTING UNLESS LABELED (N)
3. ALL EXISTING COLUMNS ARE TS3x3x3/16
4. (N) FLOOR IS 1 1/2" LW CONCRETE FILL OVER 18 GAGE VERCO PLB FORMLOK DECK. SPAN DENOTES SPAN DIRECTION FOR METAL DECK.
5. TOP OF CONCRETE SLAB IS RELATIVE TO TYPICAL FLOOR ELEVATION
6. TYPICAL TOP OF STEEL ELEVATION IS (+0'-0") RELATIVE TO TOP OF CONCRETE ELEVATION
7. ALL STEPS AND STAIRS ARE 36" WIDE



1 LEVEL 1 FRAMING
1/4" = 1'-0"

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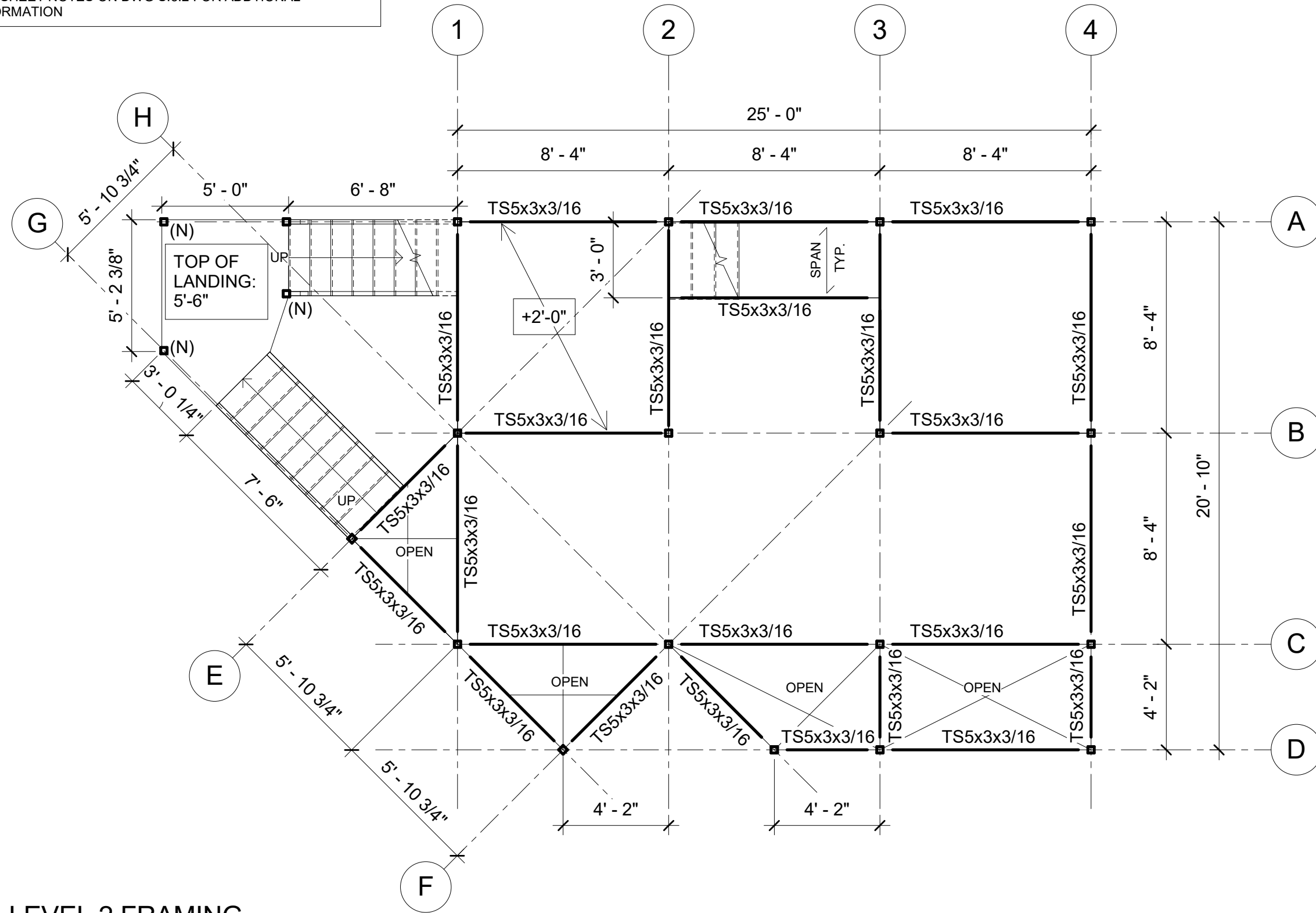
DRAWING TITLE:
1ST FLOOR PLAN

SCALE:
1/4" = 1'-0"

SHEET NUMBER:
S.3.2

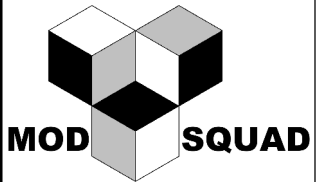
NOTES:

1. SECOND FLOOR SLAB AND STAIRS ARE PART OF PHASE 2
2. TYP. ELEVATION: 8'-4" (TOP OF FLOOR)
3. ALL BEAMS & COLUMNS ARE EXISTING UNLESS LABELED (N)
4. SEE SHEET NOTES ON DWG S.3.2 FOR ADDITIONAL INFORMATION



1 LEVEL 2 FRAMING
1/4" = 1'-0"

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DRAWING TITLE:

2ND FLOOR PLAN

SCALE:

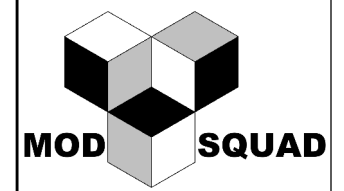
1/4" = 1'-0"

SHEET NUMBER:

S.3.3

NOTES:
 1. TYP. ELEVATION: 16'-8" (TOP OF BEAM)
 2. TYPICAL TOP OF STEEL IS (+0'-0") RELATIVE TO TYP. ELEVATION, UNLESS NOTED OTHERWISE.

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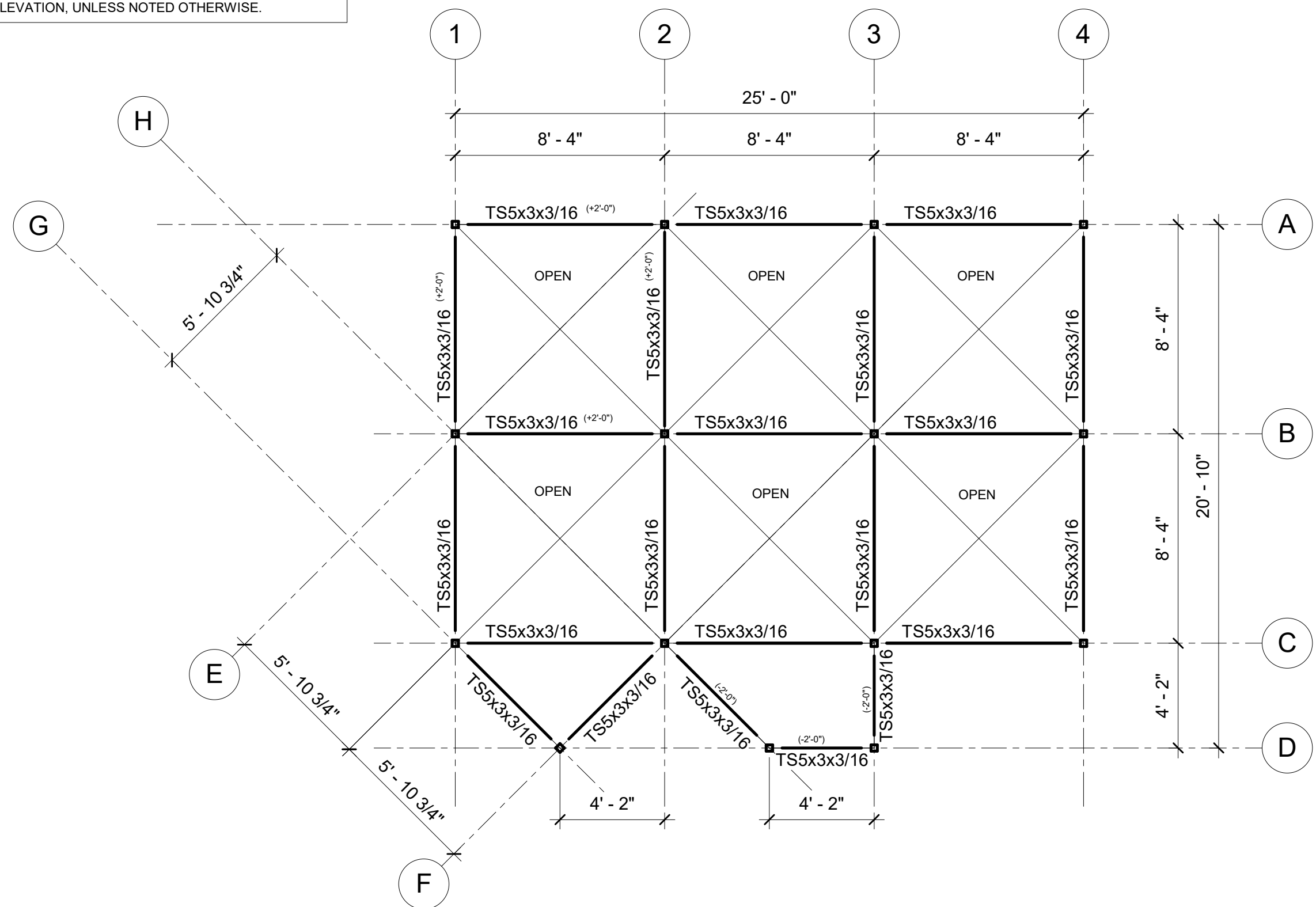
ROOF PLAN

SCALE:

1/4" = 1'-0"

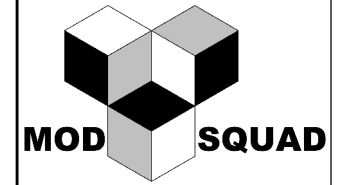
SHEET NUMBER:

S.3.4



1 ROOF FRAMING
 1/4" = 1'-0"

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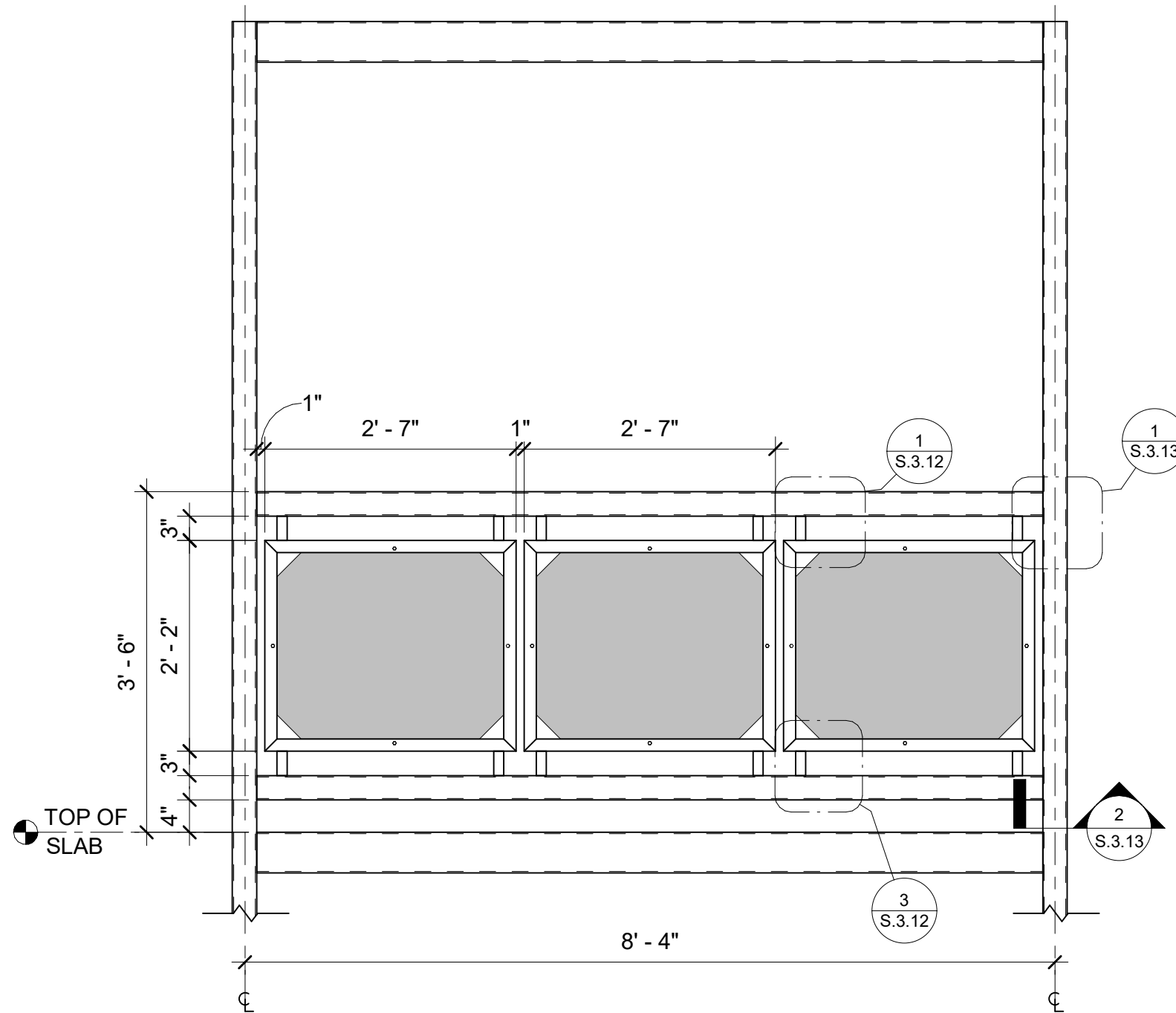
TYPICAL GUARD
RAIL DETAILS

SCALE:

3/4" = 1'-0"

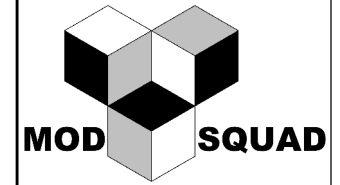
SHEET NUMBER:

S.3.10



1 GUARD RAIL EXTERIOR TYP.
3/4" = 1'-0"

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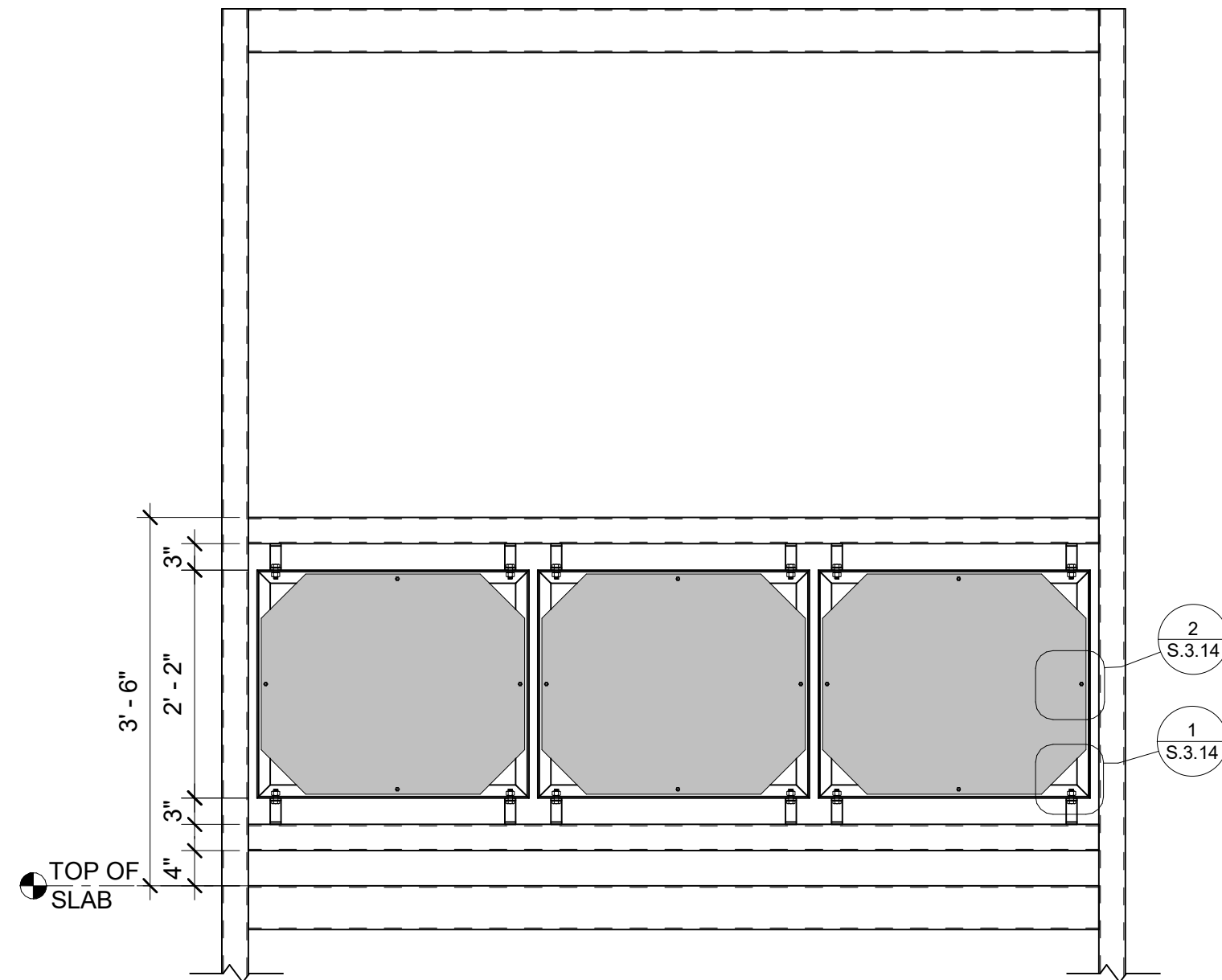
TYPICAL GUARD
RAIL DETAILS

SCALE:

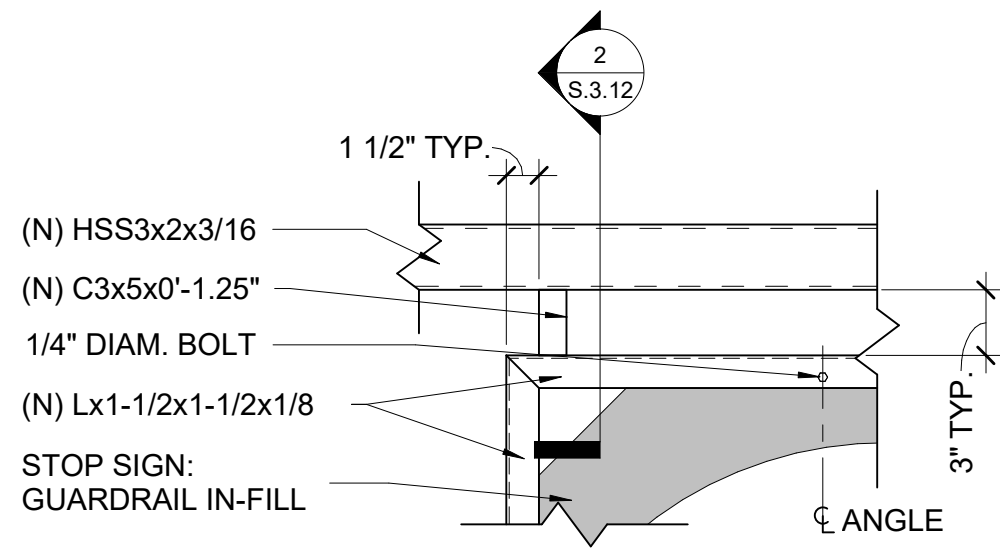
3/4" = 1'-0"

SHEET NUMBER:

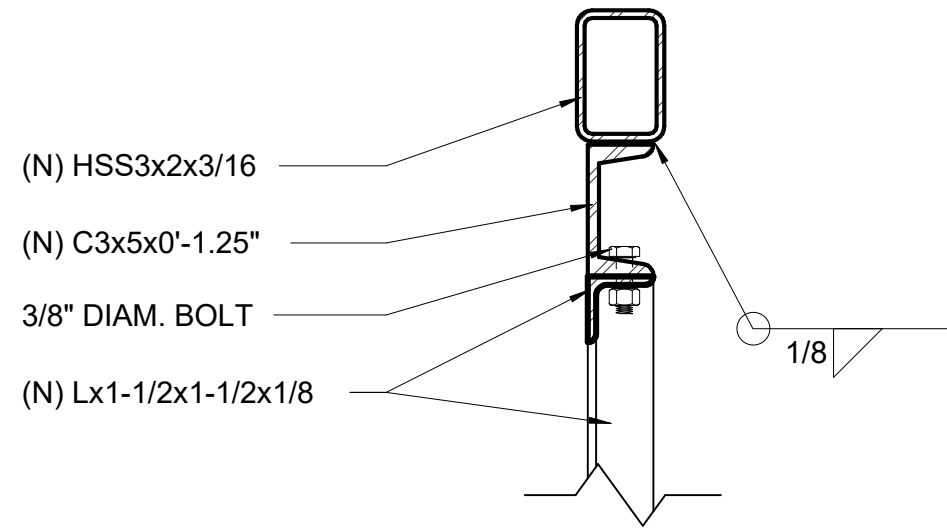
S.3.11



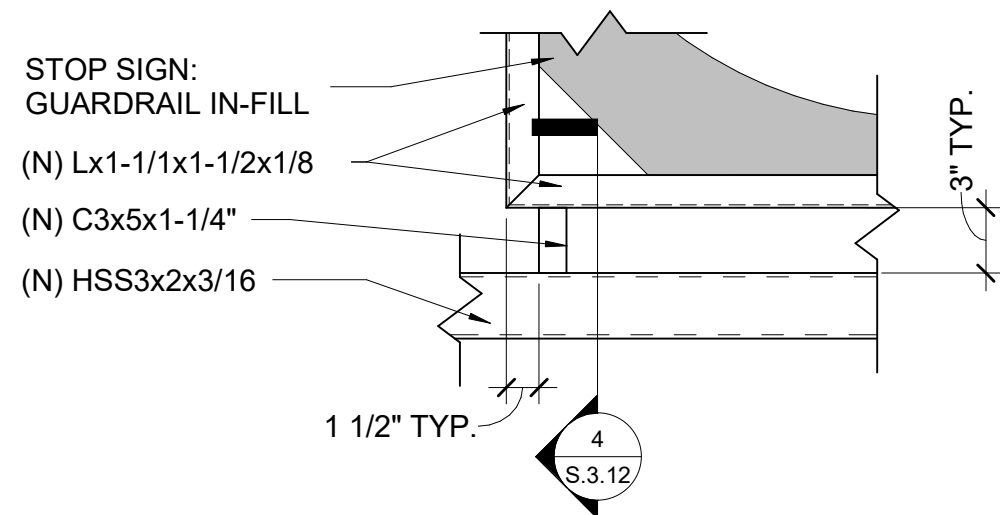
1 GUARD RAIL INTERIOR TYP.
3/4" = 1'-0"



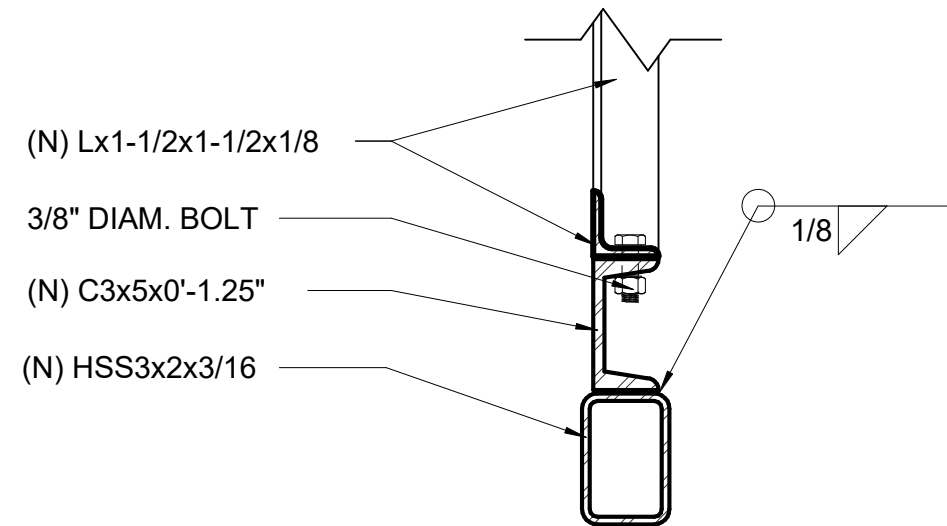
1 PANEL TO GUARD RAIL - TOP
1 1/2" = 1'-0"



2 PANEL CONNECTION - TOP
3" = 1'-0"

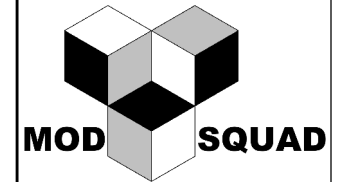


3 PANEL TO GUARD RAIL - BOTTOM
1 1/2" = 1'-0"



4 PANEL CONNECTION - BOTTOM
3" = 1'-0"

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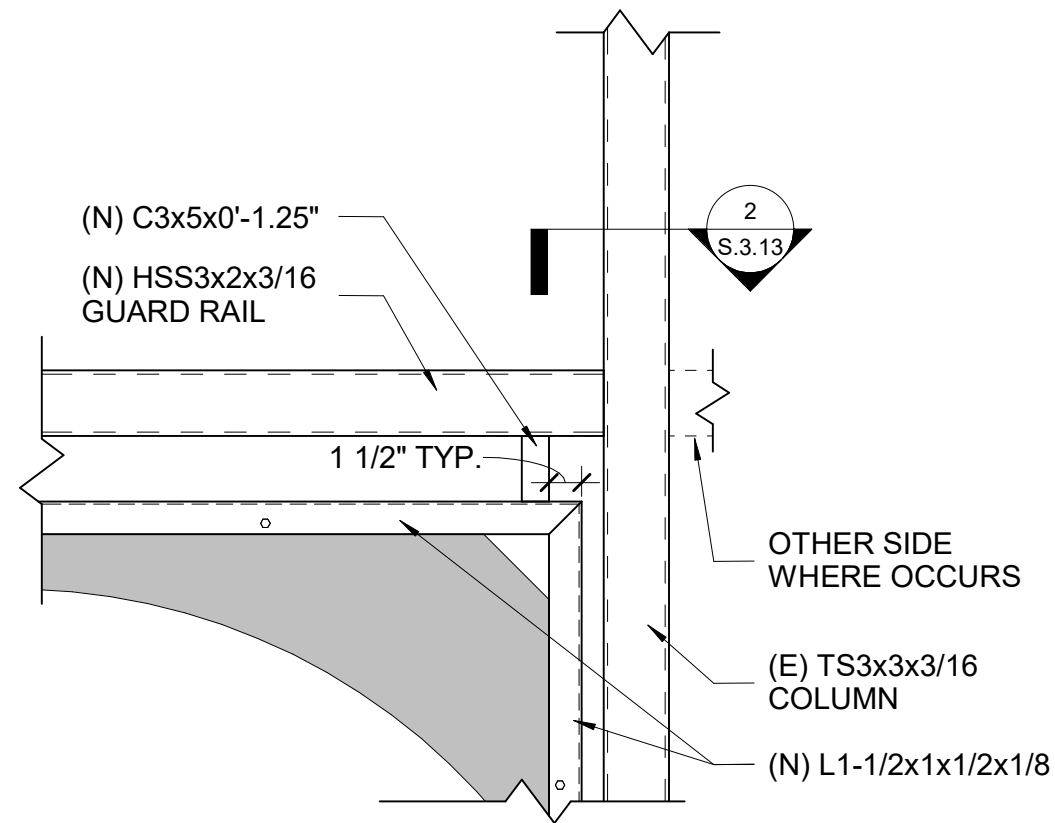
TYPICAL GUARD
RAIL DETAILS

SCALE:

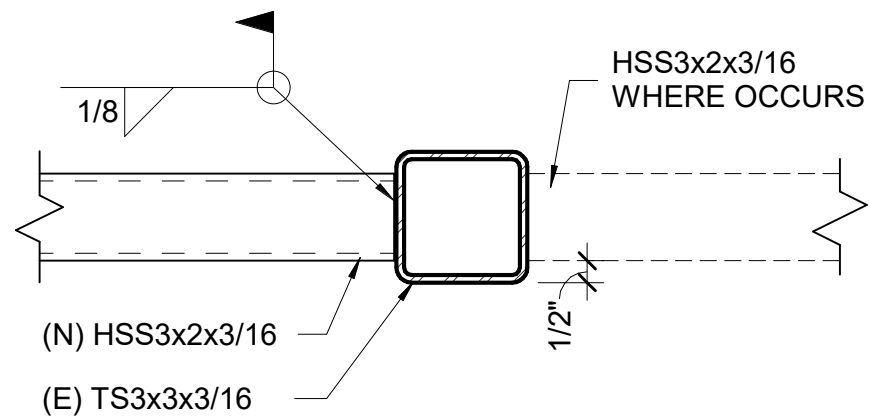
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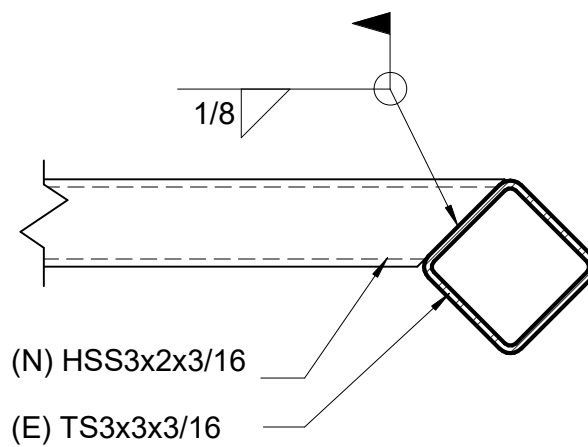
S.3.12



1 UPPER RAIL TO COLUMN CONNECTION
 1 1/2" = 1'-0"

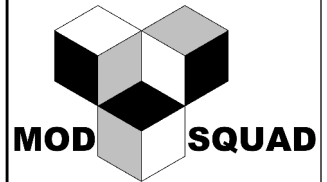


2 RAIL TO COLUMN - TOP & BOTTOM
 3" = 1'-0"



3 RAIL TO ANGLED COLUMN - TOP & BOTTOM
 3" = 1'-0"

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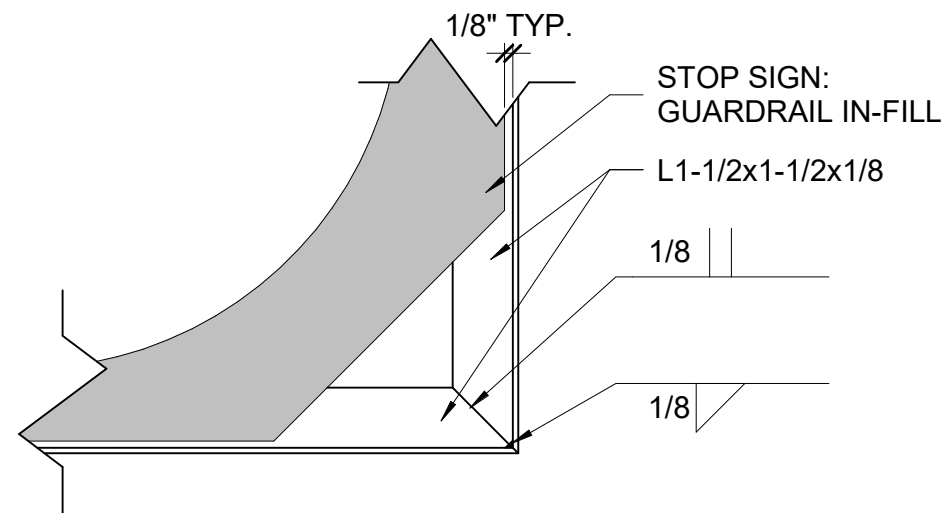
TYPICAL GUARD
RAIL DETAILS

SCALE:

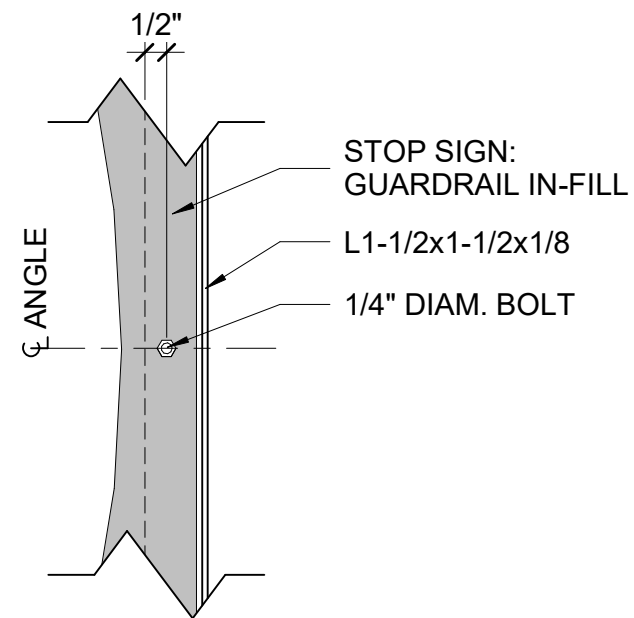
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SHEET NUMBER:

S.3.13

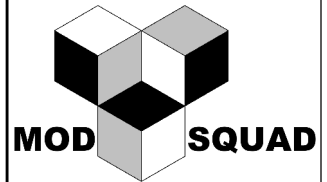


1 **PANEL CONNECTION TYP.**
3" = 1'-0"



2 **SIGN CONNECTION**
3" = 1'-0"

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DRAWING TITLE:

TYPICAL GUARD
RAIL DETAILS

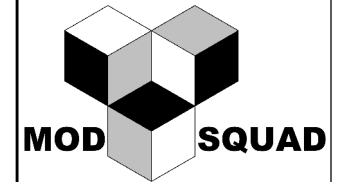
SCALE:

3" = 1'-0"

SHEET NUMBER:

S.3.14

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DRAWING TITLE:

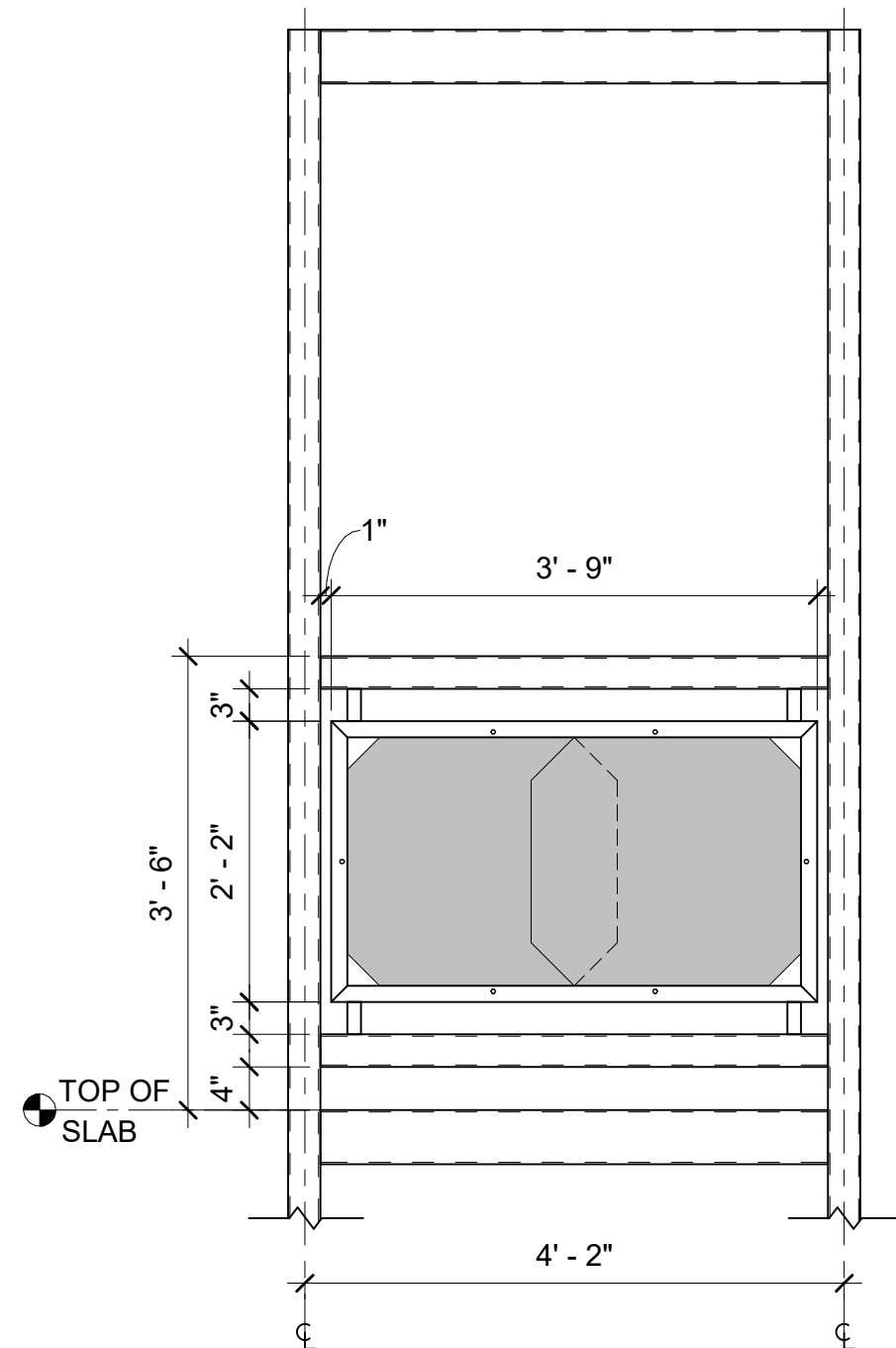
ATYPICAL GUARD
RAILS

SCALE:

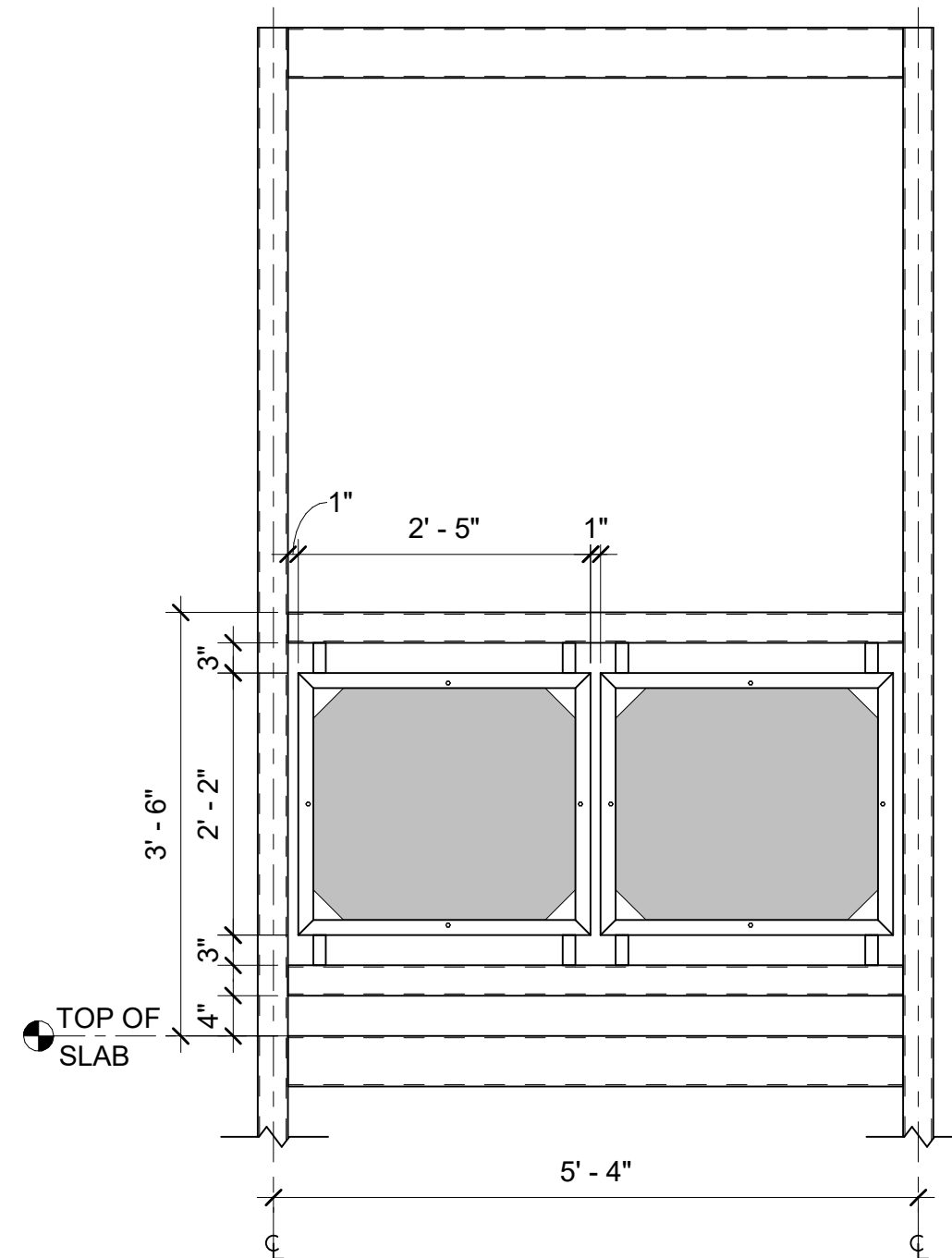
3/4" = 1'-0"

SHEET NUMBER:

S.3.15

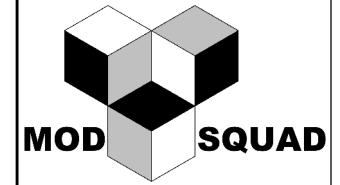


1 GUARD RAIL EXTERIOR 4'-2"
3/4" = 1'-0"



2 GUARD RAIL EXTERIOR 5'-4"
3/4" = 1'-0"

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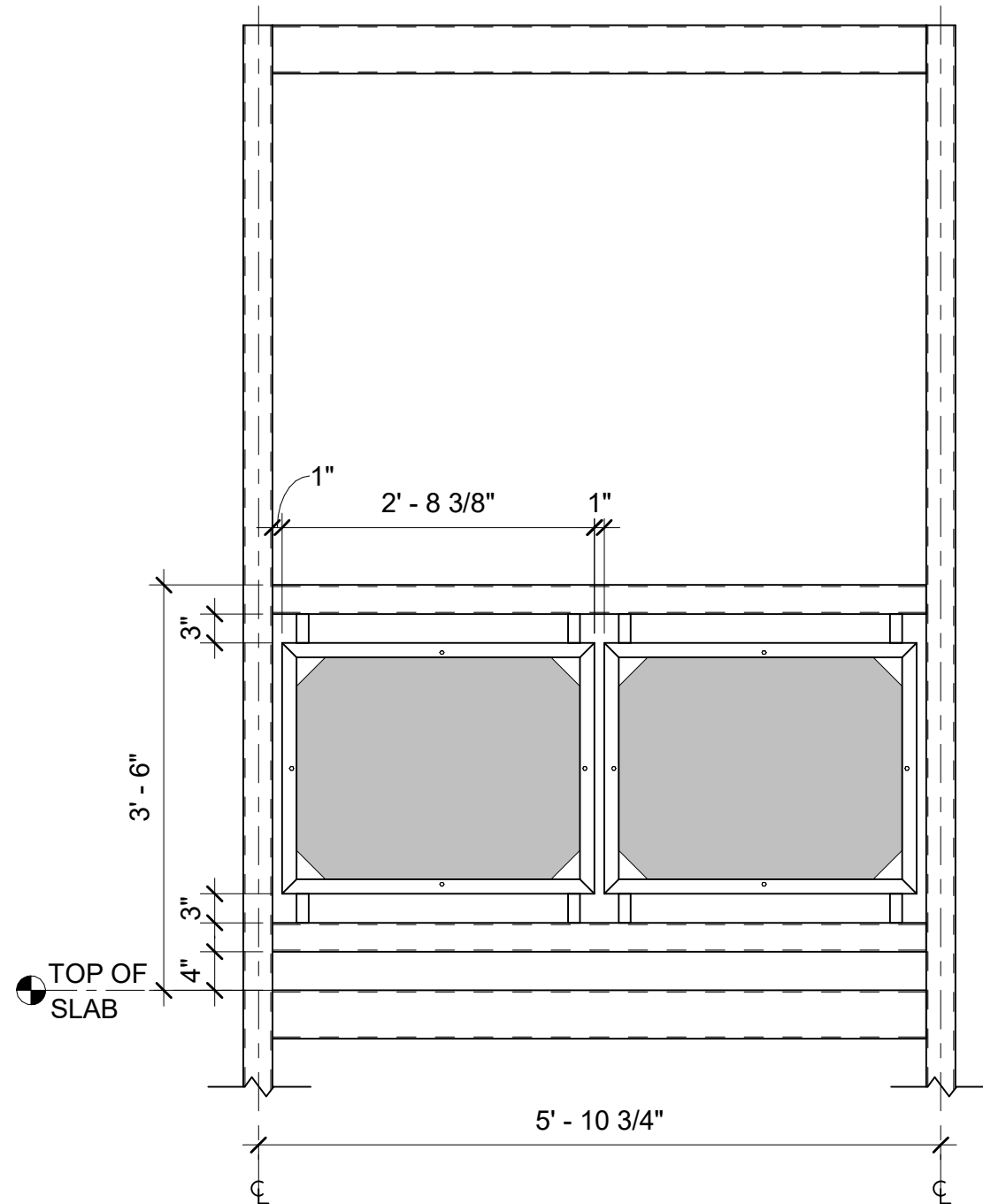
ATYPICAL GUARD
RAILS

SCALE:

3/4" = 1'-0"

SHEET NUMBER:

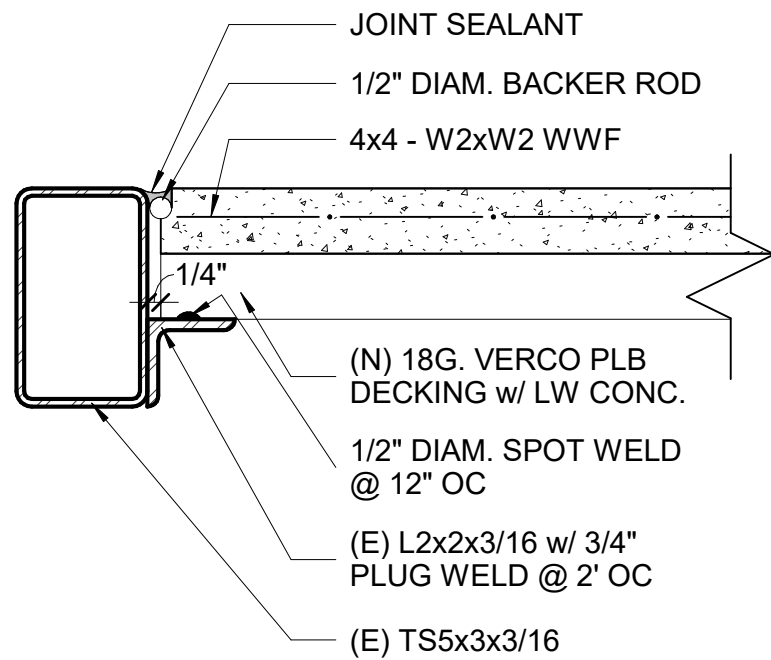
S.3.16



1

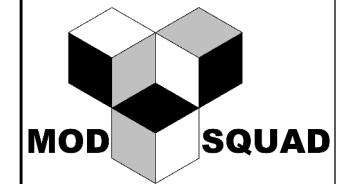
GUARD RAIL EXTERIOR 5'-10 3/4"

3/4" = 1'-0"



1 DECKING CONNECTION
3" = 1'-0"

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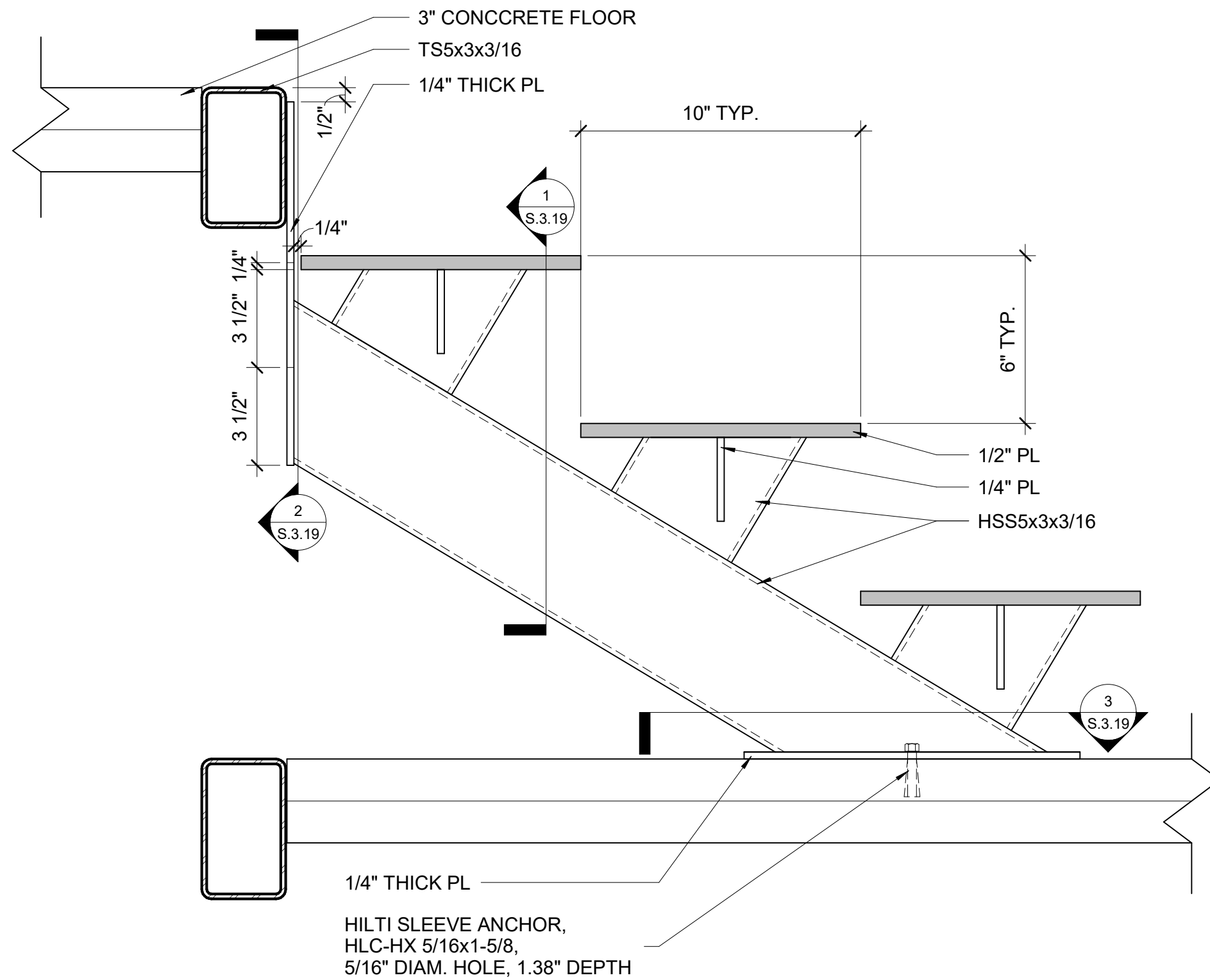
DECKING DETAILS

SCALE:

3" = 1'-0"

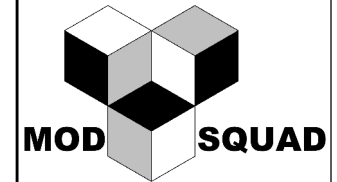
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1 MONO-STRINGER STEPS
3" = 1'-0"

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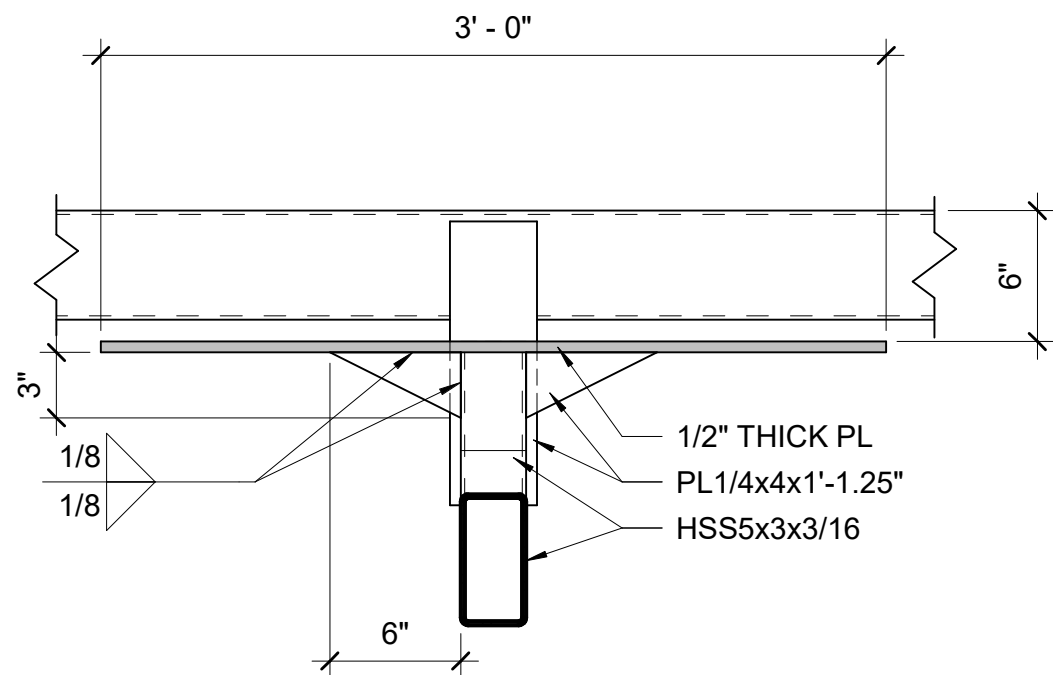
STEP DETAILS

SCALE:

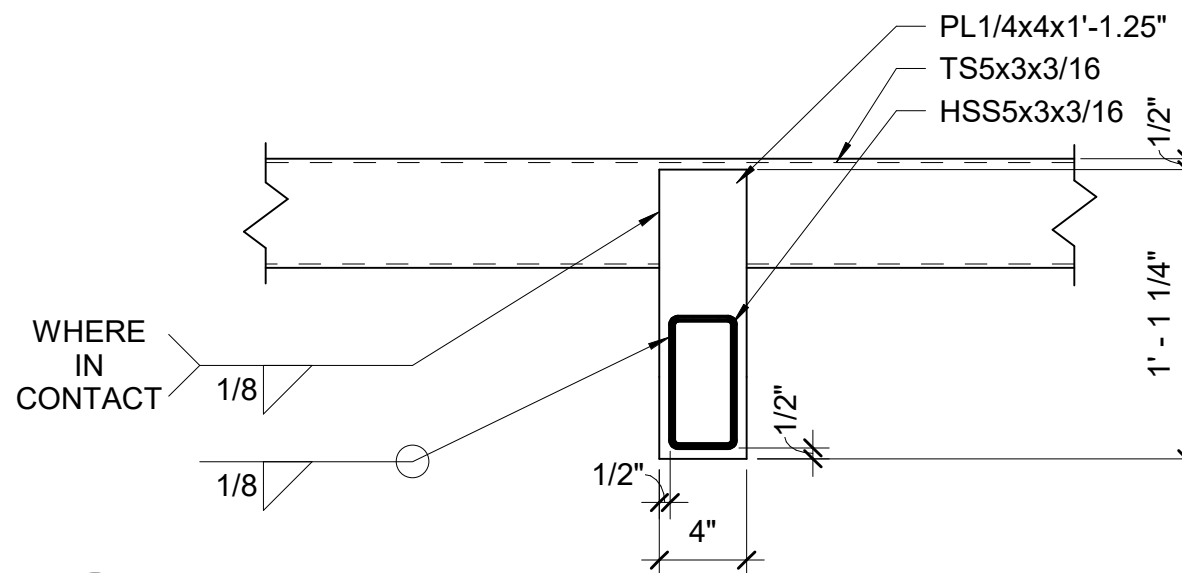
3" = 1'-0"

SHEET NUMBER:

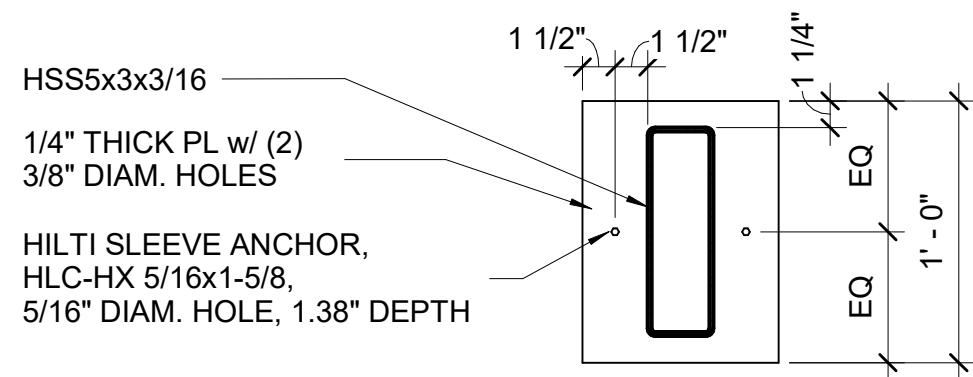
S.3.18



1 **STEPS SECTION 1**
1 1/2" = 1'-0"

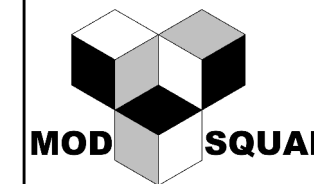


2 **STEPS SECTION 2**
1 1/2" = 1'-0"



3 **STEPS SECTION 3**
1 1/2" = 1'-0"

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DRAWING TITLE:

STEP DETAILS

SCALE:

1 1/2" = 1'-0"

SHEET NUMBER:

S.3.19

Project Description

This project will include the design of a new handrail system, connections between the rails and the existing frame, and a new steel deck with concrete fill. The Modular House will have a new handrail system surrounding every exterior side on both the lower and upper levels. The exact design of this handrail is yet to be determined. We will be incorporating the existing road signs from the south wall of the structure into the design to maintain the unique charm they currently give to the Modular house. The handrail will likely be made of steel for ease of connection to both the signs and the frame, either through welds or bolts. These connections will be designed to ensure adequate strength. Additionally, a steel deck with concrete fill will be designed to replace the existing deck on both floors. A seismic analysis will be performed on the structure to ensure that the proposed solution will be adequate for the canyon. Analysis will also be performed on the existing structure to confirm that the structure is adequate for continuation of proposed design.

Design Criteria

- Design Code: IBC 2012
ASCE 7-10
AISC Steel 314
AISC Seismic
- Building Type: Construction Type : Type I
No hour fire rating
Occupancy Group : Assembly Area A-5 (Assembly Area for viewing outside activities)
- Wind Criteria: N/A, Due to open nature of the structure
- Seismic Criteria: $S_{DS} = 0.789g$
 $S_{D1} = 0.450g$
 $C_s = .2254$
- Foundation Criteria: Use existing Foundation
- Allowable loads: Live Loads: Floor _____ 100 psf
Dead Loads: Floor (Fill and Decking) _____ 26.1 psf
- Controlling Deflections: Depth of beam shall be great than $L/240$
- GFRS: HSS Tubing (Beam and Column), Steel Decking and Fill
- LFRS: HSS Tubing Moment Frames

References	System: Project Summary	Comments
	<p>The existing weight of the Modular House is 25.7 kips. After all modifications and renovations are complete the building is going to weigh only 17 kips. The renovated building will be 34% lighter than the original building.</p> <p>Force is defined by mass multiplied by the acceleration. The design acceleration will not change. Therefore a decrease of mass by 34% means that the force the building needs to resist will also be decreased by 34%. The original lateral system was strong enough to resist the original forces with a heavier mass so the lateral system will remain unchanged and will be strong enough to resist the smaller forces that it may experience.</p> <p>In addition, by getting rid of the complexity of the multiple materials and changing the flooring system will no longer have a mass irregularity caused by the change from wood flooring to tile</p>	

References	System: <u>EXISTING LOAD TAKE OFF</u>	Comments
	ROOF	
	STRESSED SKIN PANEL	10 psf
	PARTITION	10 psf
	TOTAL	20 psf
	AREA	427.5 sf
	Load	8.55 k
	2ND FLOOR	
	1/2" PLYWOOD SHEATHING - FLOOR	1.6 psf
	3/8" PLYWOOD SHEATHING - CEILING	1.2 psf
	CERAMIC TILE - FLOORING	10 psf
	CLADDING	
	PARTITION	10 psf
	TOTAL	22.8 psf
	AREA	153 sf
	LOAD	3.5 k
	1ST FLOOR	
	1/2" PLYWOOD SHEATHING - FLOOR	1.6 psf
	3/8" PLYWOOD SHEATHING - CEILING	1.2 psf
	CERAMIC TILE - FLOORING	10 psf
	CLADDING	
	PARTITION	10 psf
	TOTAL	22.8 psf
	AREA	479.5 sf
	LOAD	10.9 k
	TUNING	
	ROOF	1 k
	2ND FLOOR RISE	0.22 k
	2ND FLOOR	0.38 k
	1ST FLOOR RISE	0.22 k
	1ST FLOOR	0.71 k
	1ST FLOOR DROP	0.22 k
	TOTAL	3 k
	TOTAL BUILDING WEIGHT	25.7 k

Existing Load Takeoff

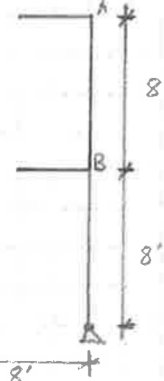
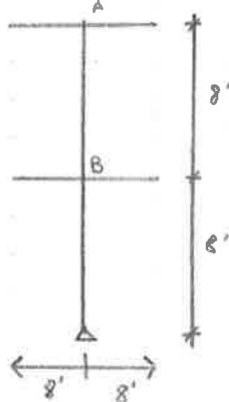
References	System: <u>SEISMIC ANALYSIS</u>	Comments
USGS	ASSUMPTIONS: SOIL CLASS: D RISK CATEGORY I/II	
	PROVIDED OUTPUT → $S_s = 1.128 g$ $S_1 = 0.430 g$ $S_{m1} = 1.183 g$ $S_{m1} = 0.675 g$ $S_{0.5} = 0.789 g$ $S_{0.1} = 0.450 g$	
	SEISMIC BASE SHEAR	
ASCB 7-10	$V = C_s W$ (12.8-1) → PERMITTED DUE TO TABLE 12.6-1 w/ RISK CAT. I or II NOT EXCEEDING 2 STORIES	
	$C_s = \frac{S_{0.5}}{(R/I_e)}$ (12.8-2) $S_{0.5} = 0.789 g$ $R = 3 \frac{1}{2}$ (12.8-1) $I_e = 1.00$	OMF
	$\therefore C_s = .2254$	
	→ LIMIT (12.8-7) $T_a = C_1 h_n^2 = 0.028 (17')^{0.8}$ $= .2701 \text{ sec}$	
	NEED NOT EXCEED. $C_s = \frac{S_{0.1}}{T(R/I_e)}$ for $T \leq T_e$ $= .4760$	
	SHALL NOT BE LESS THAN $C_s = 0.044 S_{0.5} T_e \geq 0.01$ $= .0347$	
	$\therefore V = .2254 W$	

Design Criteria 1

References	System: <u>SEISMIC ANALYSIS CONT / DECKING</u>	Comments
	<p>DECKING REQUIREMENTS</p> <ul style="list-style-type: none"> - MINIMUM 20 GAUGE - AVOID SHORING - 2 SPAN - LIGHT WEIGHT, NO FIRE RATING <p>B FORMLOCK 18 GAUGE 3 IN LW CONC. SINGLE SPAN 8'-0", NO SHORING REQ'D</p> <ul style="list-style-type: none"> - ALLOWABLE SUPER IMPOSED → 166 psf - DEAD <ul style="list-style-type: none"> - CONC → 23.2 psf - DECK → 2.9 psf - LIVE <ul style="list-style-type: none"> - Assembly / Deck → 100 psf <p>126.1 psf < 166 psf ✓</p> <p>DEAD LOAD TAKE-OFF</p> <p>2ND FLOOR RISE → DECKING: (23.2 + 2.9 psf) (64 sf) = 1.67k TUBING: 1.87 plf (4x8') = .22k</p> <p>2ND FLOOR → DECKING: (26.1 psf) (64 sf + 32 sf) = 2.51k TUBING: 6.87 plf (7x8') = .38k</p> <p>1ST FLOOR RISE → DECKING: (23.2 + 2.9 psf) (64 sf) = 1.67k TUBING: 6.87 plf (4x8') = .22k</p> <p>1ST FLOOR → DECKING: (23.2 + 2.9 psf) (206 sf) = 6.68k TUBING: 6.87 plf (13x8') = .71k</p> <p>1ST FLOOR DROP → DECKING: (23.2 + 2.9 psf) (64 sf) = 1.67k TUBING: 6.87 plf (4x8') = .22k</p> <p>SEISMIC WEIGHT = 16k + 1k (TUBING) = 17k</p> <p>∴ V = .2254 (17k) = <u>3.83k</u></p>	

AISC STEEL
TAB 1-12

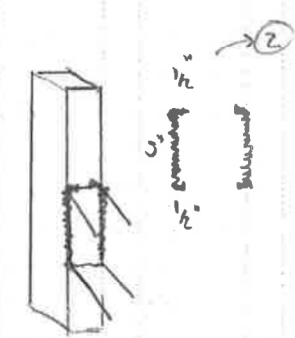
References	System: <u>FRAME ANALYSIS</u>	Comments
	<p>COLUMN FLEXURAL CAPACITY</p> <p>STEEL TUBING 3x3x3/16</p> <p>$\phi M_n = \phi M_n = \phi F_y Z$ F_y = 46 ksi</p> <p>I = 2.60 in⁴, S = 1.73 in³, r = 1.13 in</p> $Z = \frac{bh^2}{4} - (b-2t) \left(\frac{h}{2} - t \right)^2$ $= \frac{3'' \times 3''^2}{4} - (3 - 2(3/16)) \left(\frac{3}{2} - 3/16 \right)^2$ $= 2.23 \text{ in}^3$ <p>$\phi M_n = .9 (46 \text{ ksi}) (2.23 \text{ in}^3) = \underline{7.69 \text{ k-ft}}$</p> <p>BEAM FLEXURAL CAPACITY</p> <p>F7-1</p> <p>$\phi M_n = \phi F_y Z$ F_y = 46 ksi, $\phi = .9$</p> $Z = \frac{bh^2}{4} - (b-2t) \left(\frac{h}{2} - t \right)^2$ $= \frac{3 \times 5^2}{4} - (3 - 2(3/16)) \left(\frac{5}{2} - 3/16 \right)^2 \text{ in}^3$ $= 4.71 \text{ in}^3$ <p>$\phi M_n = .9 (46 \text{ ksi}) (4.71 \text{ in}^3) = \underline{16.24 \text{ k-ft}}$</p> <p>BEAM SHEAR CAPACITY</p> <p>G2-1</p> <p>$\phi V_n = \phi 0.6 F_y A_w C_v$ F_y = 46 ksi A_w = dt_w = 4 (3/16) (3/16) in² = .7852 in² C_v → h/t_w = 5' / 3/16 = 25.7 $\frac{K_v}{h/t_w} = 6$ $\sqrt{K_v E / F_y} = 53.85$ h/t_w ≤ 110 $\sqrt{K_v E / F_y}$ 25.7 ≤ 59.2 ∴ C_v = 1.0</p> <p>$\phi V_n = .9 (6) (46 \text{ ksi}) (.7852 \text{ in}^2) (1.0) = \underline{19.5k}$</p>	

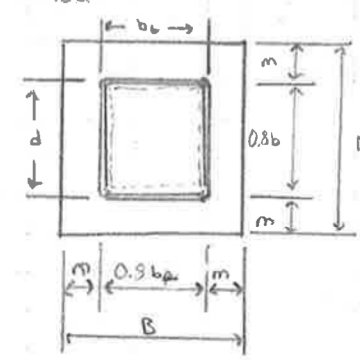
References	System: FRAME ANALYSIS	Comments
	<p><u>ALLOWABLE BEAM DEFLECTION</u></p> <p>D+L → $L/240 = 8' \times 12" / 240 = .4"$</p> <p><u>COLUMN SLENDER VALUE</u></p> <p>• DETERMINE K → CORNER</p>  <p>COL: $3 \times 3 \times 3/16 \rightarrow I = 2.60 \text{ in}^4$ BEAM: $5 \times 3 \times 3/16 \rightarrow I = 9.61 \text{ in}^4$</p> $G_A = \frac{EI_c/L_c}{EI_b/L_b} = \frac{I_c}{I_b} = \frac{2.60}{9.61} = .271$ $G_B = \frac{2(EI_c/L_c)}{EI_b/L_b} = \frac{1570.8}{2903.0} = .541$ $K = 0.66 \text{ (FIG C-A-7.1)}$ <p>SLENDER → $\frac{KL}{r} = \frac{0.66(8 \times 12)''}{1.13 \text{ in}} = 56.1 < 200 \checkmark$</p> <p>→ CENTER</p>  <p>$G_A = \frac{I_c}{2I_b} = \frac{2.60}{9.61 \times 2} = .136$</p> $G_B = \frac{I_c}{I_b} = \frac{2.60}{9.61} = .271$ $K = 0.59 \text{ (C-A-7.1)}$ $\frac{KL}{r} = \frac{0.59(8 \times 12)''}{1.13} = 50.1 < 200 \checkmark$	

AISC STEEL

AISC STEEL

References	System: FRAME ANALYSIS	Comments
	<p><u>COMPRESSION STRENGTH COLUMN</u></p> <p>E3-1 $P_n = A_g F_{cr}, A_g = 1.89 \text{ in}^2$</p> $\frac{KL}{r} = 56.1, 4.71 \sqrt{\frac{E}{F_y}} = 4.71 \sqrt{\frac{29000}{46}} = 118.3$ $\therefore F_{cr} = (0.658^{F_y/F_c}) F_y$ $F_c = \frac{\pi^2 E}{(KL/r)^2} = \frac{\pi^2 (29000)}{56.1^2} = 90.9$ $\rightarrow F_{cr} = (0.658^{46/90.9}) 46 = 37.2 \text{ ksi}$ $P_n = 1.89 (37.2 \text{ ksi}) = 70.3 \text{ K}$ $\phi_c = 0.9 \rightarrow \phi_c P_n = 63.3 \text{ K}$ <p><u>SHEAR STRENGTH COLUMN</u></p> <p>SECTION G5 → IN ACCORDANCE TO SEC. G2.1 w/ $A_w = 2ht$</p> <p>TS $3 \times 3 \times 3/16$ $h = 2.66 \text{ in}$ $t = 0.93 \text{ (Nom. THICK)} = .174$ $A_w = .9257 \text{ in}^2$ $K_v = 5$</p> <p>G2-1 $V_n = 0.6 F_y A_w C_v$ → C_v</p> <p>- $h/t_w = 14.2$ - $\sqrt{K_v E / F_y} = \sqrt{5(29000) / 46} = 56.1$ 1.10... = 61.8 $\therefore C_v = 1.0$</p> <p>G2-3 $V_n = 0.6 (46 \text{ ksi}) (.9257 \text{ in}^2) (1.0) = 25.6 \text{ K}$ $\phi_v = 0.9$ $\phi_v V_n = 23 \text{ K}$</p>	

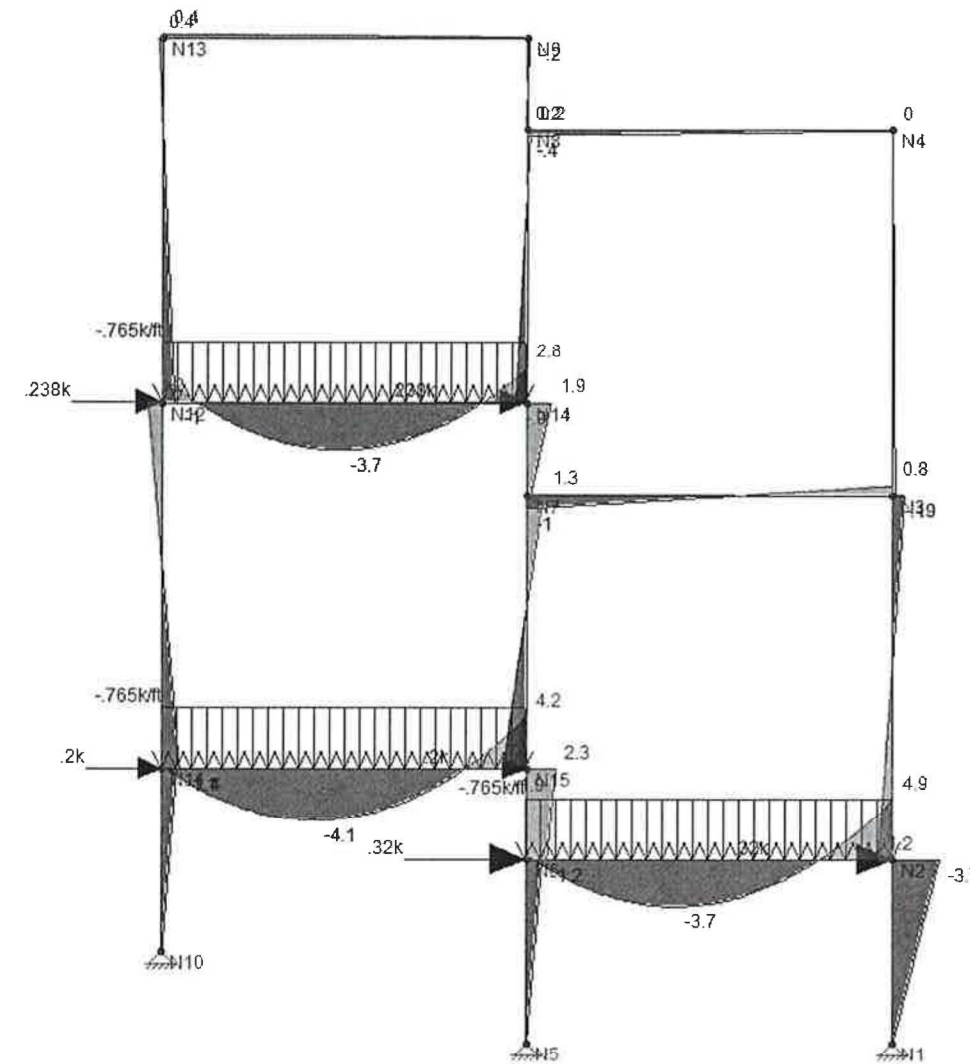
References	System: FRAME ANALYSIS	Comments
J4-8 Tab 2-4	<p><u>WELD CONNECTION</u></p> <p>• BLOCK SHEAR</p> $\phi R_n = \phi [0.6 F_u A_{nv} + U_{ts} F_u A_{nt}]$ $\phi = 0.75$ $F_u = 58 \text{ ksi}$ $A_{nv} = 15" \times 6" \times 2$ $U_{ts} = 1.0$ $A_{nt} = 2.5" \times 6" + \frac{1}{2} \times 6"$ $= 3" \times 6" \times 2$ <p>Assume $\frac{1}{8}"$ WELD</p> $= 0.75 [0.6 (58 \text{ ksi}) (10 (1/8")) + 1.0 (58 \text{ ksi}) (6 (1/8"))]$ $= 65.25 \text{ k}$ 	
AISC STEEL 16.1-147, K3	<p>HSS TO HSS</p> <p>ϕM_n IN ACCORDANCE W/ SEC B3.6</p> <p>→ FULLY RESTRAINED CONNECTION</p> <p>→ T-CONNECTION</p> $B = B_b / B = 3 \text{ in} / 3 \text{ in} = 1.00$	
K3-10	<p>$B > 0.85$</p> $M_n = F_y^* t (B - t) (H_b + 5t)$ $F_y = 46 \text{ ksi}$ $B = 3 \text{ in}$ $t = .1744 \text{ in} = 0.93 (2/12)$ $H_b = 5 \text{ in}$ $\therefore M_n = 46 (.1744) (3 - .1744) (5 + 5 (.1744))$ $= 133 \text{ K-in}$ $= 11.1 \text{ K-ft}, \phi = 1.00$ <p>$\phi M_n = 11.1 \text{ K-ft}$</p>	

References	System: FRAME ANALYSIS	Comments
	<p><u>FRAME SUMMARY</u></p> <p>COLUMN:</p> <p>FLEXURE: 7.69 K-ft</p> <p>COMPRESSION: 63.3 K</p> <p>SHEAR: 23 K</p> <p>SLENDER RATIO: < 200</p> <p>BEAM:</p> <p>FLEXURE: 16.24 K-ft</p> <p>SHEAR: 19.5 K</p> <p>DEFLECTION: .4"</p> <p>CONNECTION</p> <p>WELD 65.25</p> <p>MOM CONN 11.1 K-ft</p> <p><u>BASE PLATE</u></p> <p>R_{ba}</p>  <p>$N + B = 8"$ (From Modular House)</p> $\therefore m = \frac{8" - 0.8(3")}{2} = 2.8"$ <ul style="list-style-type: none"> • PLATE THICKNESS → $\frac{1}{2}"$ • ANCHOR ROD HOLES → $\frac{3}{8}"$ DIA <p>• PLATE CAPACITY</p> <p>SHEAR YIELDING</p> $R_n = 0.60 F_y A_{gv}$ $F_y = 36 \text{ ksi}$ $A_{gv} = \frac{1}{2}" (8") = 4 \text{ in}^2$ $\phi R_n = 0.6 (36 \text{ ksi}) (4 \text{ in}^2)$ $= 86.4 \text{ K}$	
14-2		
34-3		

References	System: FRAME ANALYSIS	Comments
AISC STEEL TABLE D3.2	<p><u>BASE PLATE CONT.</u></p> <ul style="list-style-type: none"> ANCHOR BOLT CAPACITY ASSUMING A307 → TENSILE 45 ksi → SHEAR 27 ksi $A = \frac{\pi}{4}(d^2) = .7854 \text{ in}^2$ $TEN = 35.3 \text{ k}$ $SHEAR = 21.2 \text{ k}$ PLATE FLEXURAL CAP. $M_n = F_y Z$ $Z = \frac{bh^3}{4} = \frac{8 \cdot (\frac{1}{2})^3}{4} = .5 \text{ in}^3$ $= 36 \text{ ksi} \cdot (.5 \text{ in}^3)$ $= 18 \text{ k-in}$ $= 1.5 \text{ k-ft}$ $\phi M_n = 1.35 \text{ k-ft}$ BEARING STRENGTH ON CONC $P_p = 0.85 f_c' A_1$; ASSUME 4000 psi CONC $0.85(4000 \text{ psi})(8 \times 8 - 4 \times \frac{\pi}{4}(\frac{3}{8})^2)$ $= 216.1 \text{ k}$ <u>BASE PLATE SUMMARY</u> PLATE THICKNESS: $\frac{1}{2}$" BOLT ϕ: $\frac{3}{8}$" PLATE SHEAR CAPACITY = 86.4 k FLEXURAL CAPACITY = 1.35 k-ft BOLT TENSILE: 35.3 k SHEAR: 21.2 k 	
J8-1		

FRAME ON GRID ①

*Modeled w/ Rigid Diaphragm

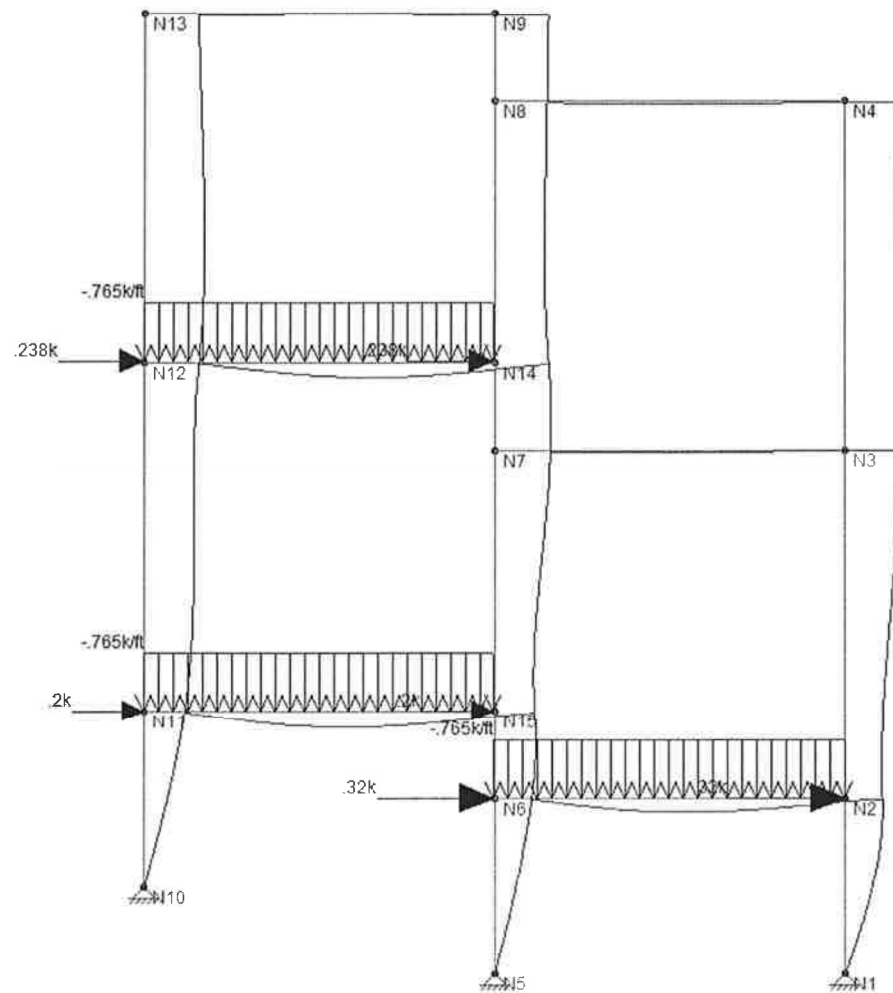


	M_{max}
BM.	4.9 k-ft
COL.	3.7 k-ft

MOMENT

Note: $\phi M_n = 7.69 \text{ k-ft}$ TS3x3 COL

$\phi M_n = 16.24 \text{ k-ft}$ TS5x3 BMS

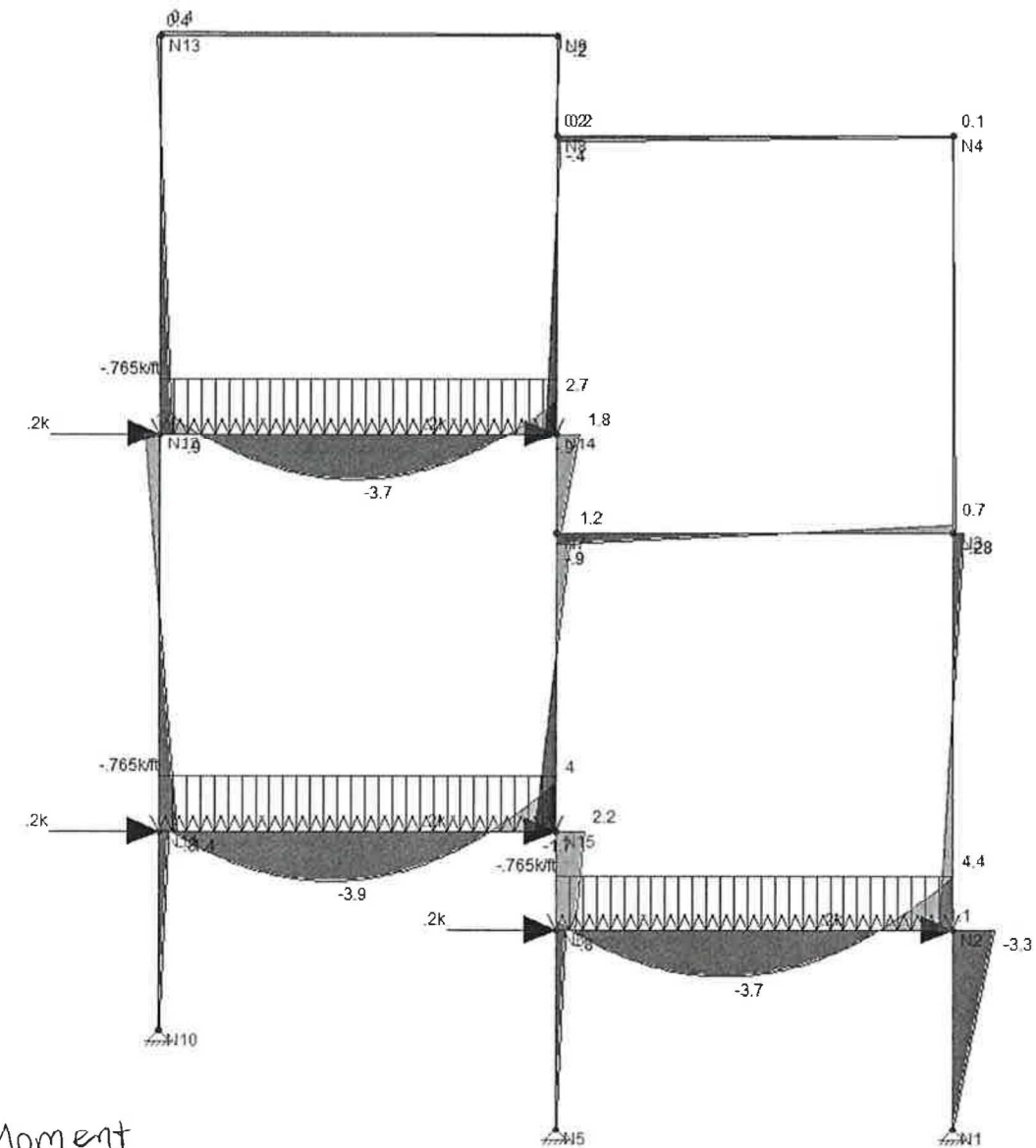


Deflection

Joint Deflections			
	L	Joint Label	X [in]
1	1	N1	0
2	1	N2	.502
3	1	N3	.757
4	1	N4	.712
5	1	N5	0
6	1	N6	.503
7	1	N7	.757
8	1	N8	.712
9	1	N9	.732
10	1	N10	0
11	1	N11	.545
12	1	N12	.738
13	1	N13	.733
14	1	N14	.738
15	1	N15	.546

Max Story Drift: .546"

FRAME ON GRID ①
* Modelled w/ Flexible Diaphragm

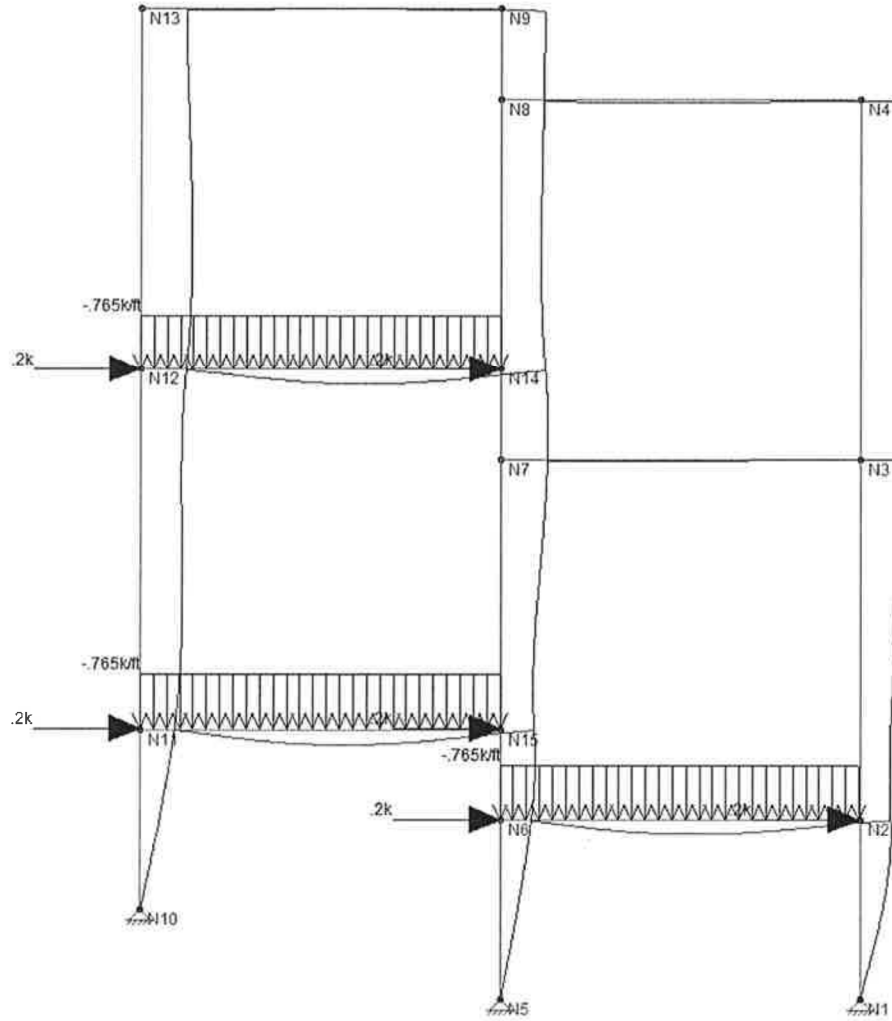


Moment

Note: $\phi M_n \text{ COL} = 7.69 \text{ k-ft}$

$\phi M_n \text{ BEAM} = 16.23 \text{ k-ft}$

	M_{max}
B11	4.4 k-ft
Col	3.3 k-ft

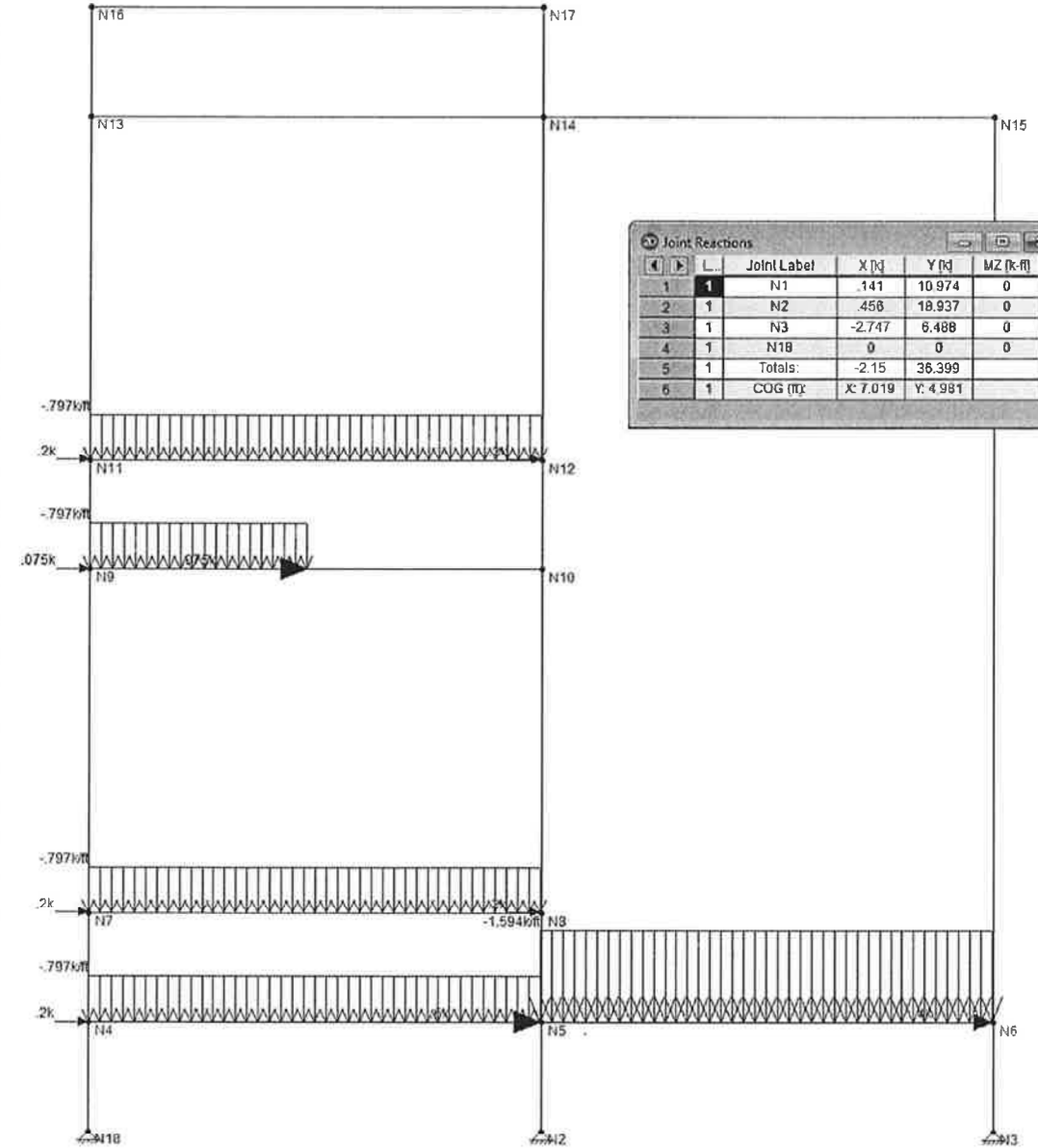


Deflection

L	Joint Label	X [in]
1	N1	0
2	N2	.412
3	N3	.626
4	N4	.574
5	N5	0
6	N6	.413
7	N7	.626
8	N8	.574
9	N9	.594
10	N10	0
11	N11	.452
12	N12	.602
13	N13	.595
14	N14	.601
15	N15	.453

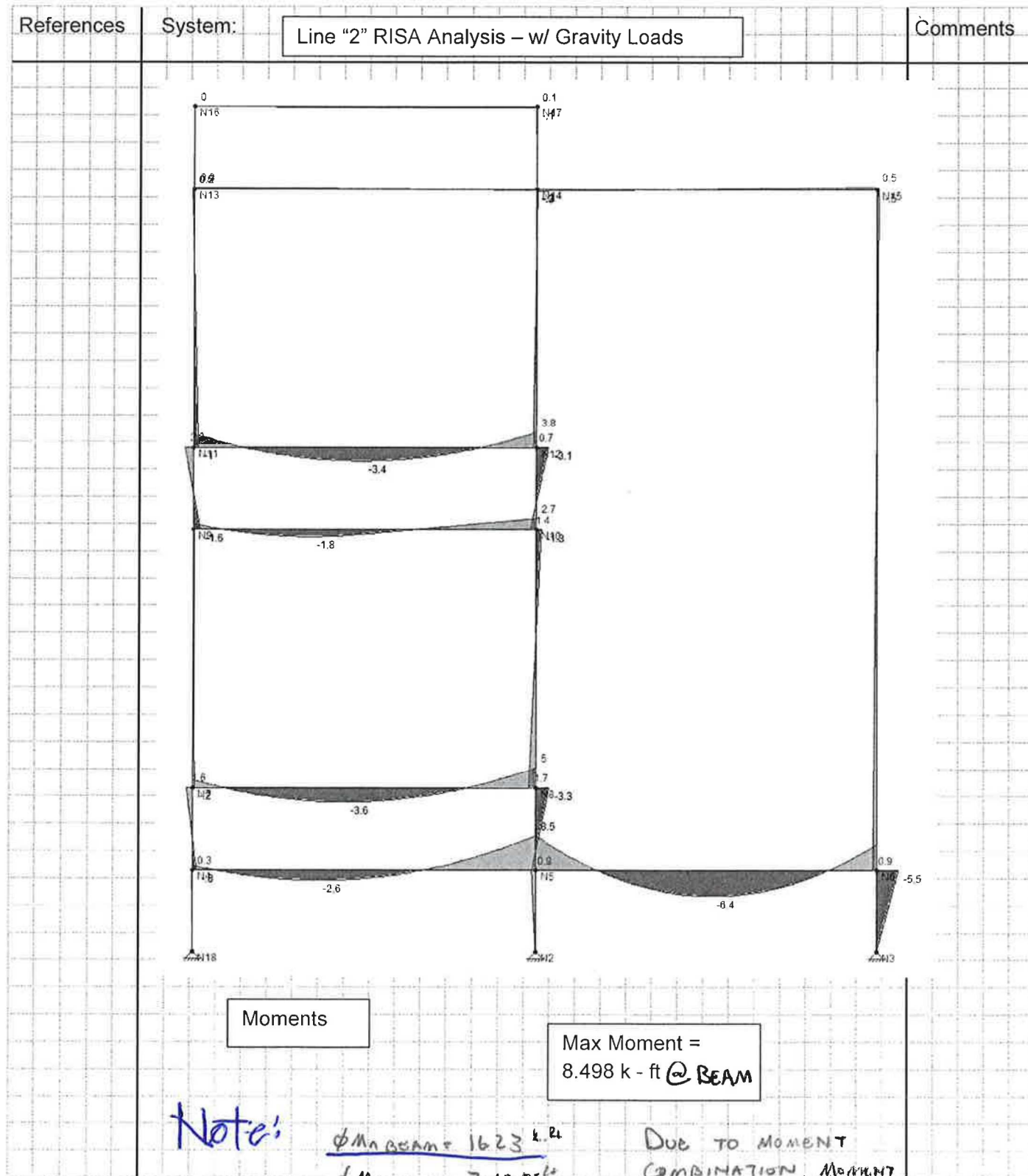
Max Story Drift: .453"

References	System:	Comments
	Line "2" RISA Analysis - w/ Gravity Loads	

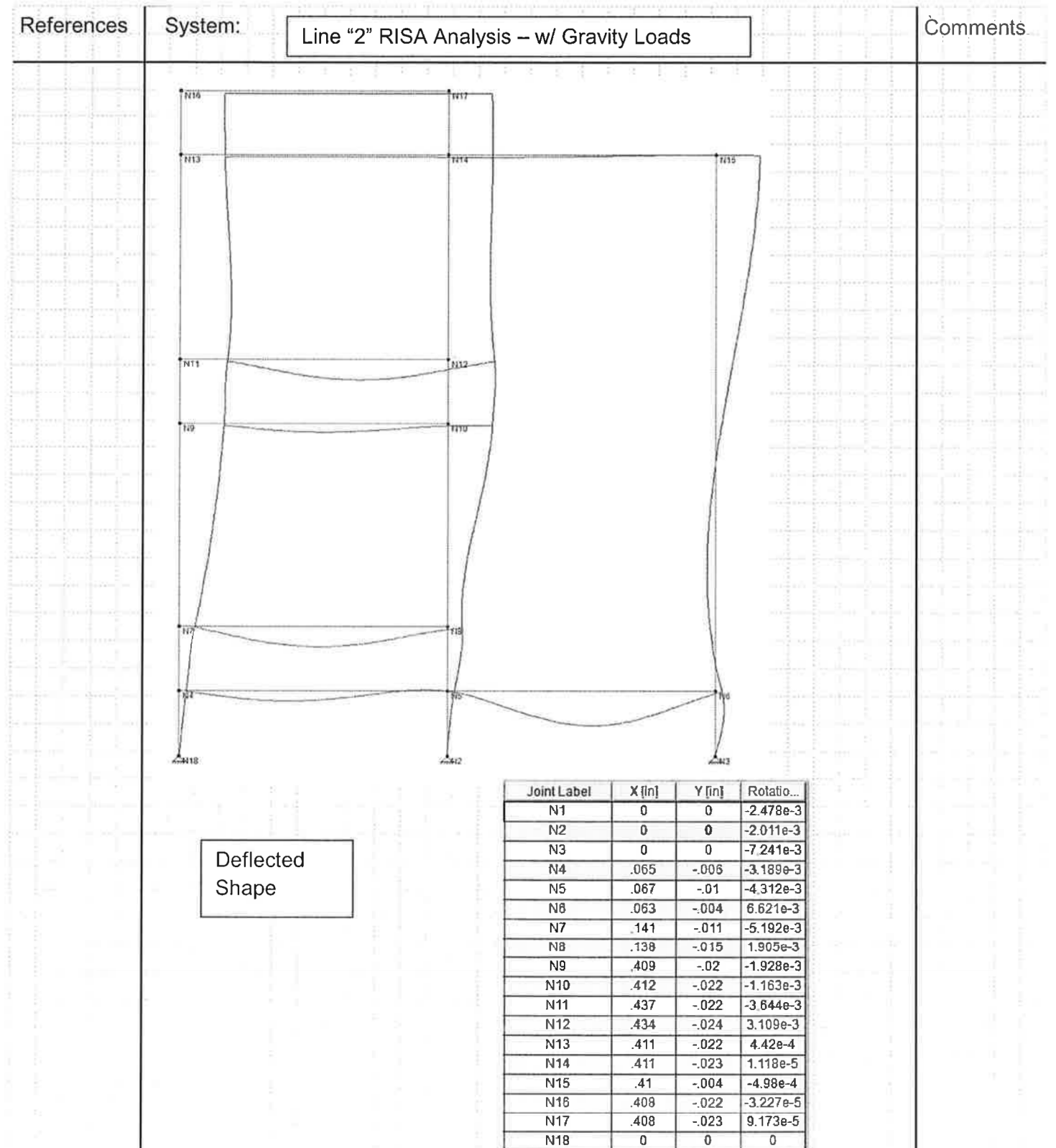


L	Joint Label	X [k]	Y [k]	MZ [k-ft]
1	N1	.141	10.974	0
2	N2	.456	18.937	0
3	N3	-2.747	6.488	0
4	N18	0	0	0
5	Totals:	-2.15	36.399	
6	COG (ft):	X: 7.019	Y: 4.981	

Loads and Reactions



RISA Gravity Analysis 6

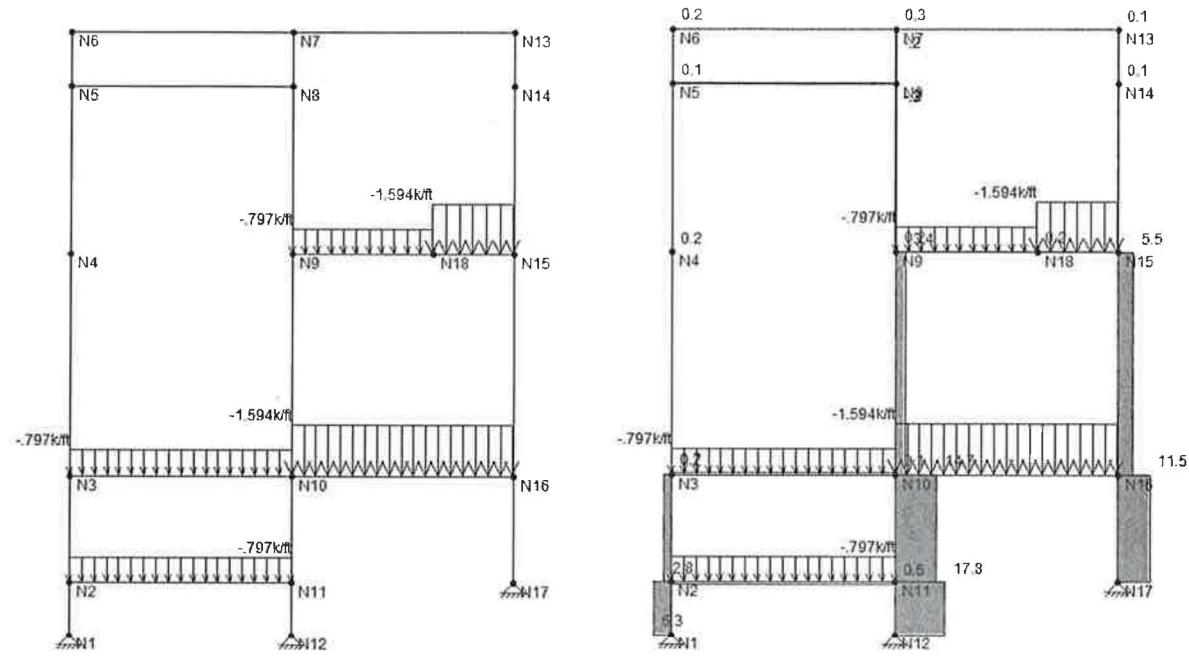


RISA Gravity Analysis 7

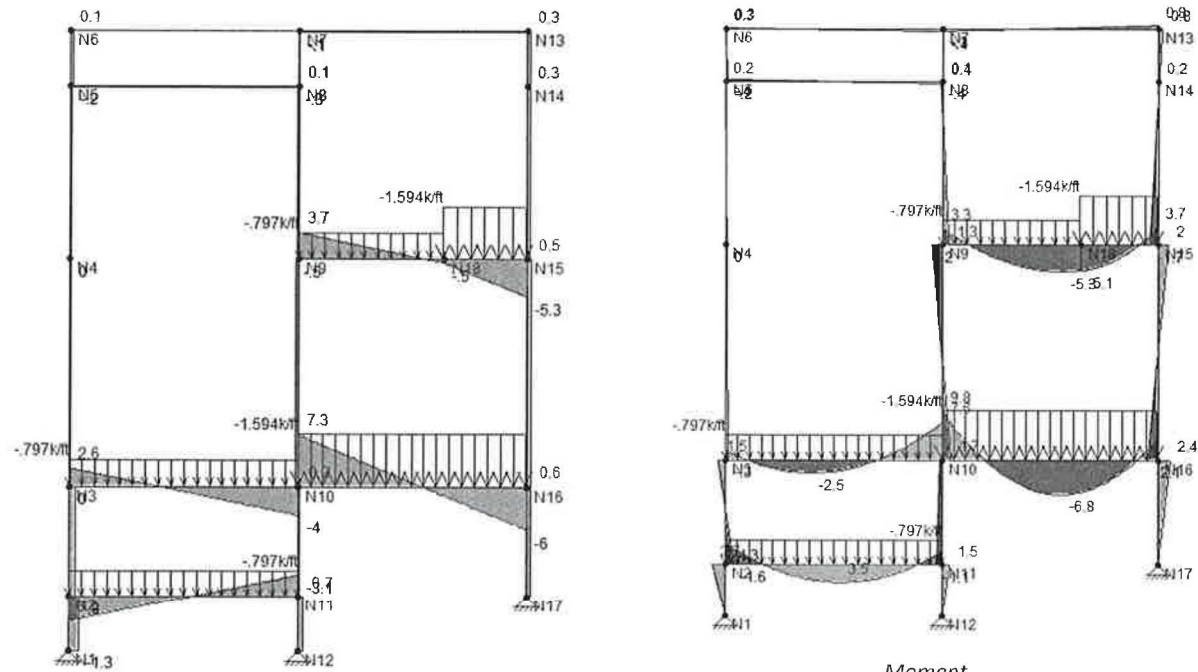
Building 21- 122E. Cal Poly
San Luis Obispo, California 93410

BY: _____ SHEET No. **19 of 81**
(IBC 2012)

Gridline 3 – Gravity



Axial



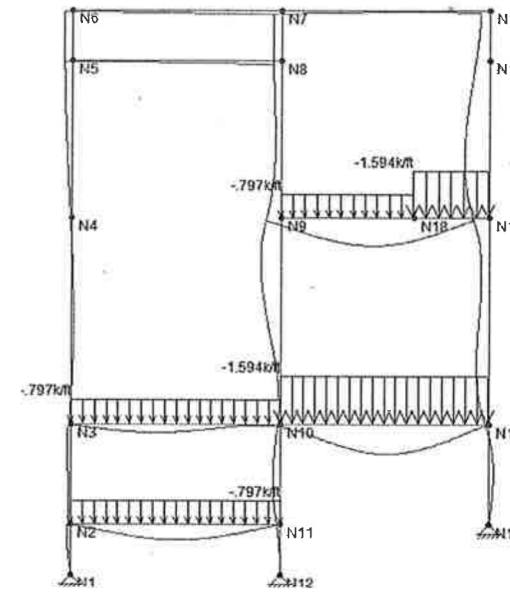
Shear

Moment

Note: $\phi M_n_{col} = 7.69 \text{ k-ft}$
 $\phi M_n_{beam} = 16.23 \text{ k-ft}$

Building 21- 122E. Cal Poly
San Luis Obispo, California 93410

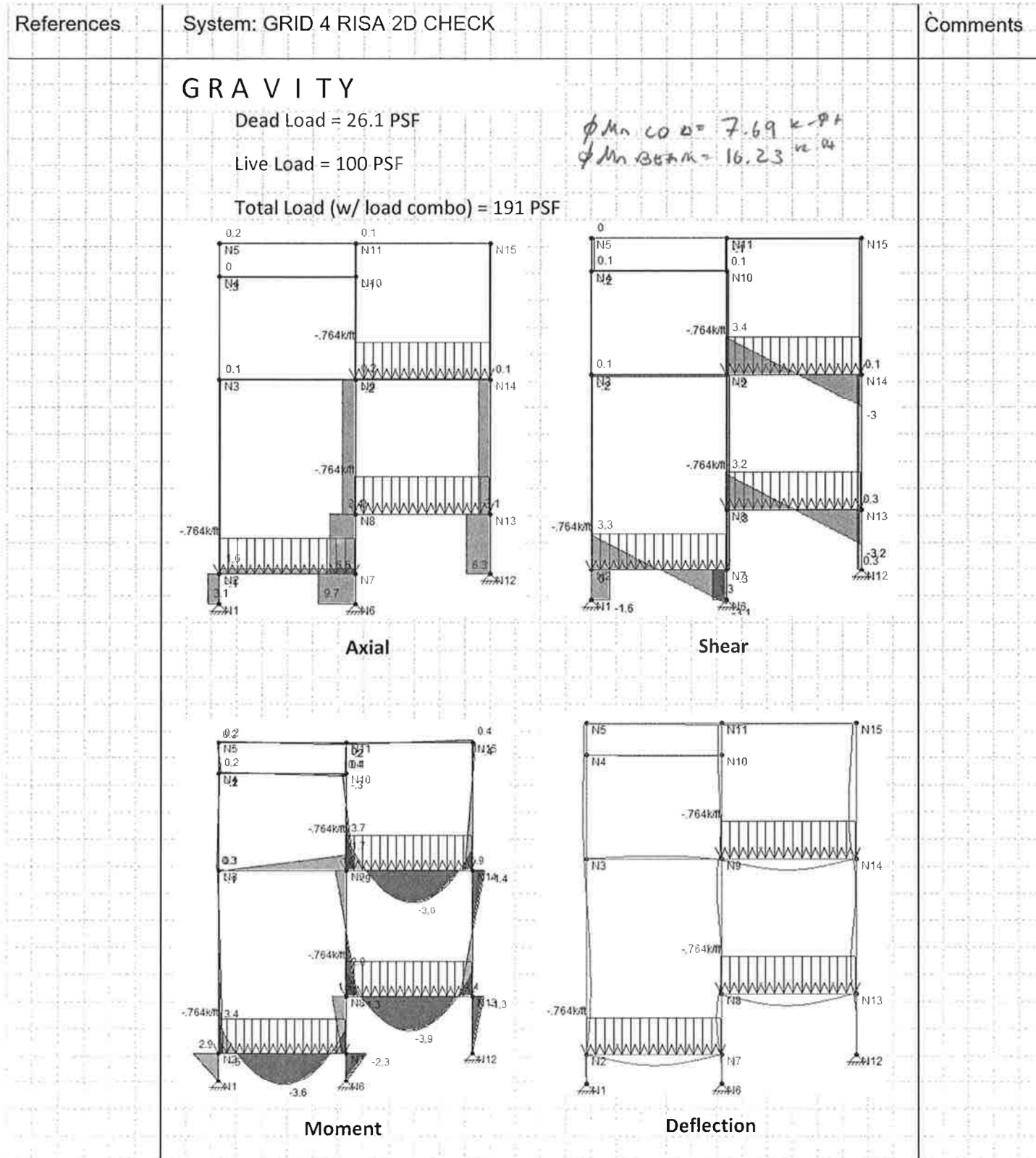
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(IBC 2012)



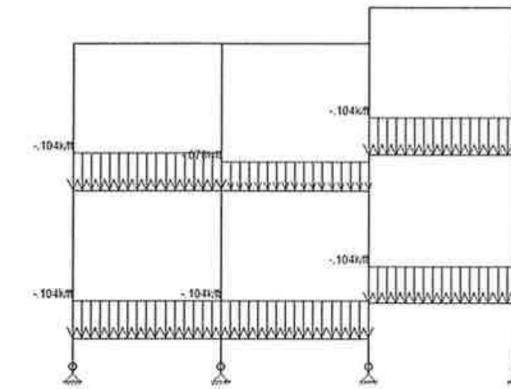
Deflected Shape

Joint Deflections					
		Joint Label	X [in]	Y [in]	Rotatio...
1	1	N1	0	0	3.96e-3
2	1	N2	-0.44	-0.03	-2.835e-3
3	1	N3	-0.39	-0.07	-2.74e-3
4	1	N4	-0.21	-0.07	1.314e-3
5	1	N5	-0.99	-0.07	1.083e-4
6	1	N6	-1.05	-0.07	-7.433e-5
7	1	N7	-1.05	-0.33	2.195e-4
8	1	N8	-0.99	-0.33	2.135e-4
9	1	N9	-1.86	-0.34	-6.903e-3
10	1	N10	-0.4	-0.26	-3.486e-3
11	1	N11	-0.45	-0.1	4.419e-3
12	1	N12	0	0	7.062e-4
13	1	N13	-1.06	-0.25	-1.184e-3
14	1	N14	-1.7	-0.25	-3.623e-3
15	1	N15	-1.87	-0.25	8.195e-3
16	1	N16	-0.4	-0.13	9.12e-3
17	1	N17	0	0	-3.209e-3
18	1	N18	-1.86	-3.08	3.977e-3

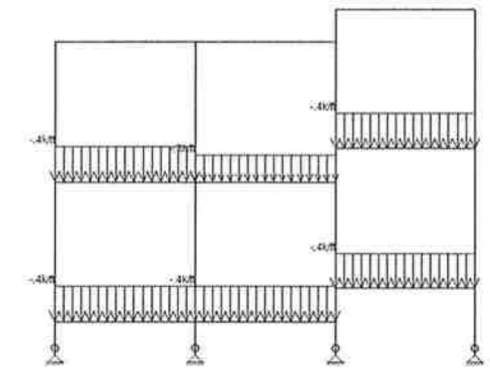
Gridline A - Gravity



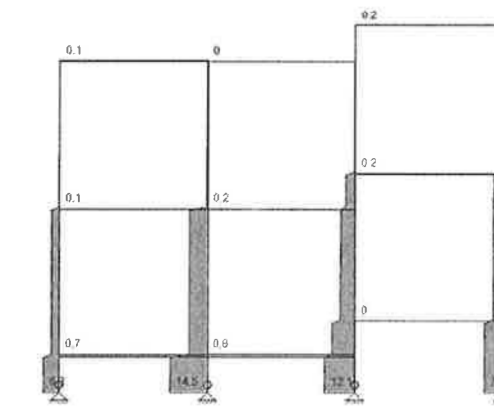
RISA Gravity Analysis 10



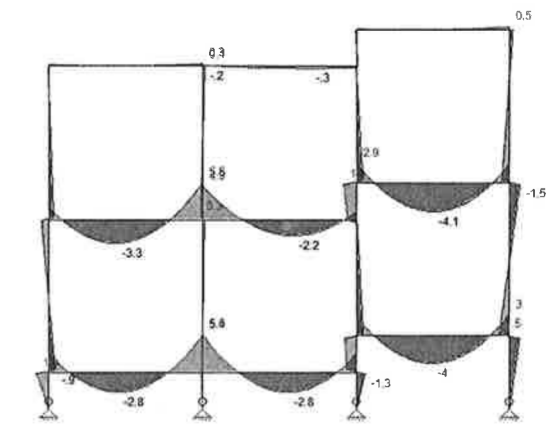
Dead Loading



Live Loading

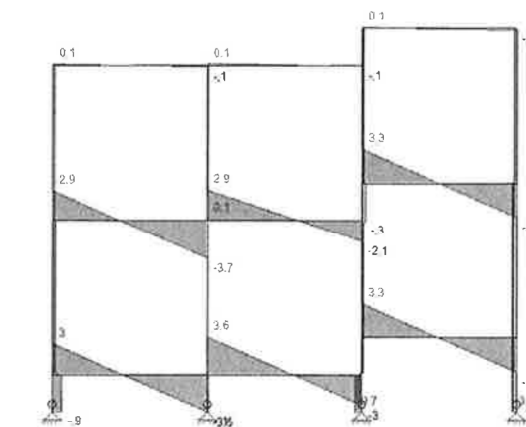


Axial



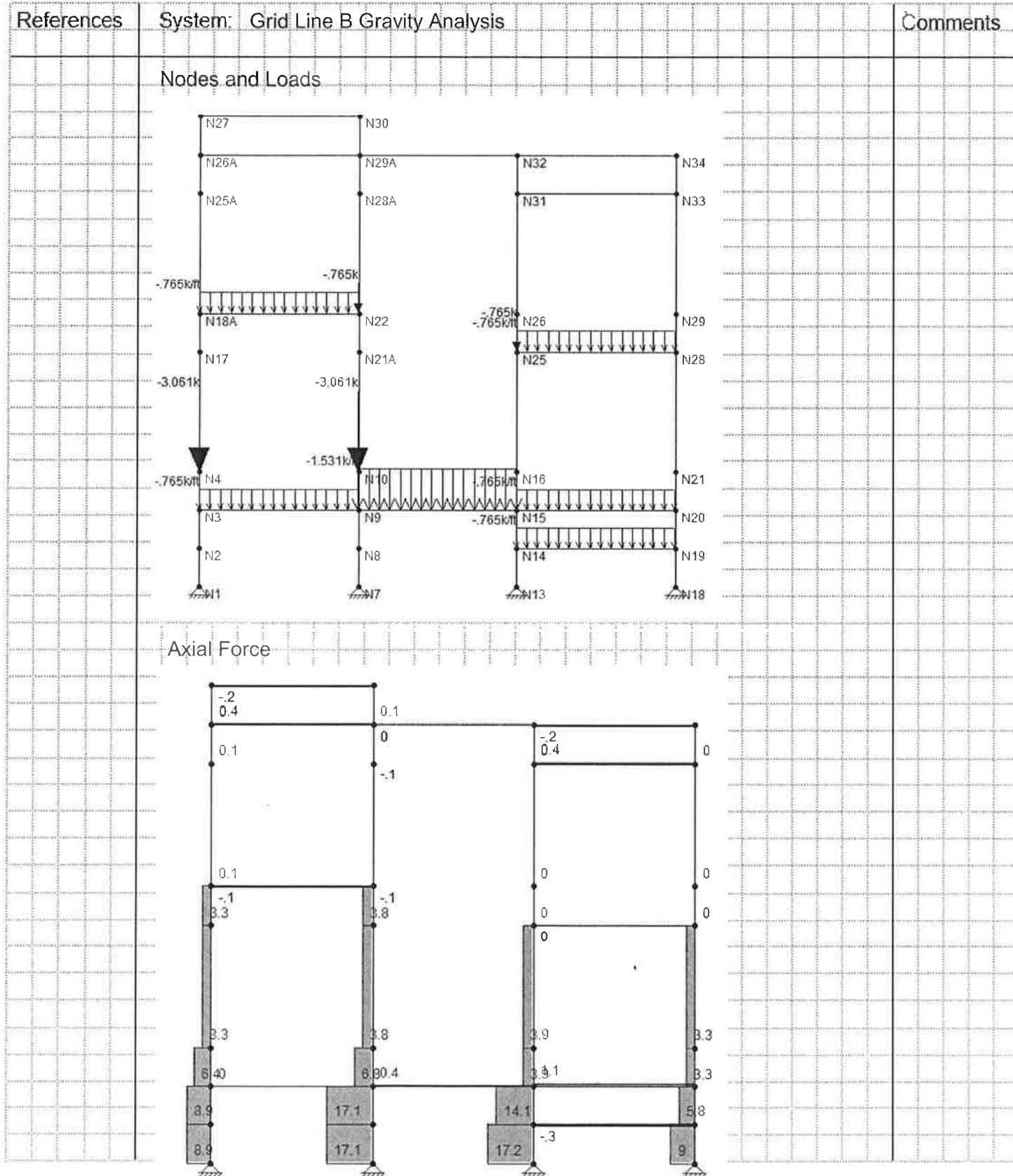
Moment

$\phi M_n \text{ BEAM} = 16.23 \text{ k-ft}$
 $\phi M_n \text{ COL} = 7.69 \text{ k-ft}$

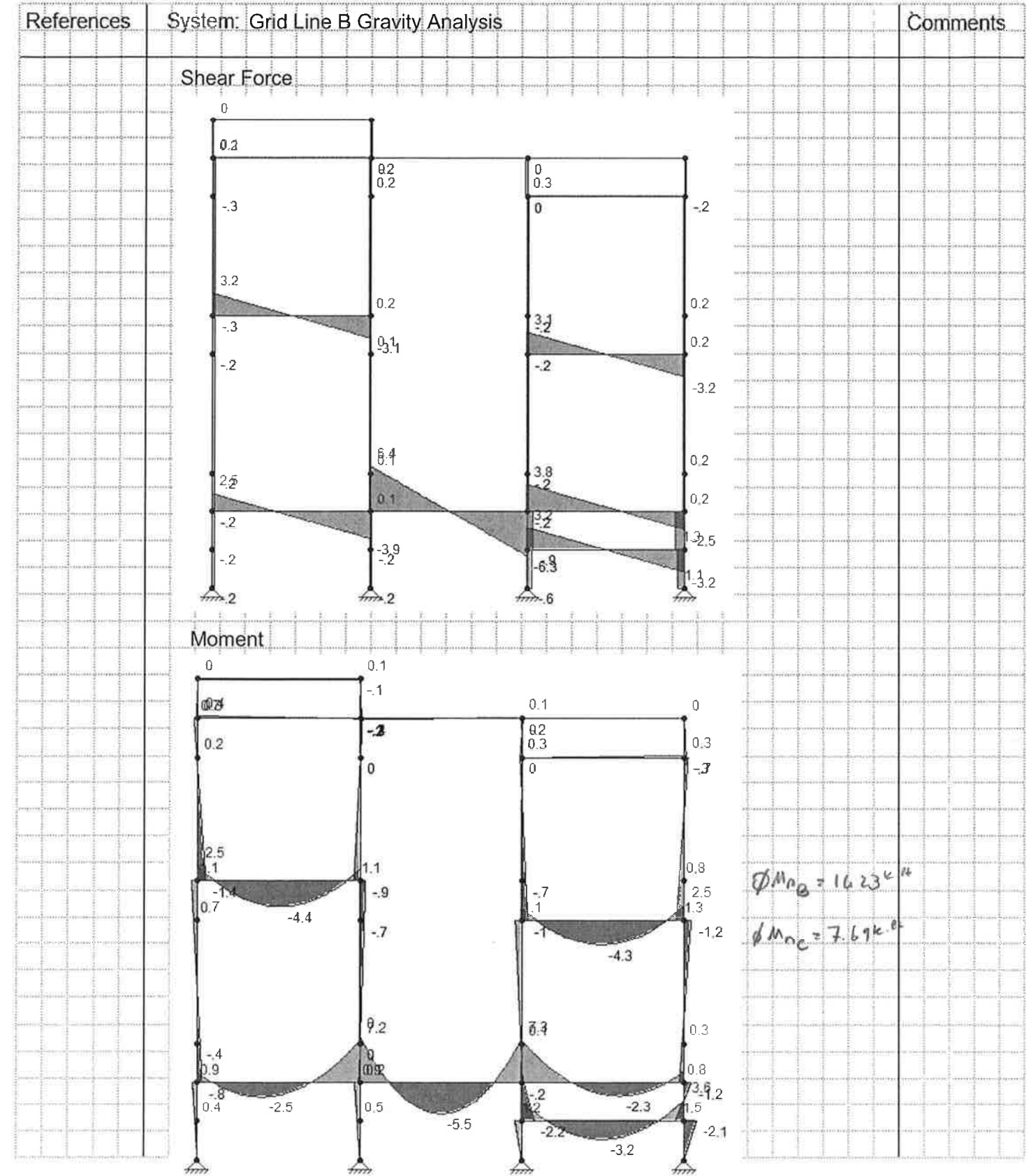


Shear

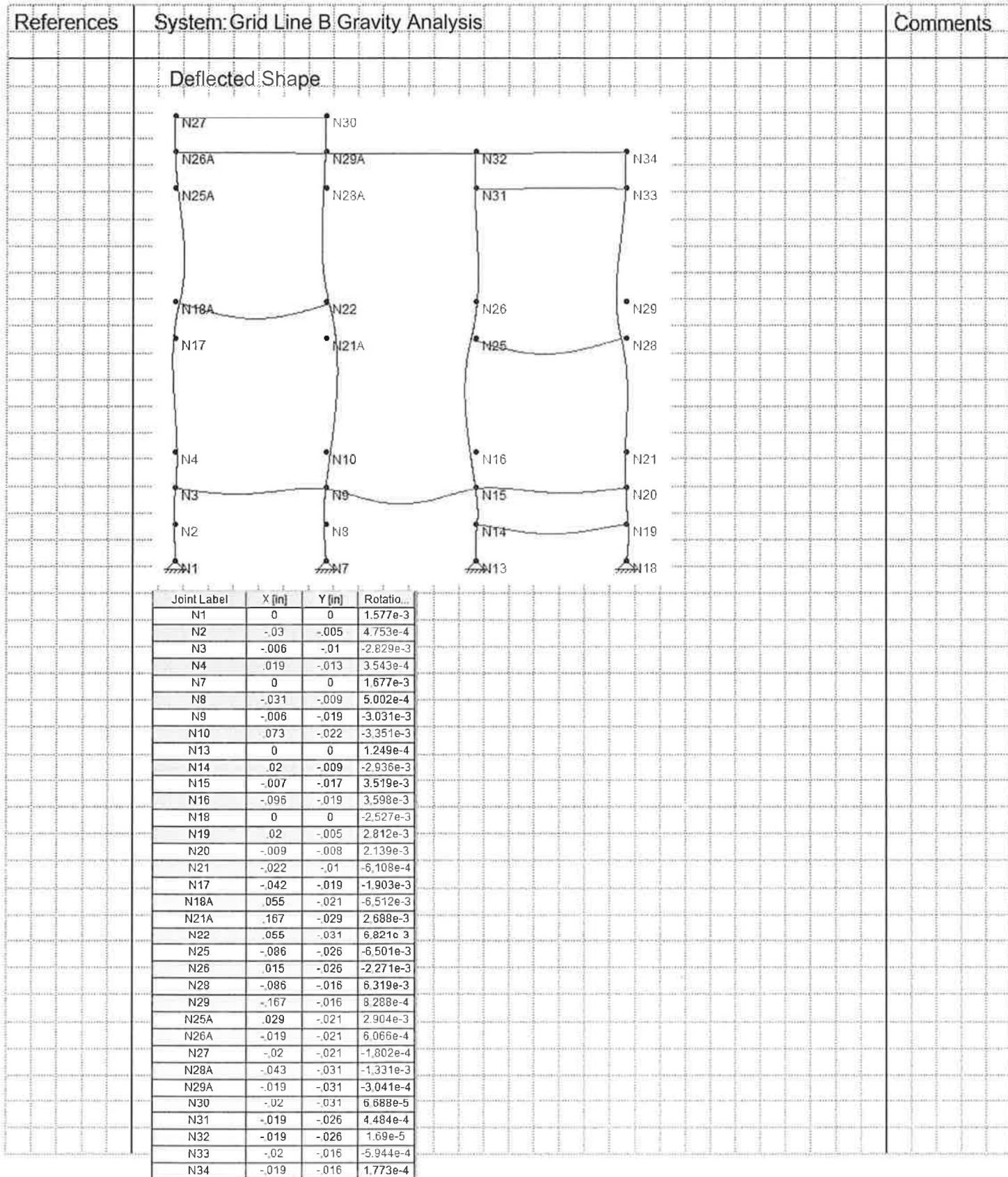
RISA Gravity Analysis 11



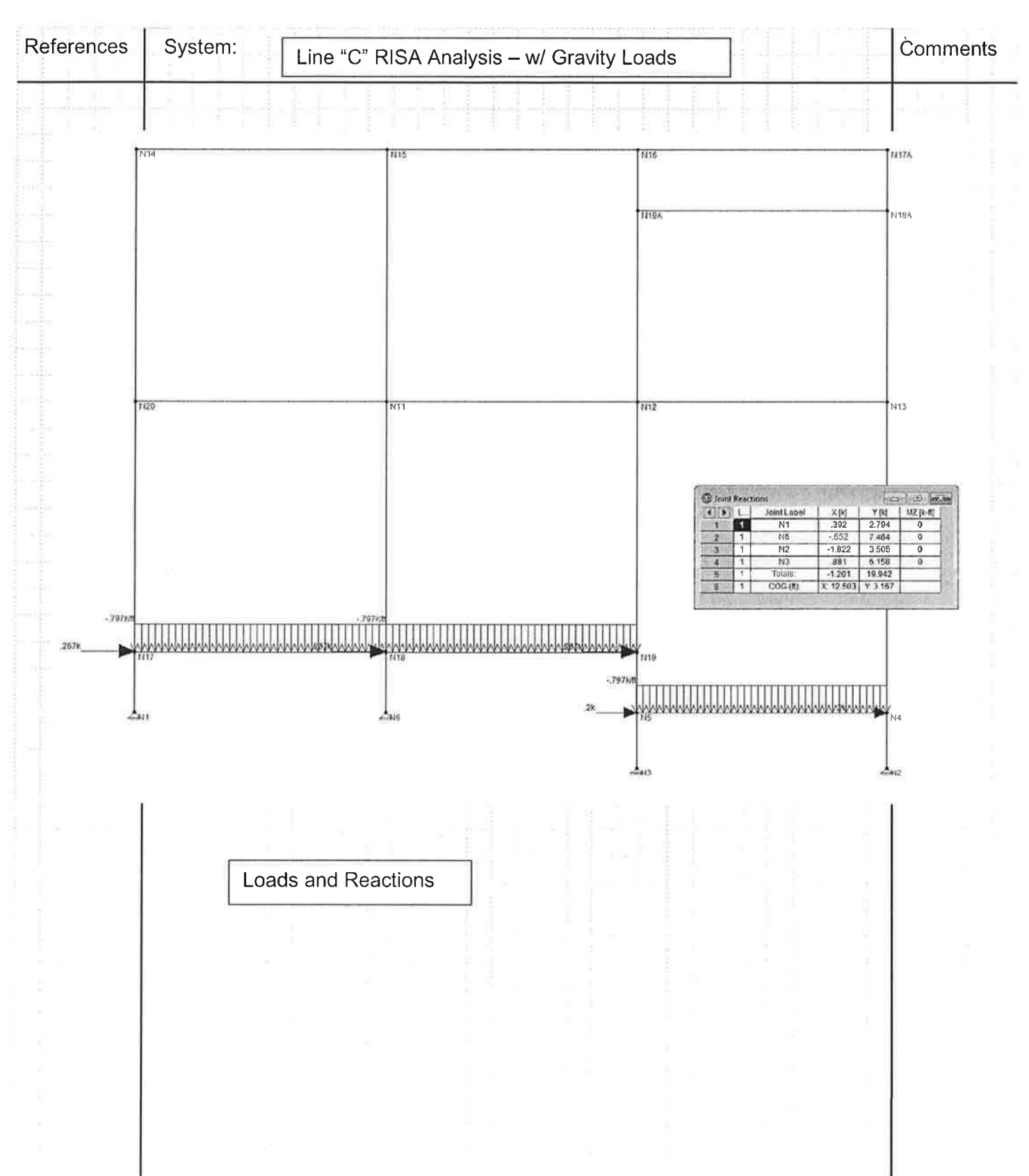
RISA Gravity Analysis 12



RISA Gravity Analysis 13

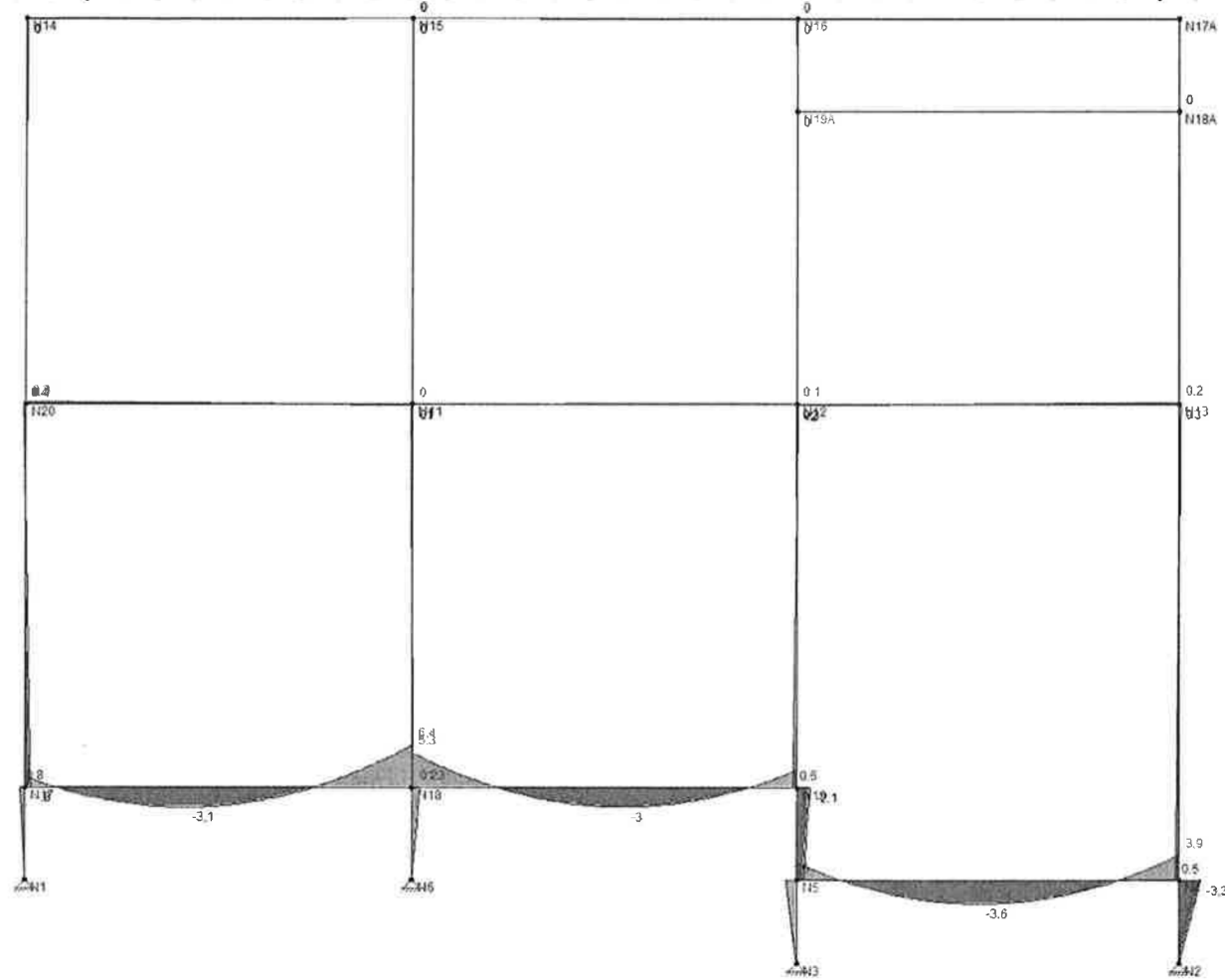


RISA Gravity Analysis 14



RISA Gravity Analysis 15

References	System: Line "C" RISA Analysis - w/ Gravity Loads	Comments
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Moments

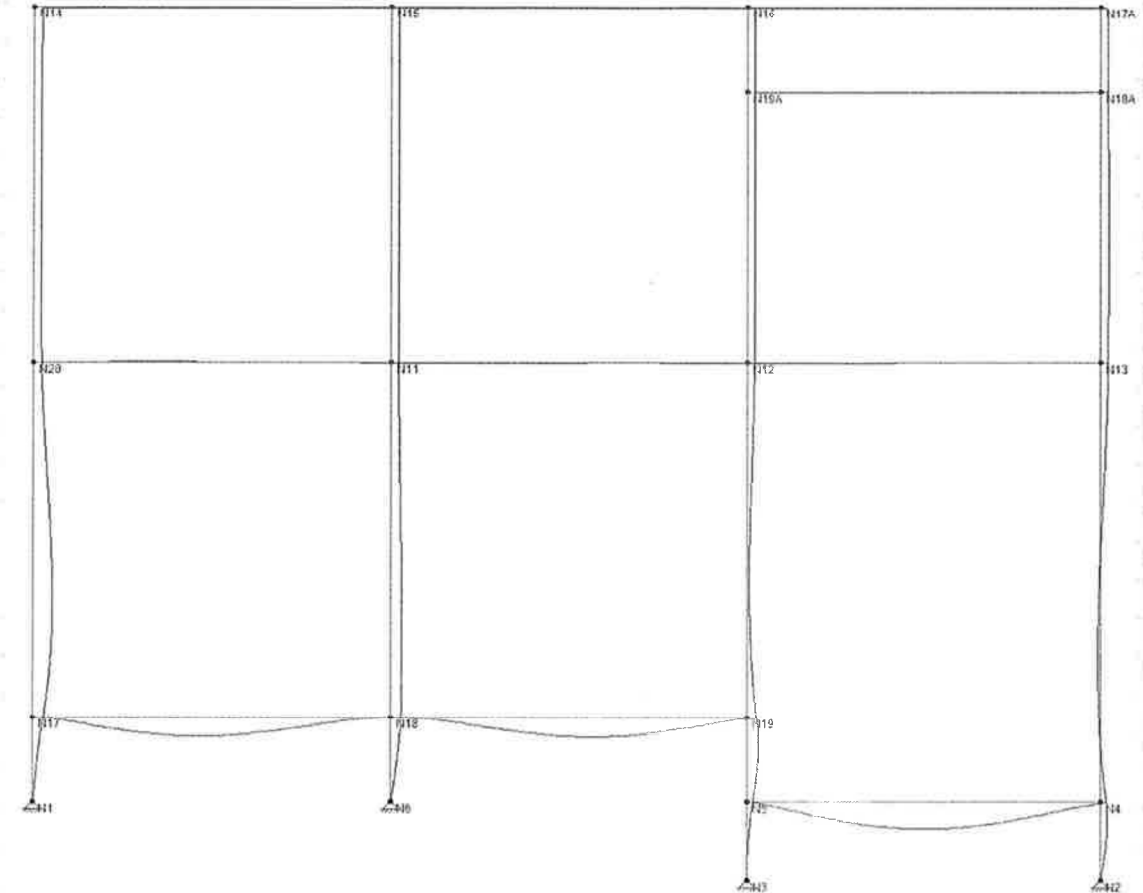
Max Moment =
6.42 k - ft

$$\phi M_{nD} = 16.23 \text{ k-ft}$$

$$\phi M_{nC} = 7.69 \text{ k-ft}$$

RISA Gravity Analysis 16

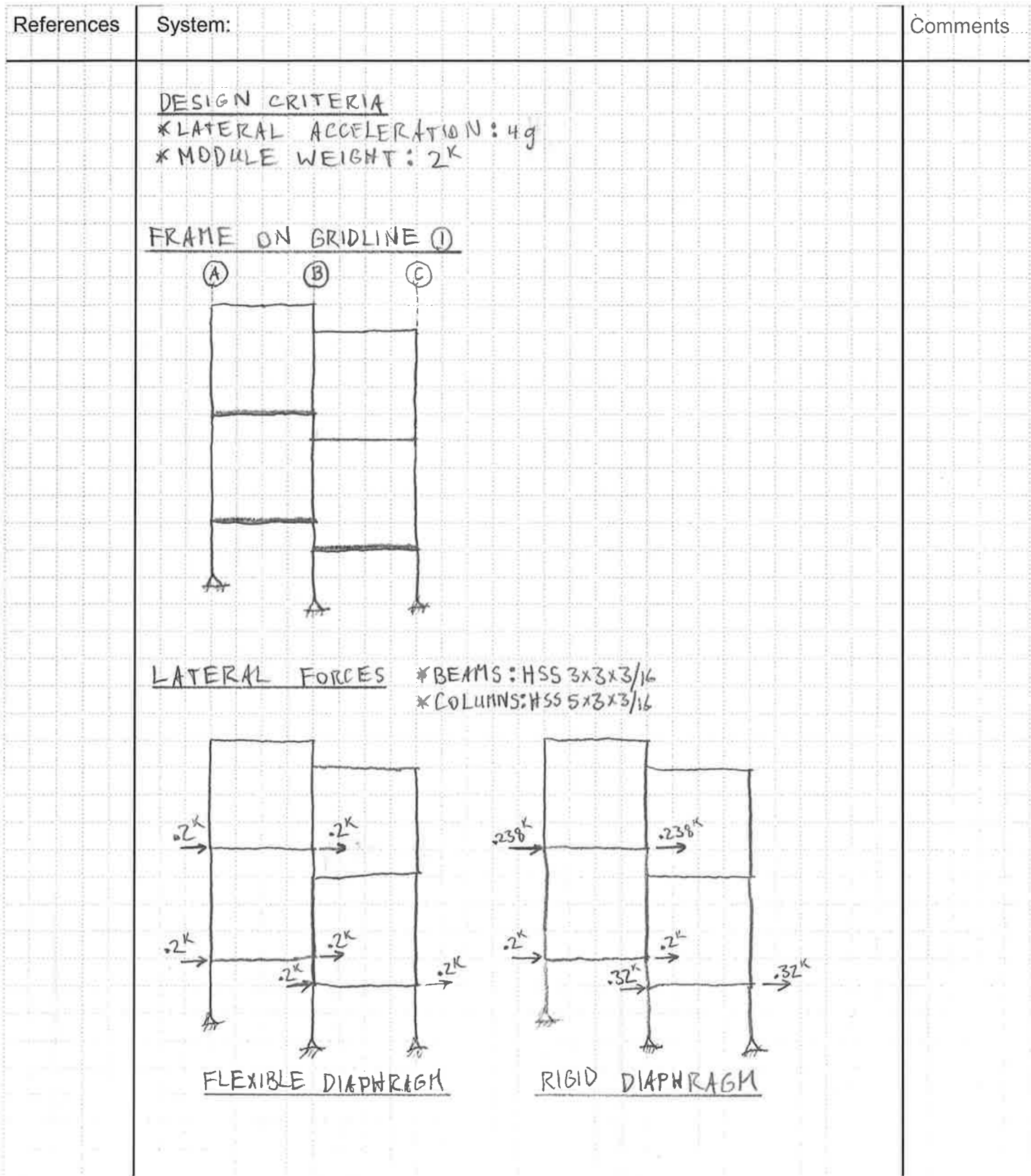
References	System: Line "C" RISA Analysis - w/ Gravity Loads	Comments
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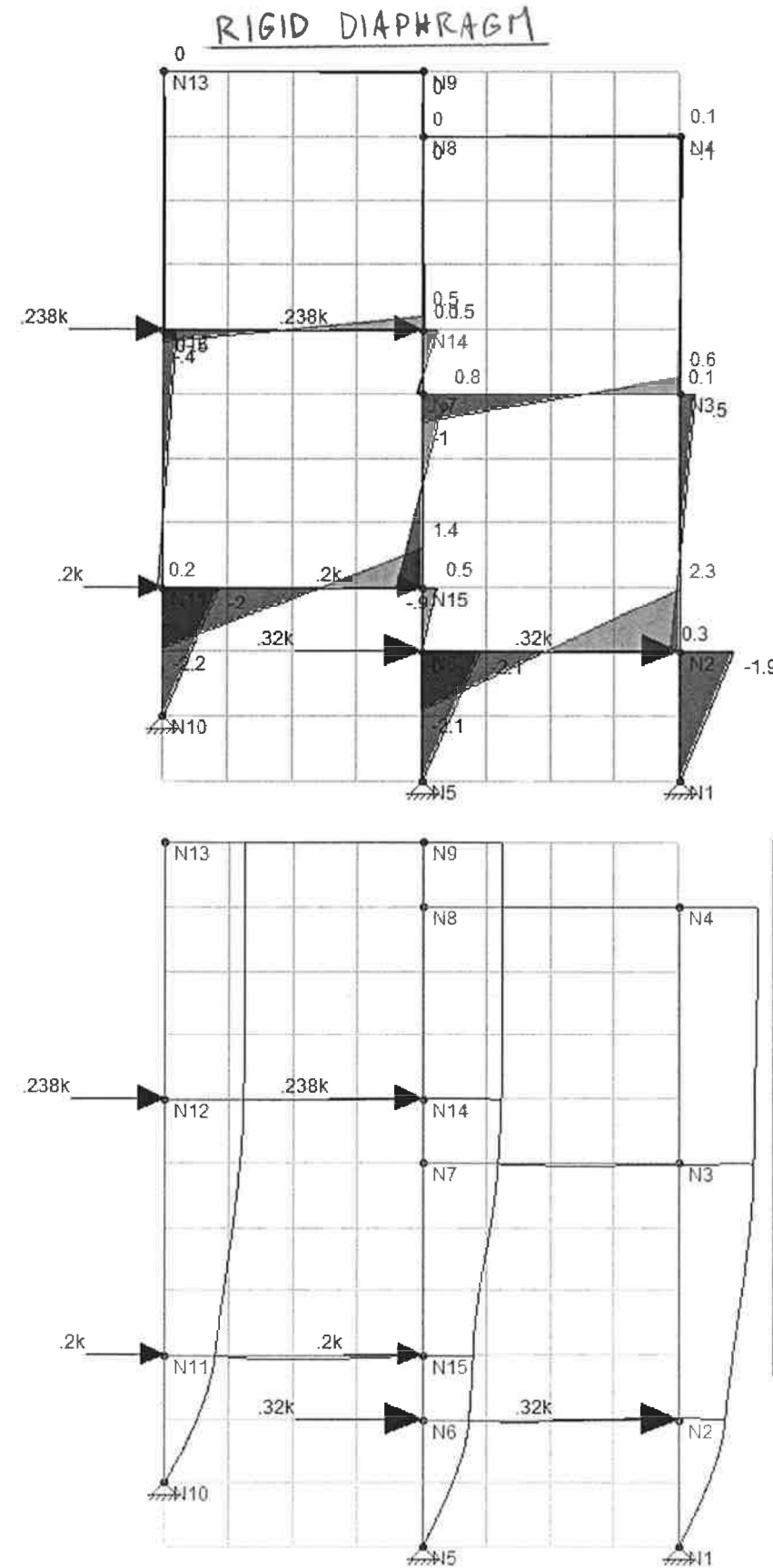
Deflected
Shape

Joint Label	X [in]	Y [in]	Rotatio...
N1	0	0	-2.342e-3
N2	0	0	-4.29e-3
N3	0	0	-8.598e-4
N4	.042	-.002	3.432e-3
N5	.044	-.003	-4.595e-3
N6	0	0	-3.957e-3
N17	.071	-.002	-4.318e-3
N18	.07	-.004	-6.662e-4
N19	.07	-.005	3.362e-3
N20	.056	-.002	4.275e-4
N11	.055	-.004	-1.7e-5
N12	.055	-.005	-1.068e-4
N13	.055	-.002	-2.221e-4
N14	.055	-.002	-7.05e-5
N15	.055	-.004	-8.569e-6
N16	.055	-.005	1.977e-5
N17A	.055	-.002	3.549e-5
N18A	.056	-.002	4.114e-5
N19A	.056	-.005	3.438e-5

RISA Gravity Analysis 17



RISA Analysis - Lateral 1



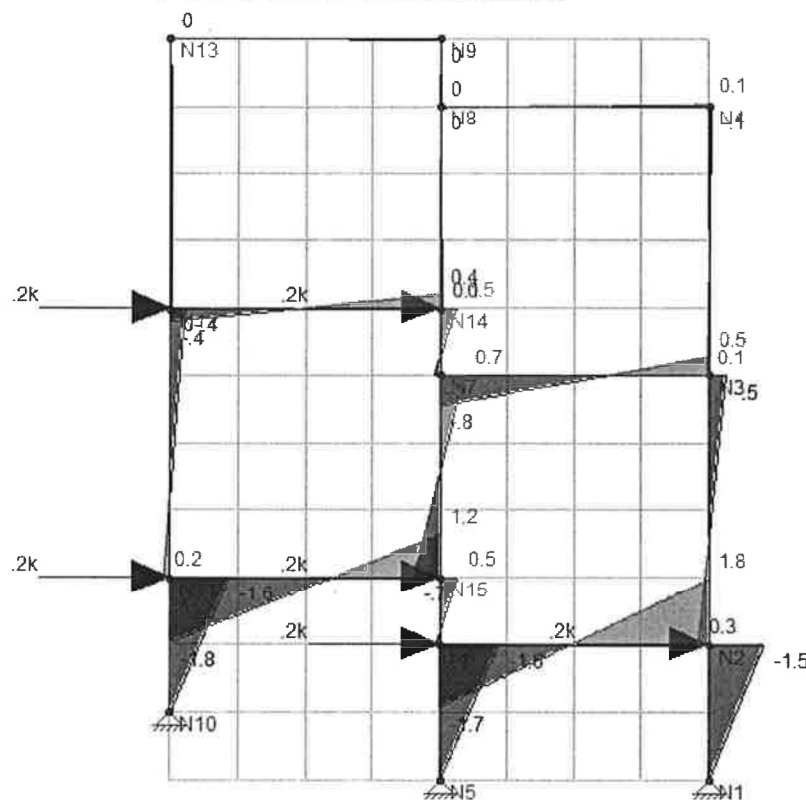
	M_{Max}
BM.	2.3 K-ft
COL.	2.2 K-ft

L	Joint Label	X [in]
1	N1	0
2	N2	.433
3	N3	.702
4	N4	.744
5	N5	0
6	N6	.433
7	N7	.702
8	N8	.744
9	N9	.744
10	N10	0
11	N11	.47
12	N12	.734
13	N13	.744
14	N14	.733
15	N15	.47

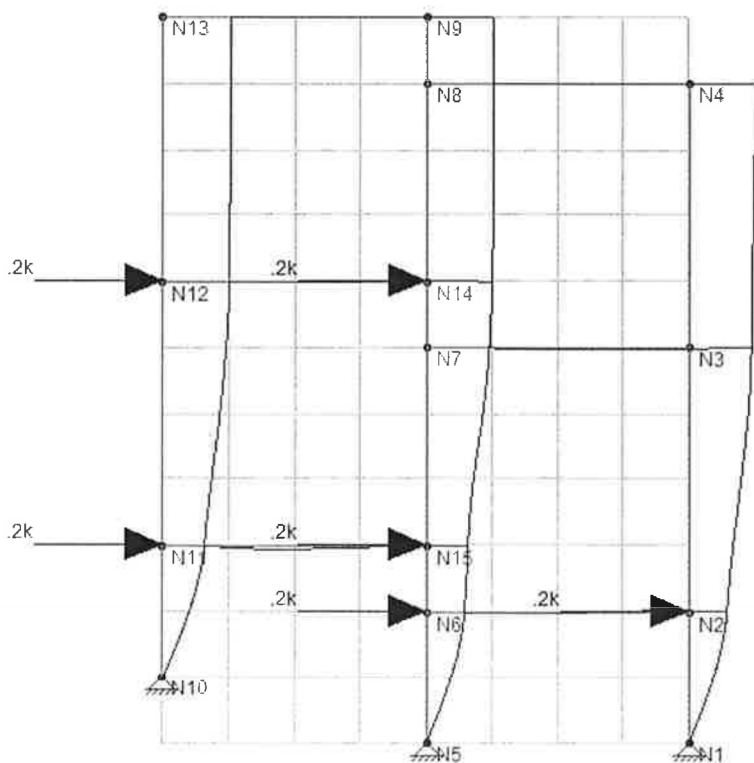
MAX STORY DRIFT: .47"
 * CONSERVATIVE, SINCE
 MODELED W/ A PIN @ BASE

RISA Analysis - Lateral 2

FLEXIBLE DIAPHRAGM



	M_{max}
BM.	1.8 k-ft
COL.	1.8 k-ft



L	Joint Label	X [in]
1	N1	0
2	N2	.343
3	N3	.571
4	N4	.606
5	N5	0
6	N6	.343
7	N7	.571
8	N8	.606
9	N9	.606
10	N10	0
11	N11	.377
12	N12	.597
13	N13	.606
14	N14	.597
15	N15	.377

MAX STORY DRIFT: .38"

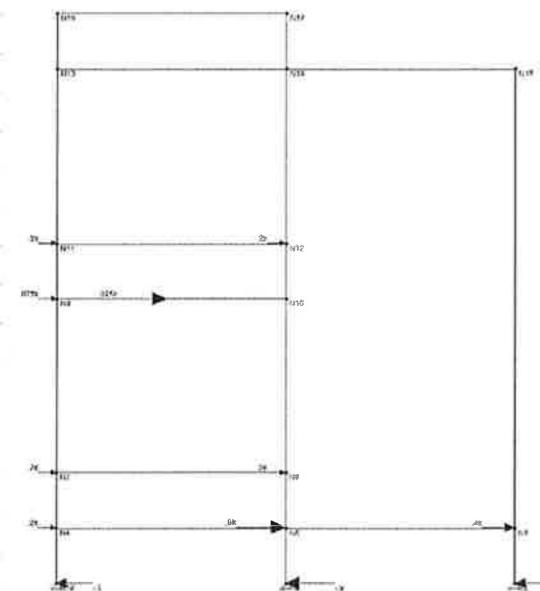
*CONSERVATIVE, SINCE MODELED
w/ A PIN @ BASE

References

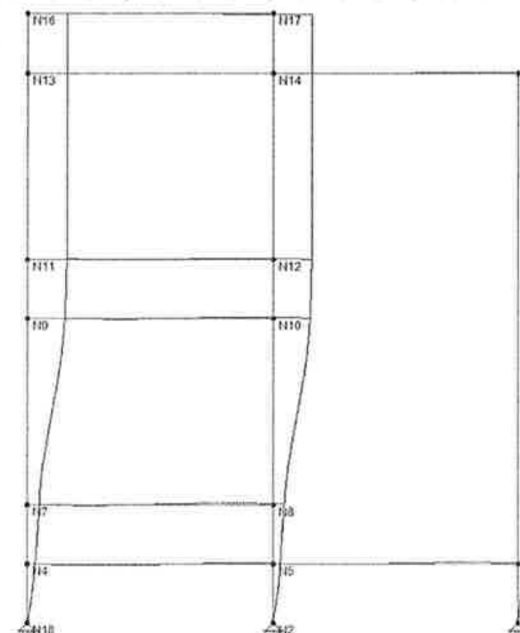
System:

Line "2" RISA Analysis - Tributary Area

Comments

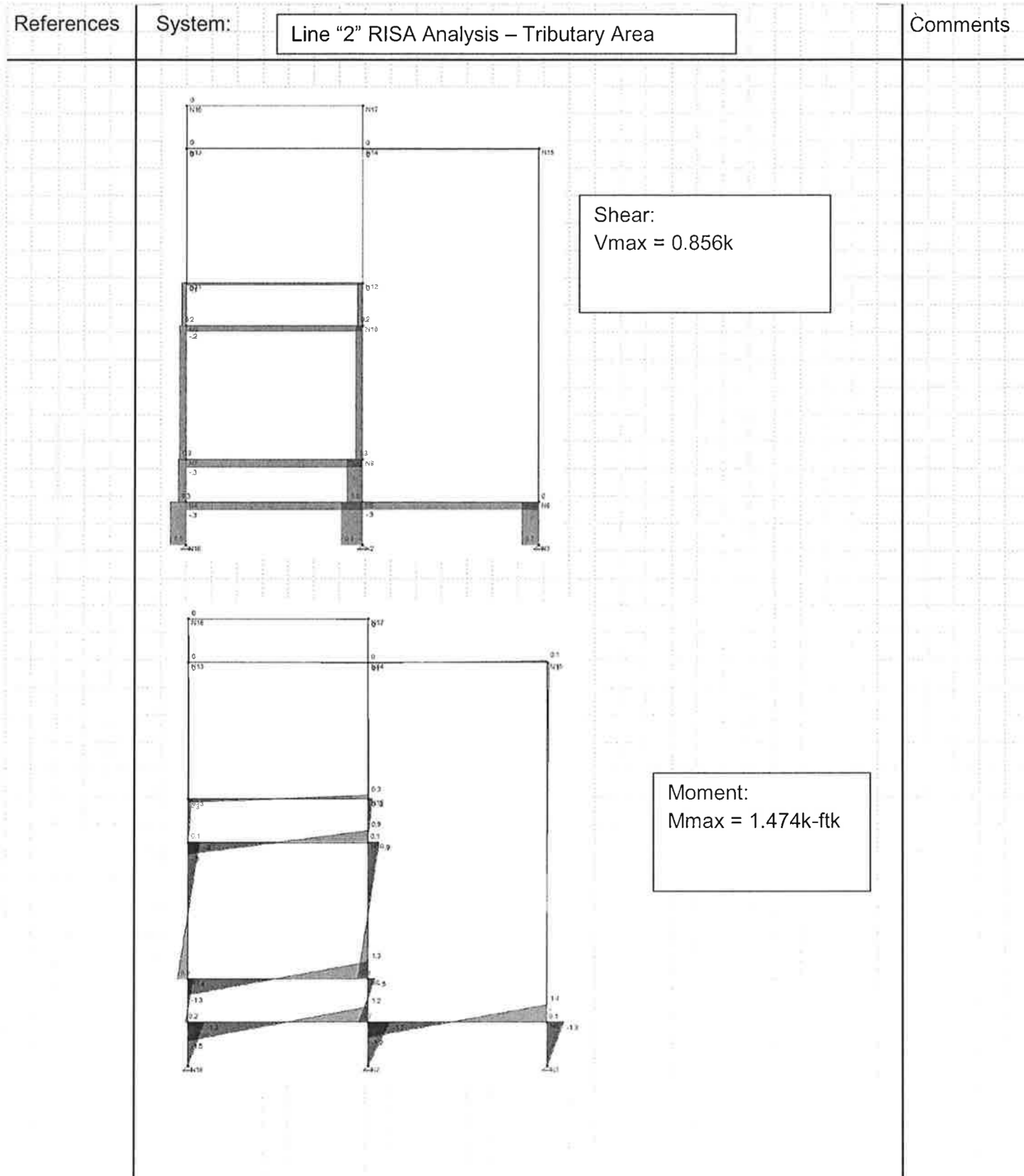


Model

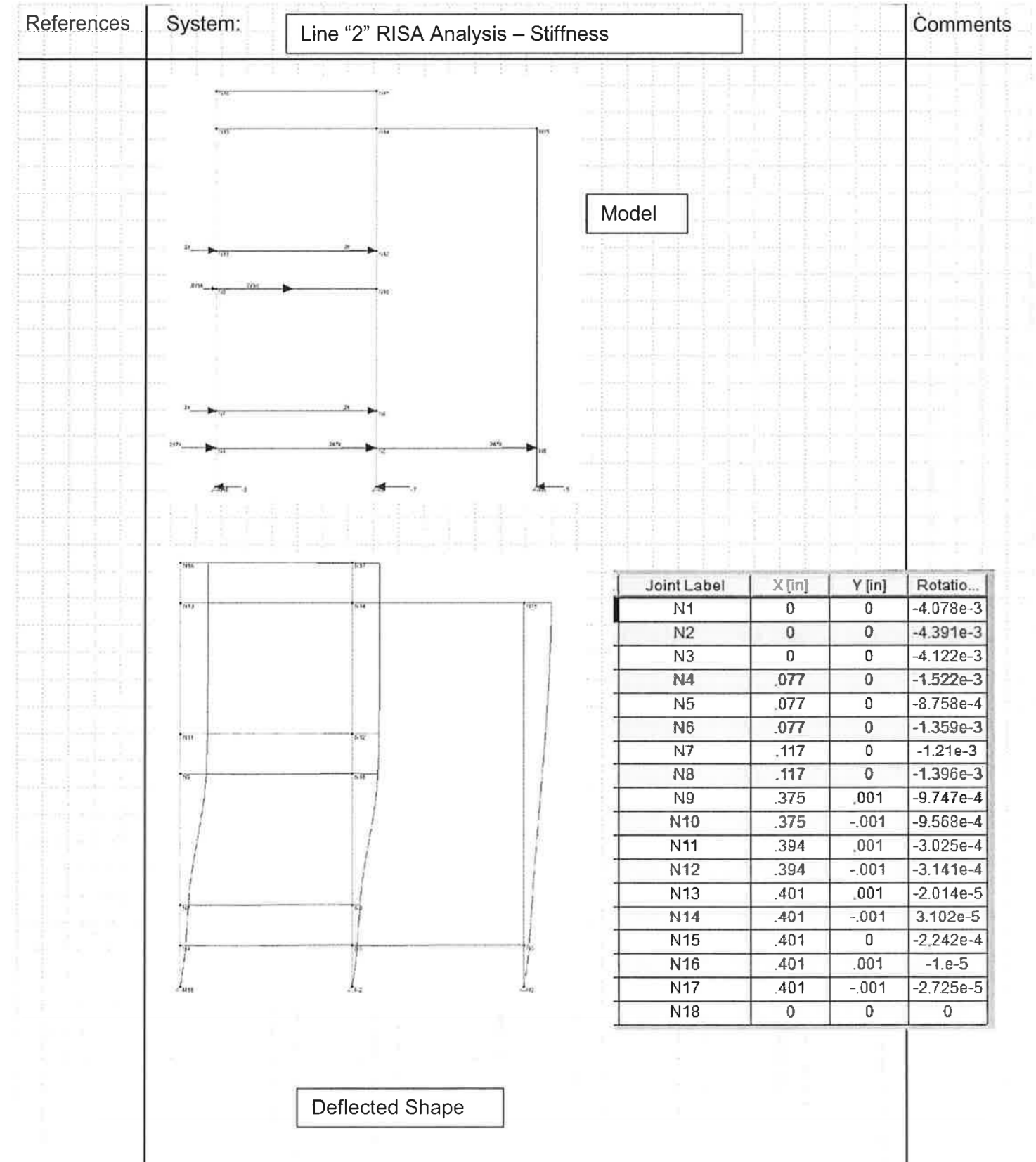


Deflected Shape

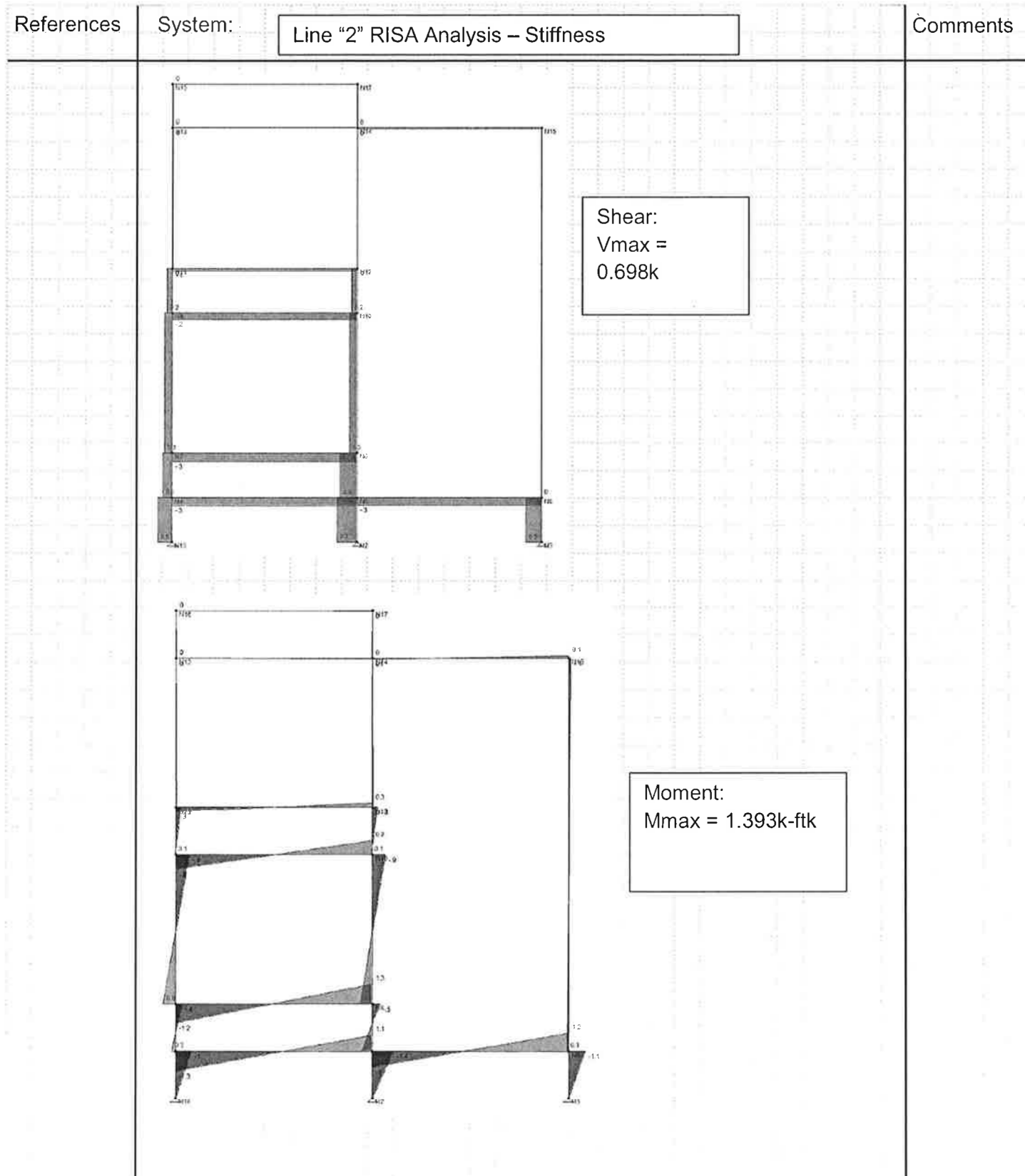
Joint Label	X [in]	Y [in]	Rotatio...
N1	0	0	-4.926e-3
N2	0	0	-5.314e-3
N3	0	0	-4.975e-3
N4	.093	0	-1.749e-3
N5	.093	0	-9.963e-4
N6	.093	0	-1.622e-3
N7	.135	0	-1.232e-3
N8	.135	0	-1.435e-3
N9	.395	.001	-9.81e-4
N10	.395	-.001	-9.615e-4
N11	.414	.001	-3.067e-4
N12	.414	-.001	-3.186e-4
N13	.422	.001	-2.319e-5
N14	.422	-.001	2.67e-5
N15	.422	0	-2.106e-4
N16	.422	.001	-1.138e-5
N17	.422	-.001	-2.816e-5
N18	0	0	0



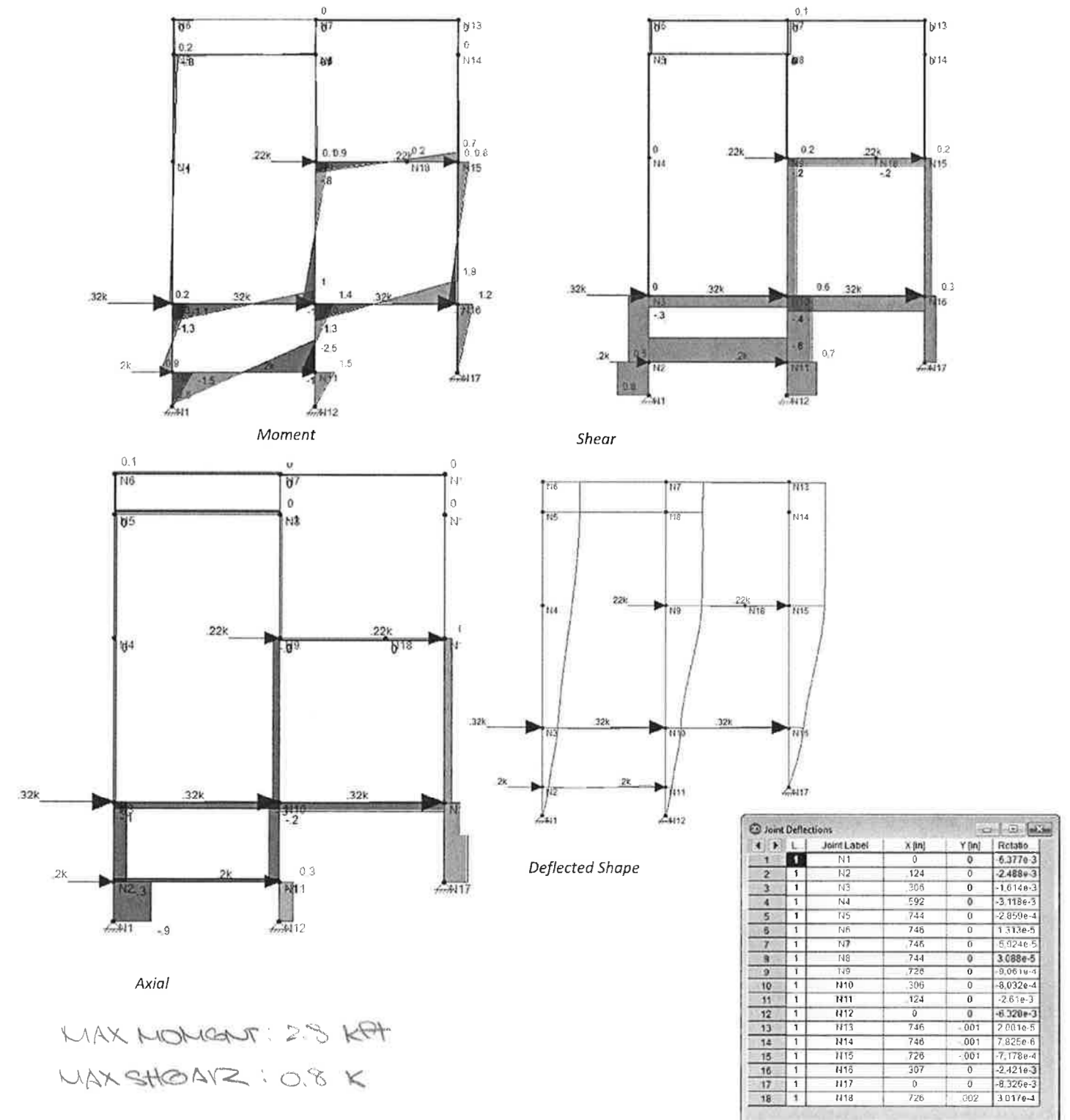
RISA Analysis - Lateral 5



RISA Analysis - Lateral 6



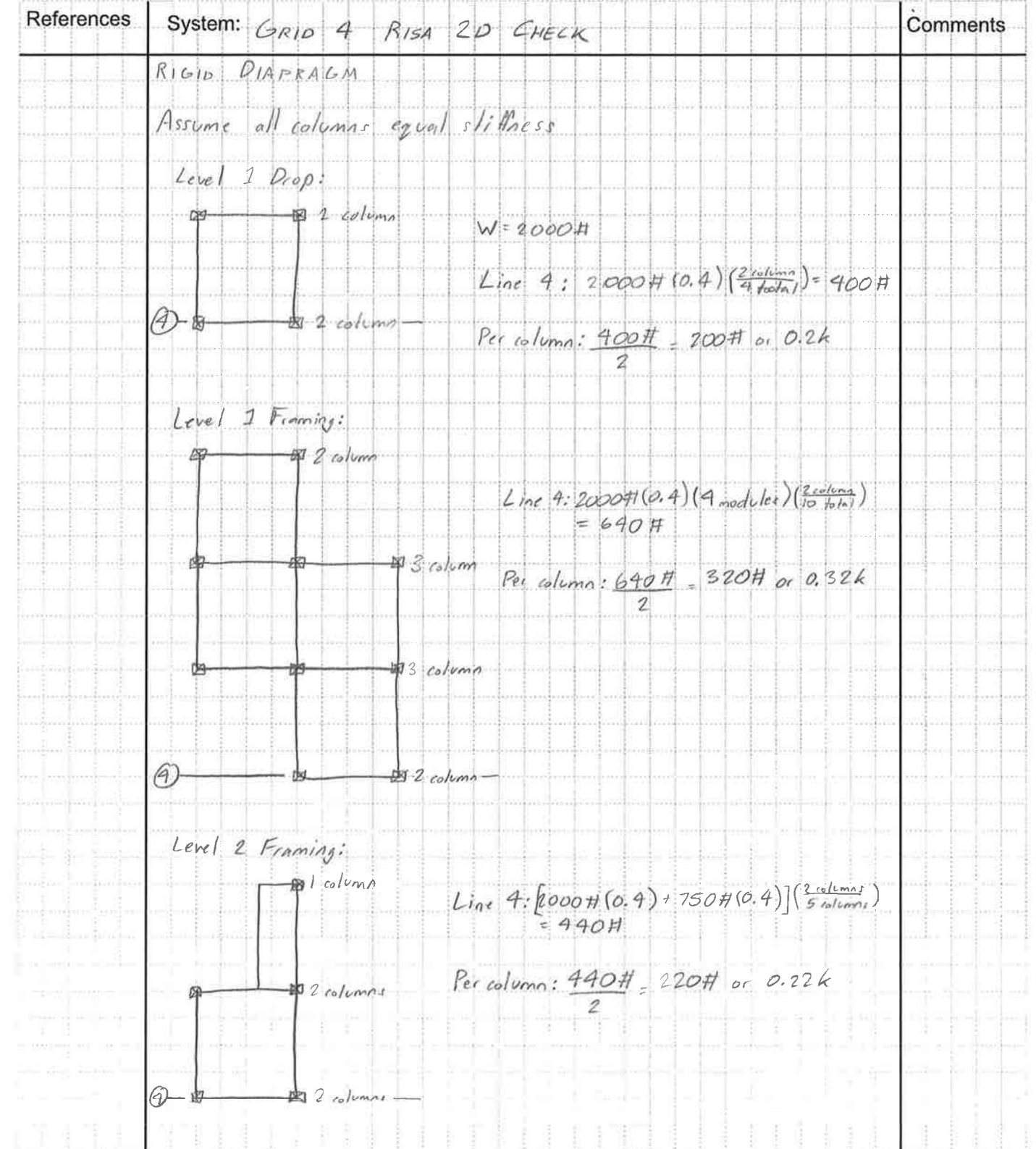
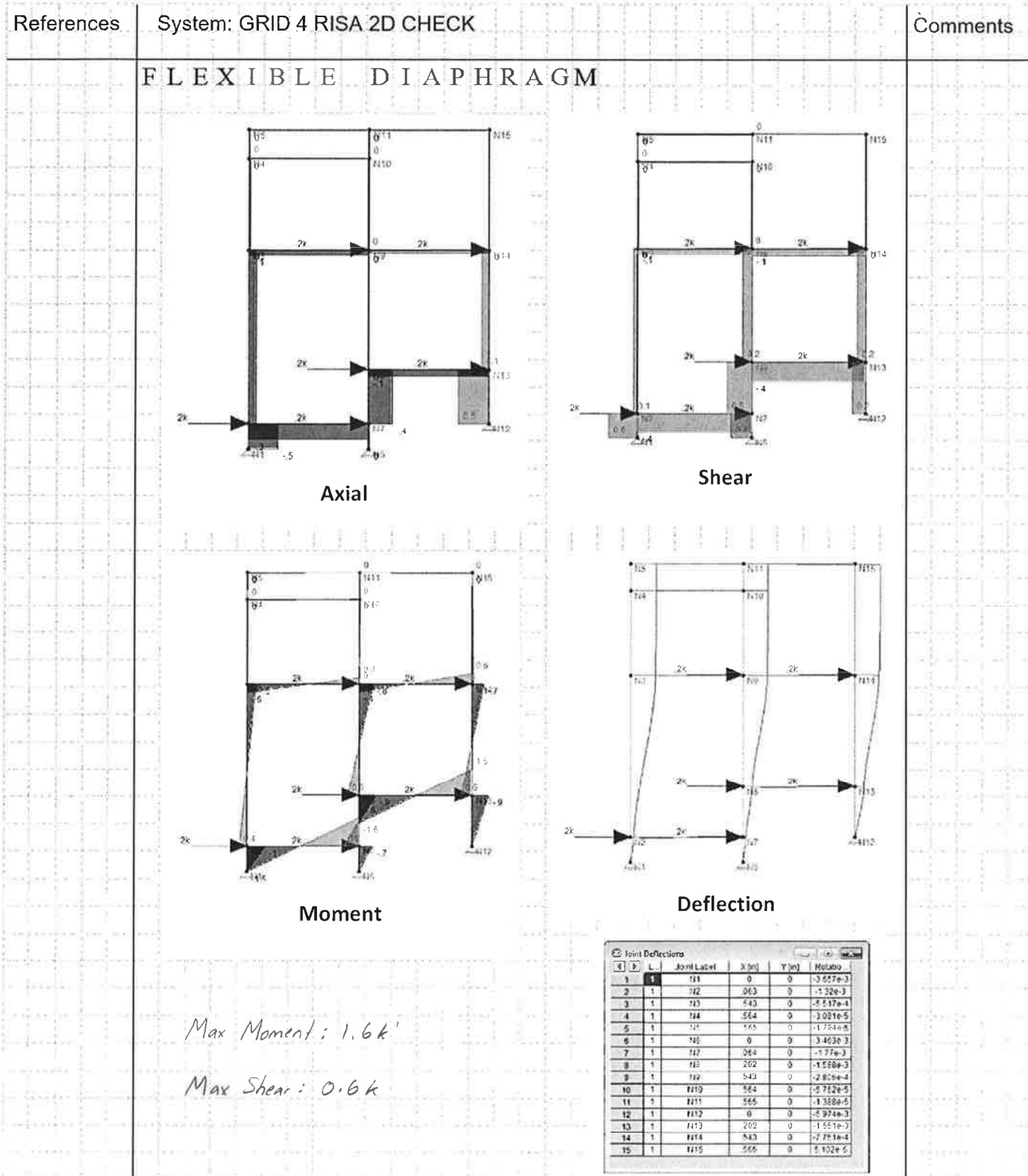
RISA Analysis - Lateral 7

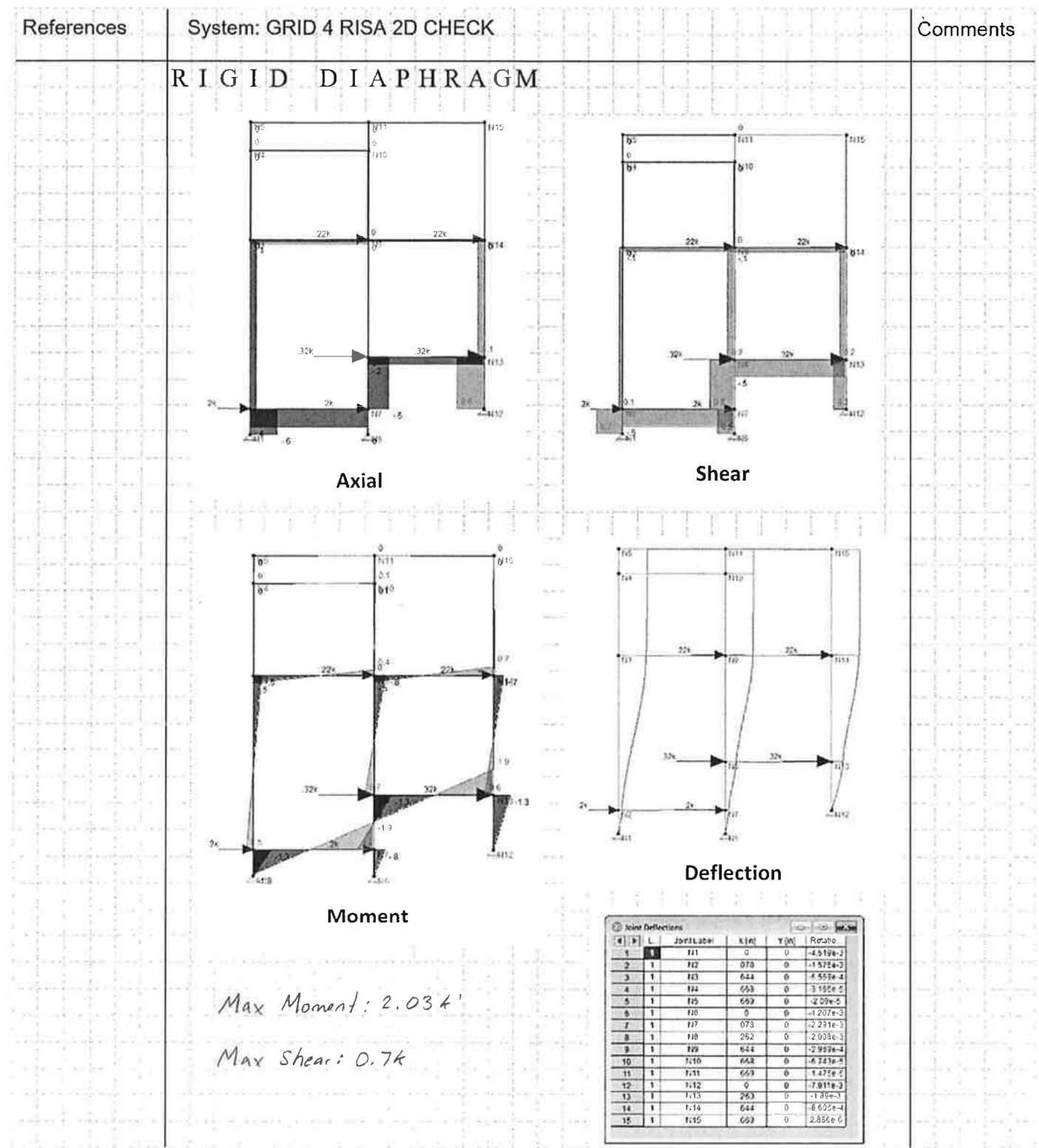


RISA Analysis - Lateral 8

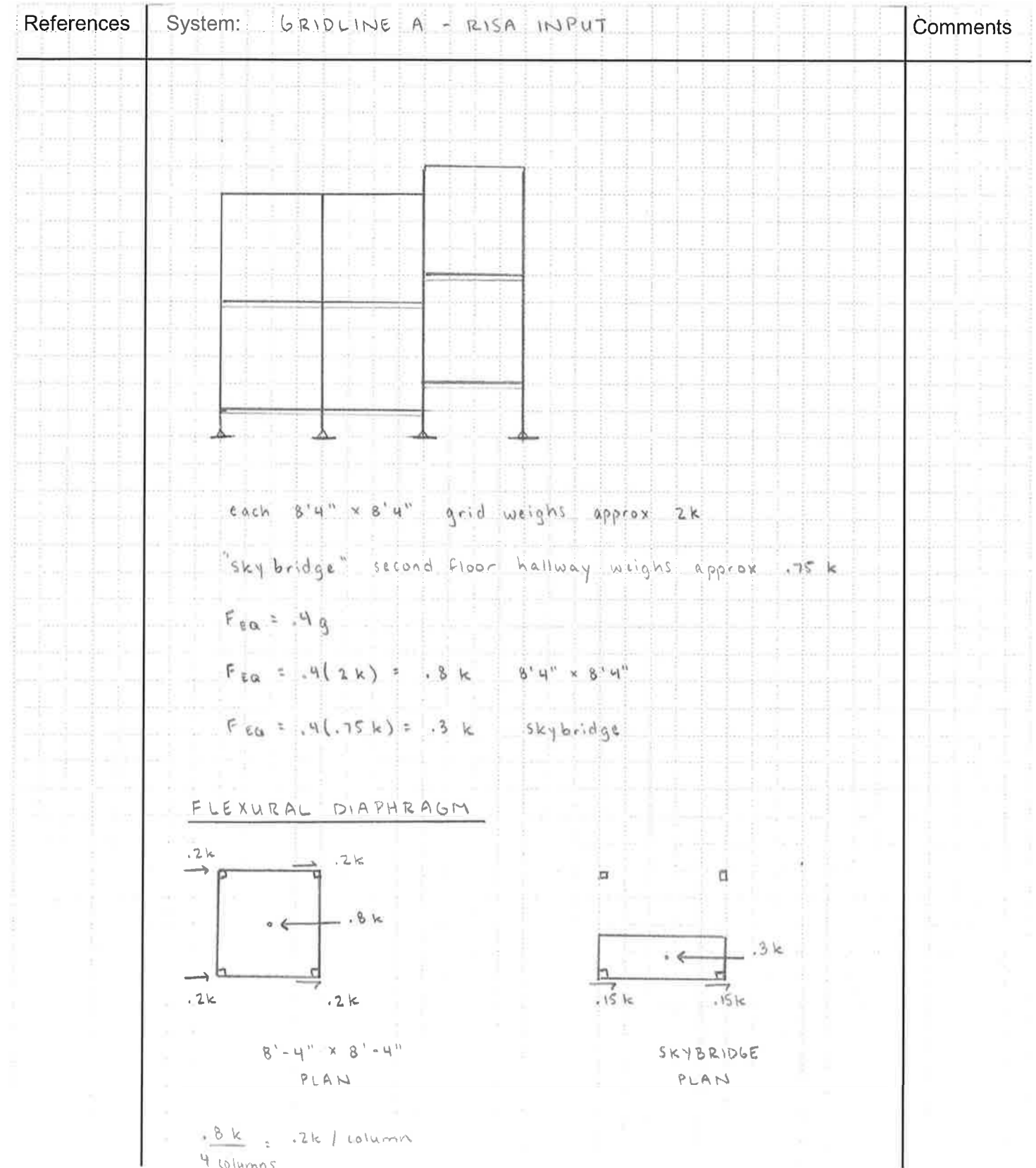
References	System: <u>GRIDING 3-RIGID DIAPHRAGM</u>	Comments
	<p><u>LEVEL 1 FRAMING</u></p> <p>Level 1 Framing Depth: $800\# \times 4 = 3200\#$ 10 columns $3200\# \times (\frac{3}{15}) = 960\#$</p> <p><u>LEVEL 2 FRAMING</u></p> <p>Level 2 Framing depth: $800\# + (750)(0.4) = 1100\#$ 2 columns $1100\# \times (\frac{2}{5}) = 440\#$</p>	

References	System: <u>GRID 4-RISA 2D-CHECK</u>	Comments
	<p><u>FLEXIBLE DIAPHRAGM</u></p> <p>Look at individual trib areas:</p> <p>Weight of each module: $2000\#$ Force = $0.4W$</p> <p><u>Level 1 Drop:</u></p> <p>$W_1 = \frac{1}{4}(2000\#) = 500\# = W_2$ $F_1 = 500\#(0.4) = 200\# \text{ or } 0.2k = F_2$</p> <p><u>Level 1 Framing:</u></p> <p>$W_3 = \frac{1}{4}(2000\#) = 500\# = W_4$ $F_3 = 500\#(0.4) = 200\# \text{ or } 0.2k = F_4$</p> <p><u>Level 2 Framing:</u></p> <p>$W_5 = \frac{1}{4}(2000\#) = 500\# = W_6$ $F_5 = 500\#(0.4) = 200\# \text{ or } 0.2k = F_6$</p>	

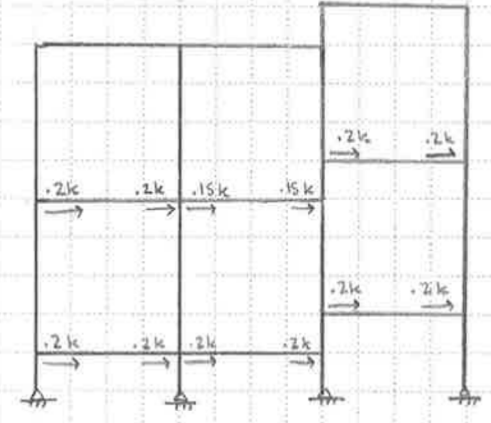
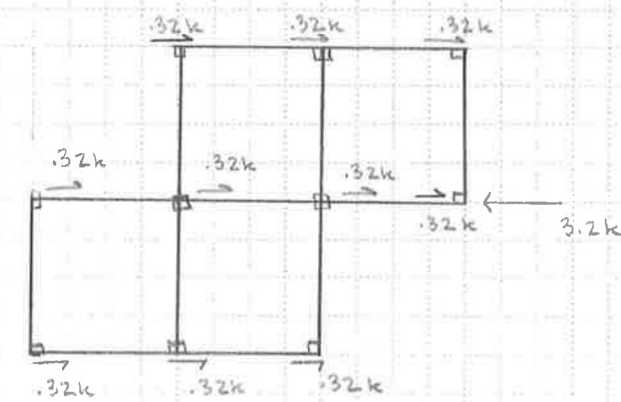
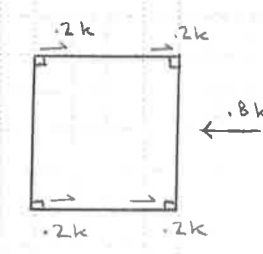
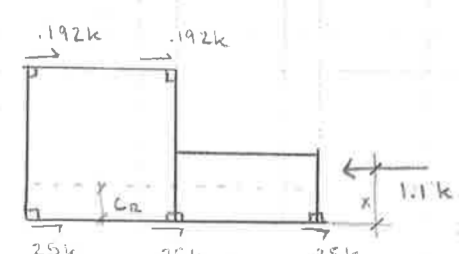




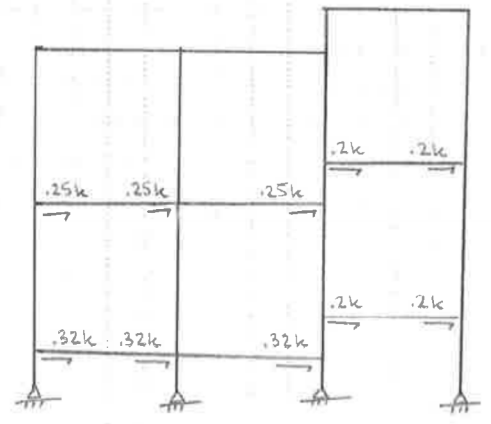
RISA Analysis - Lateral 13



RISA Analysis - Lateral 14

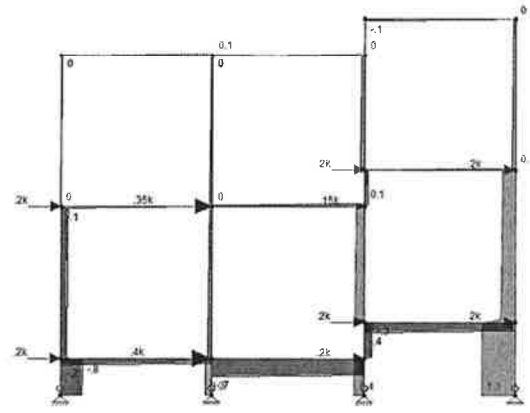
References	System:	Comments
	 <p>FLEXIBLE DIAPHRAGM</p>	
	 <p>RIGID DIAPHRAGM</p>	
	 <p>FIRST FLOOR PLAN</p> <p>RISE</p>	
	<p>$\frac{3.2k}{10 \text{ columns}} = .32k / \text{column}$</p>  <p>SECOND FLOOR PLAN</p>	

RISA Analysis - Lateral 15

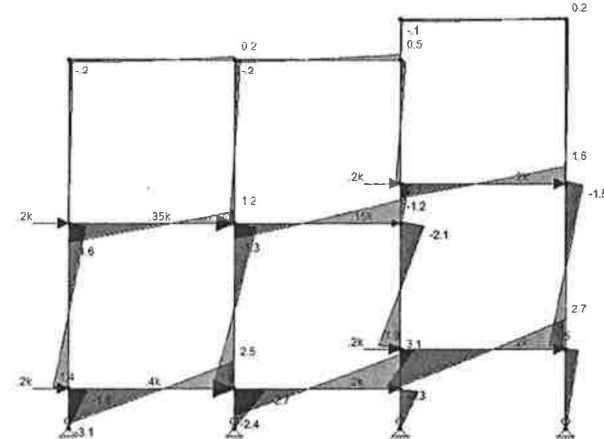
References	System:	Comments
	<p>Equivalent force = $.8 + .3 = 1.1k$</p> <p>$x = \left[.8 \left(\frac{8'4''}{2} \right) + .3 \left(\frac{2'8''}{2} \right) \right] \frac{1}{1.1k} = 3.73'$</p> <p>center of rigidity</p> <p>$c_r = \frac{2(k)(3'4'') + 3(k)(0')}{5(k)} = 3.47'$</p> <p>torsional moment = $1.11k(3.73' - 3.47') = .29kft$</p> <p>$F_D = \frac{1.11k}{5 \text{ columns}} = .22k / \text{column}$</p> <p>$F_T = \frac{.29kft}{3.47'} \cdot \frac{1}{3 \text{ columns}} = .028k / \text{column (gridline A)}$</p> <p>$F_T = \frac{.29kft}{(8'4'' - 3.47')} \cdot \frac{1}{2 \text{ columns}} = .028k / \text{column (gridline B)}$</p> <p>gridline A = $F_D + F_T = .248k$</p> <p>gridline B = $F_D - F_T = .192k$</p>  <p>RIGID DIAPHRAGM</p>	

RISA Analysis - Lateral 16

Gridline A - Flexible Diaphragm

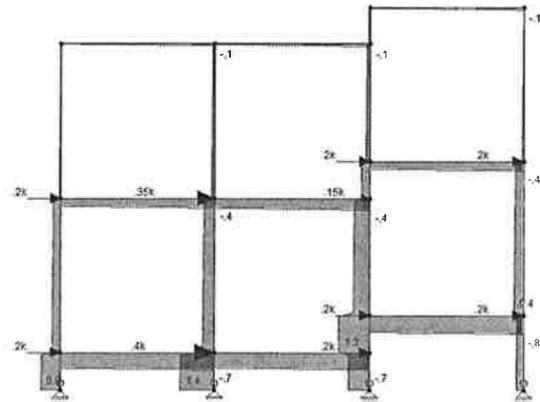


Axial

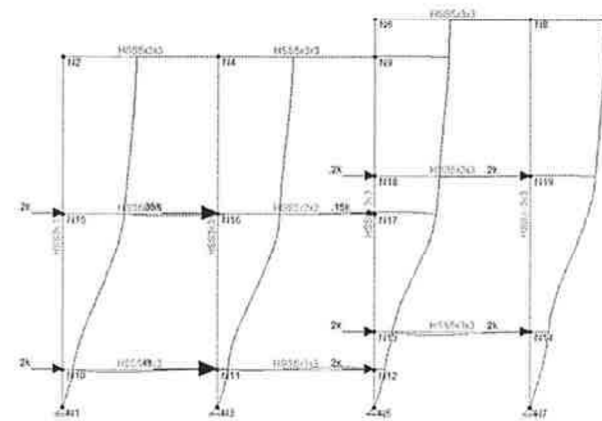


Moment

Max moment: 3.1 k-ft
Max axial: 1.3 k
Max shear: 1.4 k



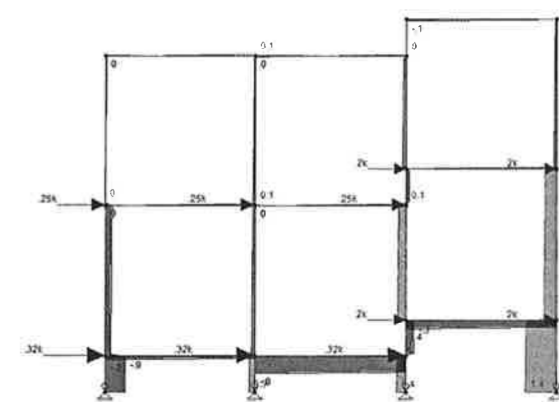
Shear



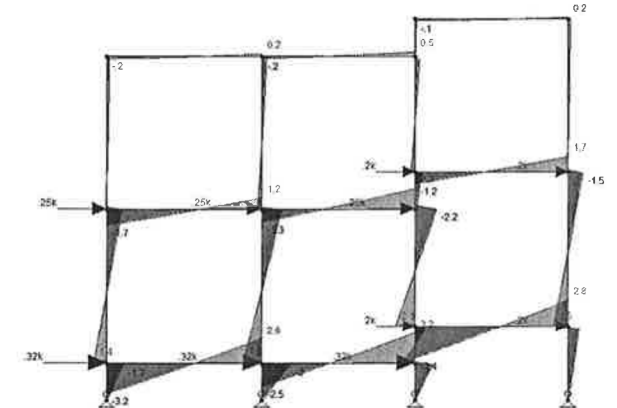
Deflected Shape

Joint Deflections					
L...	Joint Label	X [in]	Y [in]	Rotatio...	
1	N1	0	0	0	
2	N2	1.184	.001	-4.111e-4	
3	N3	0	0	0	
4	N4	1.184	0	-1.187e-4	
5	N5	0	0	0	
6	N6	1.195	0	-2.393e-4	
7	N7	0	0	0	
8	N8	1.195	-.003	-1.417e-4	
9	N9	1.184	0	-5.597e-4	
10	N10	.162	0	-3.894e-3	
11	N11	.163	0	-1.805e-3	
12	N12	.164	0	-3.786e-3	
13	N13	.287	0	-4.089e-3	
14	N14	.288	-.001	-2.089e-3	
15	N15	.983	.001	-2.283e-3	
16	N16	.983	0	-6.316e-4	
17	N17	.983	0	-2.882e-3	
18	N18	1.037	0	-9.384e-4	
19	N19	1.037	-.003	-1.969e-3	

Gridline A - Rigid Diaphragm

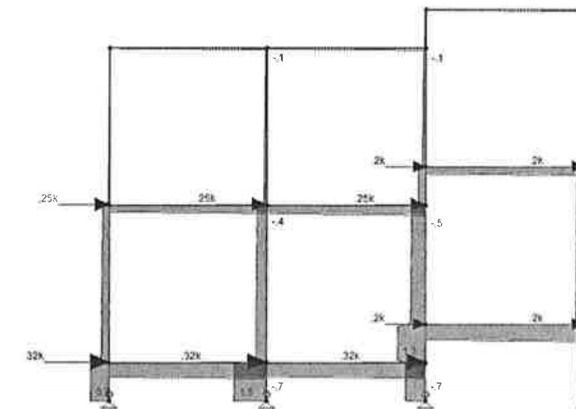


Axial

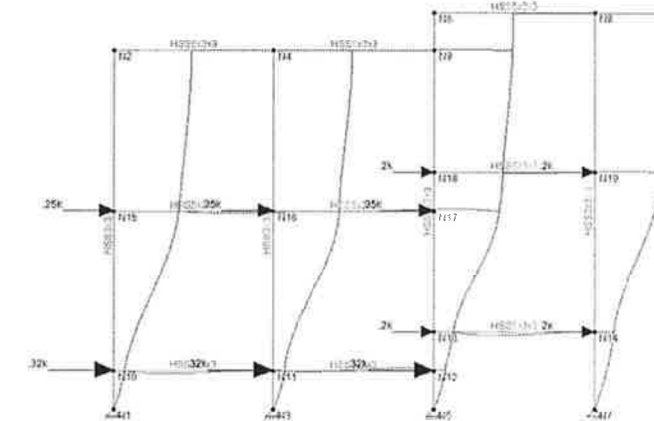


Moment

Max moment: 3.2 k-ft
Max axial: 1.4 k
Max shear: 1.5 k



Shear

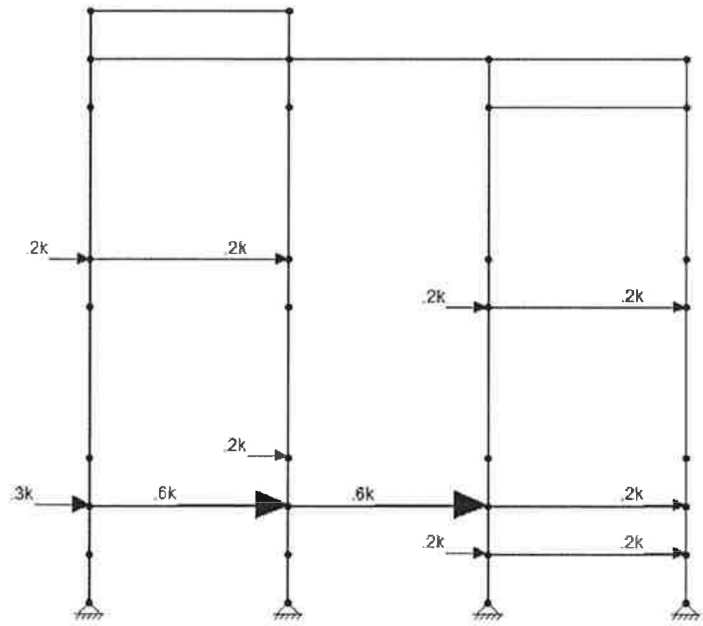


Deflected Shape

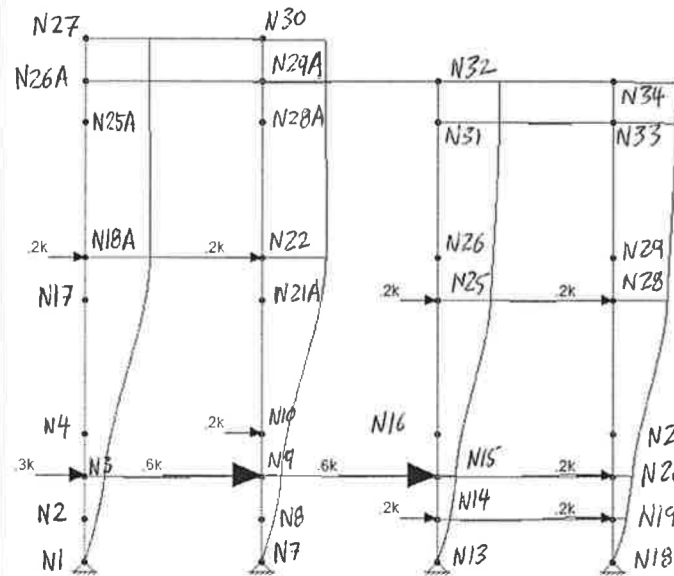
Joint Deflections					
L...	Joint Label	X [in]	Y [in]	Rotatio...	
1	N1	0	0	0	
2	N2	1.217	.001	-4.102e-4	
3	N3	0	0	0	
4	N4	1.217	0	-1.193e-4	
5	N5	0	0	0	
6	N6	1.228	0	-2.439e-4	
7	N7	0	0	0	
8	N8	1.228	-.003	-1.376e-4	
9	N9	1.217	0	-5.658e-4	
10	N10	.171	0	-4.067e-3	
11	N11	.171	0	-1.885e-3	
12	N12	.172	0	-3.941e-3	
13	N13	.299	0	-4.188e-3	
14	N14	.3	-.001	-2.172e-3	
15	N15	1.015	.001	-2.328e-3	
16	N16	1.015	0	-6.475e-4	
17	N17	1.015	0	-2.943e-3	
18	N18	1.069	0	-9.291e-4	
19	N19	1.069	-.003	-2.022e-3	

References System: Modular House Grid B Flexible Diaphragm Comments

Loads Applied



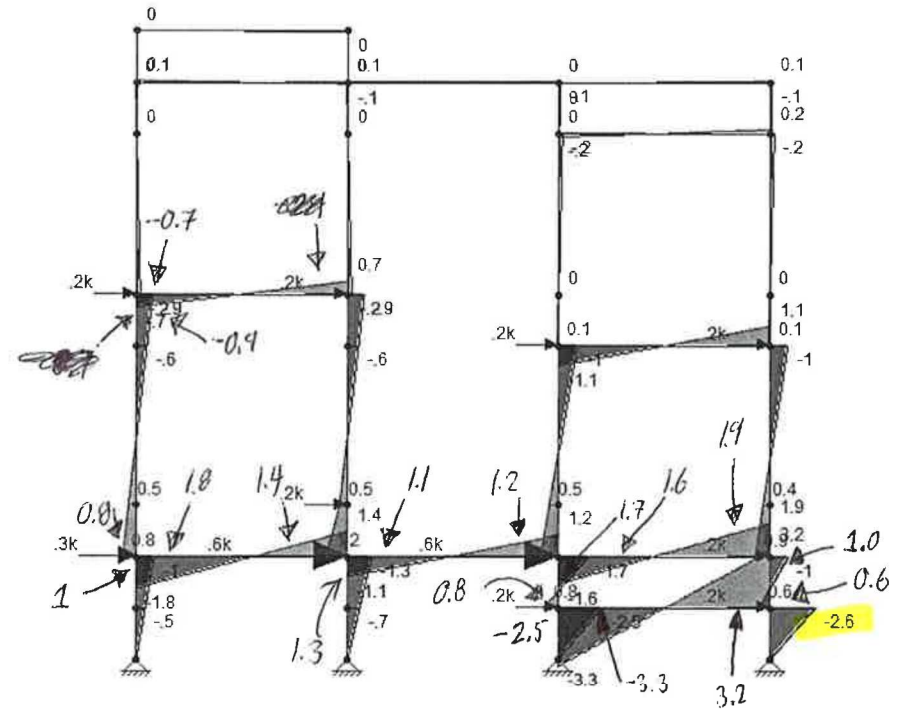
Deflections



ID	L	Joint Label	X (in)	Y (in)	Rotatio...
1	1	N1	0	0	-7.353e-3
2	1	N2	167	0	-6.071e-3
3	1	N3	272	0	-2.225e-3
4	1	N4	387	0	-5.349e-3
5	1	N7	0	0	-7.895e-3
6	1	N8	177	0	-6.195e-3
7	1	N9	272	0	-1.092e-3
8	1	N10	357	0	-5.357e-3
9	1	N13	0	0	-9.639e-3
10	1	N14	185	0	-3.457e-3
11	1	N15	27	0	-1.272e-3
12	1	N16	354	.001	-5.262e-3
13	1	N18	0	0	-9.715e-3
14	1	N19	184	0	-3.236e-3
15	1	N20	27	-.001	-2.291e-3
16	1	N21	366	-.001	-5.53e-3
17	1	N17	844	0	-4.436e-3
18	1	N18A	909	.001	-7.35e-4
19	1	N21A	842	0	-4.541e-3
20	1	N22	909	0	-7.701e-4
21	1	N25	.764	.002	-1.241e-3
22	1	N26	.796	.002	-1.529e-3
23	1	N28	.764	-.002	-1.109e-3
24	1	N29	.796	-.002	-1.5e-3
25	1	N25A	.898	0	4.366e-4
26	1	N26A	.891	0	7.81e-5
27	1	N27	.89	0	8.697e-7
28	1	N28A	.898	0	4.473e-4
29	1	N29A	.891	0	7.545e-5
30	1	N30	.89	0	-6.956e-7
31	1	N31	.886	.002	-2.405e-4
32	1	N32	.891	.002	-6.581e-5
33	1	N33	.886	-.002	-2.392e-4
34	1	N34	.891	-.002	-1.046e-4

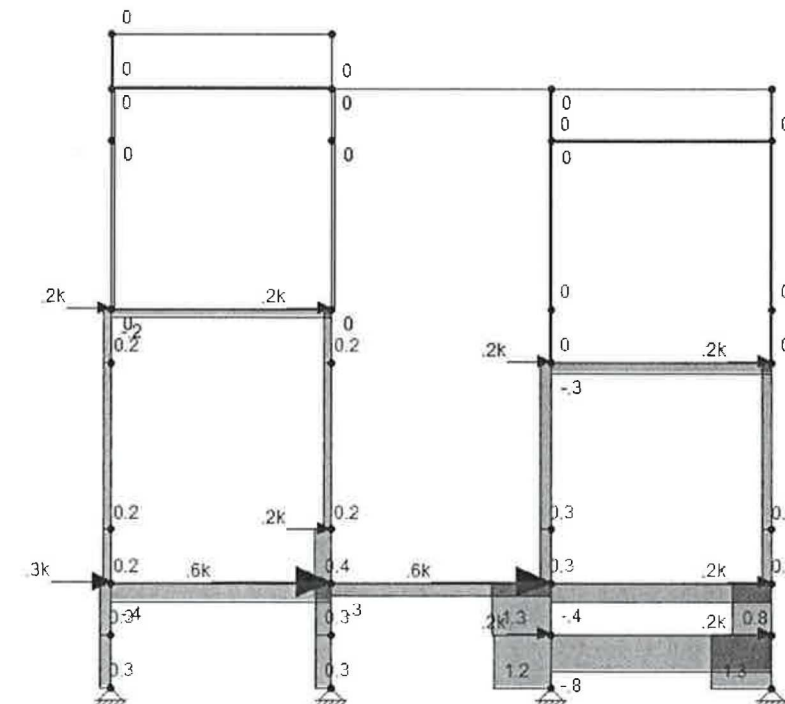
References System: Modular House Grid B Flexible Diaphragm Comments

Moments

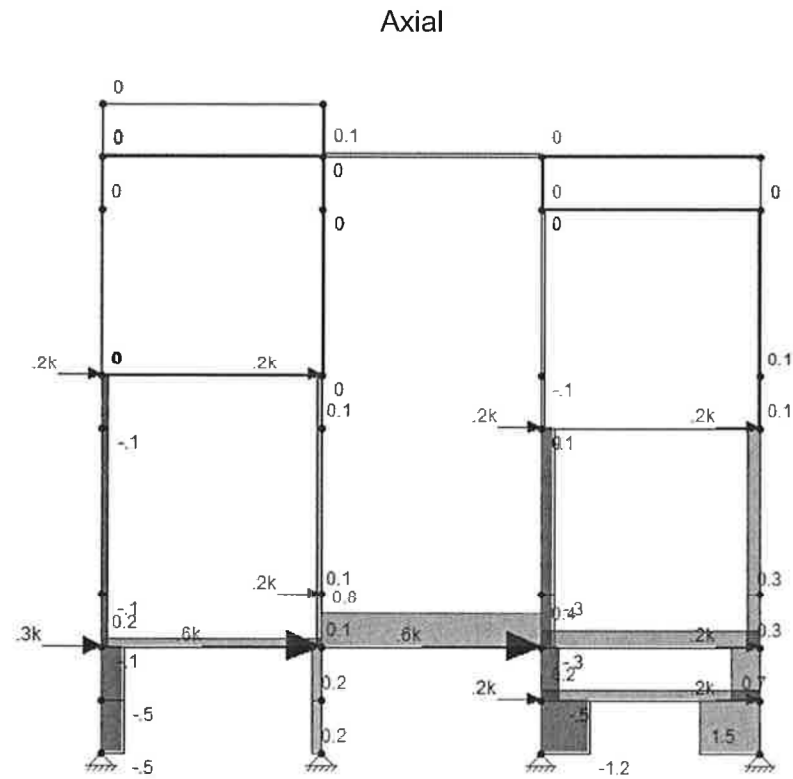


$M_{max} = -2.6 \text{ kft}$

Shear



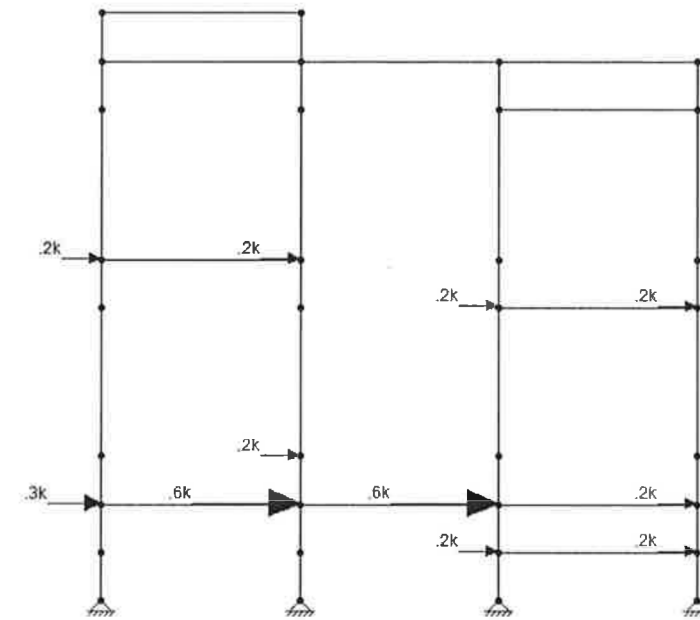
References System: Modular House Grid B Flexible Diaphragm Comments



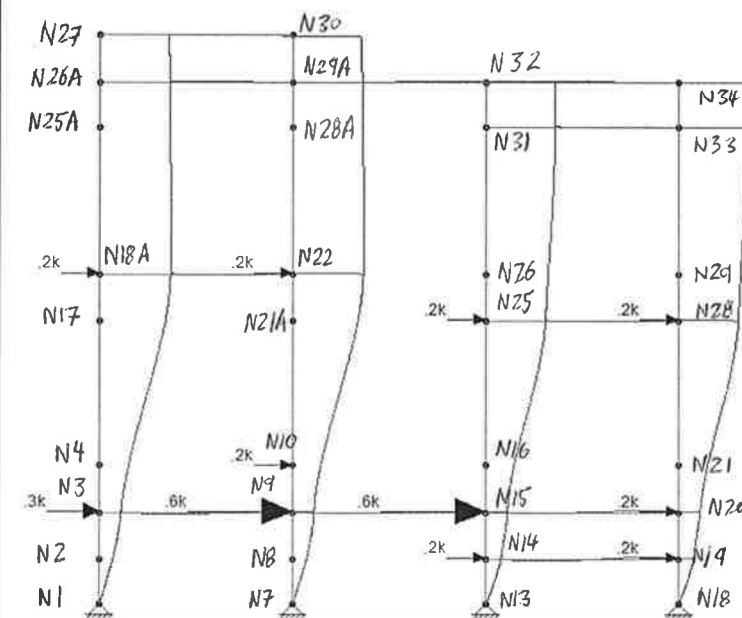
RISA Analysis - Lateral 21

References System: Modular House Grid B Rigid Diaphragm Comments

Loads Applied



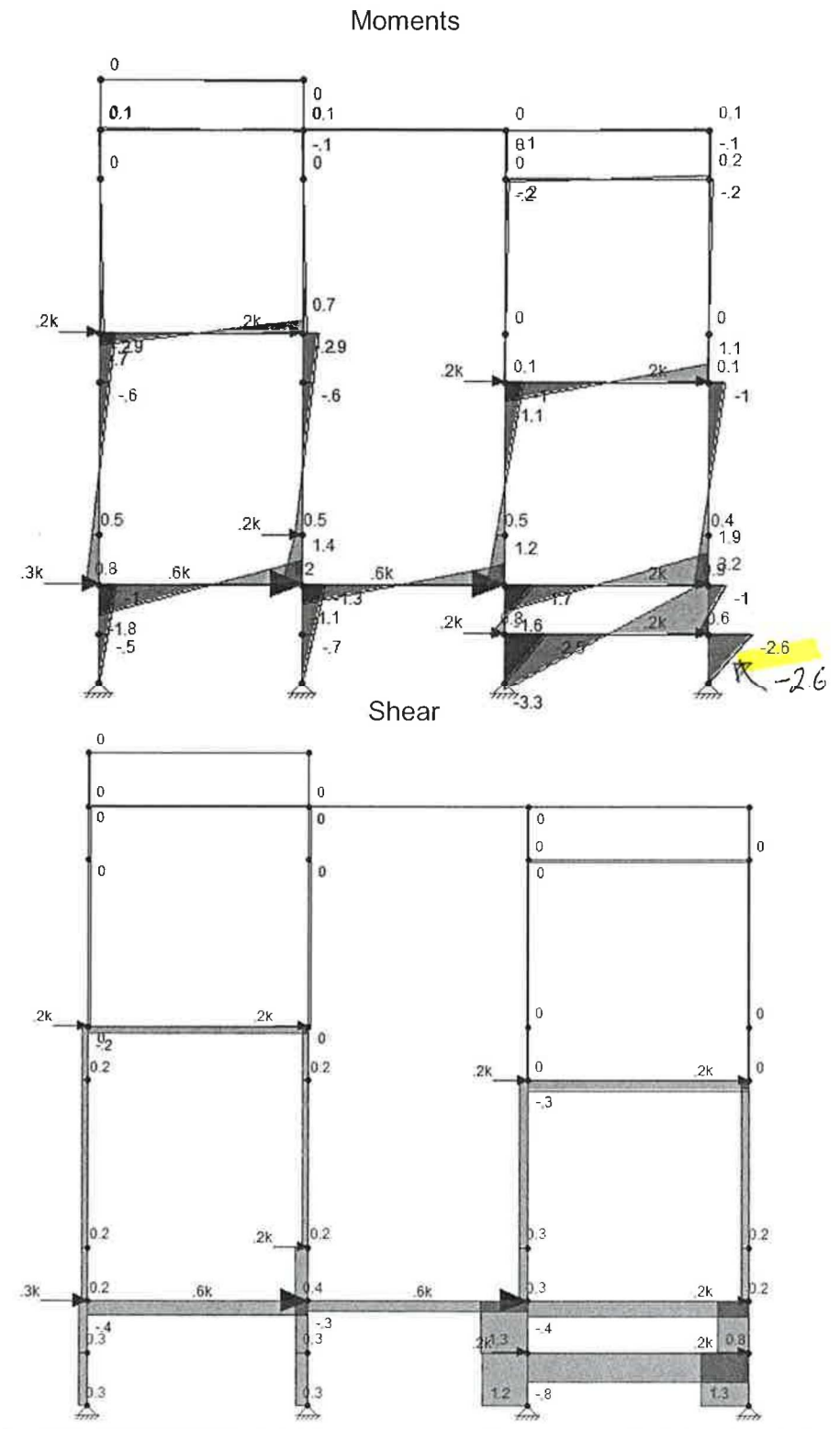
Deflections



Joint Label	X [in]	Y [in]	Rotatio...
N1	0	0	-7.353e-3
N2	167	0	-6.071e-3
N3	272	0	-2.225e-3
N4	367	0	-5.349e-3
N7	0	0	-7.895e-3
N8	177	0	-6.195e-3
N9	272	0	-1.092e-3
N10	357	0	-5.357e-3
N13	0	0	-9.639e-3
N14	185	0	-3.457e-3
N15	27	0	-1.272e-3
N16	354	0.01	-5.262e-3
N18	0	0	-9.715e-3
N19	184	0	-3.236e-3
N20	27	-0.01	-2.291e-3
N21	368	-0.01	-5.53e-3
N17	844	0	-4.436e-3
N18A	909	0.01	-7.39e-4
N21A	842	0	-4.541e-3
N22	909	0	-7.701e-4
N25	764	0.02	-1.241e-3
N26	798	0.02	-1.529e-3
N28	784	-0.02	-1.109e-3
N29	796	-0.02	-1.5e-3
N25A	898	0	4.366e-4
N26A	891	0	7.81e-5
N27	89	0	8.697e-7
N28A	898	0	4.473e-4
N29A	891	0	7.545e-5
N30	89	0	-6.956e-7
N31	886	0.02	-2.405e-4
N32	891	0.02	-6.561e-5
N33	886	-0.02	-2.392e-4
N34	891	-0.02	-1.046e-4

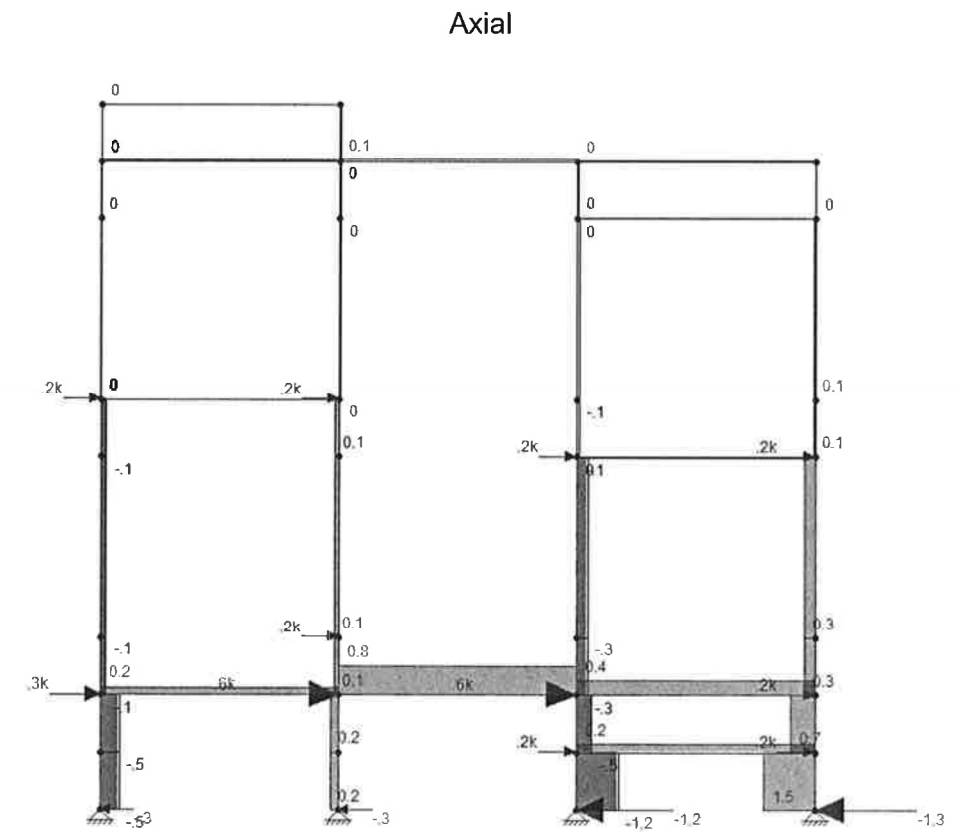
RISA Analysis - Lateral 22

References	System: Modular House Grid B Rigid Diaphragm	Comments
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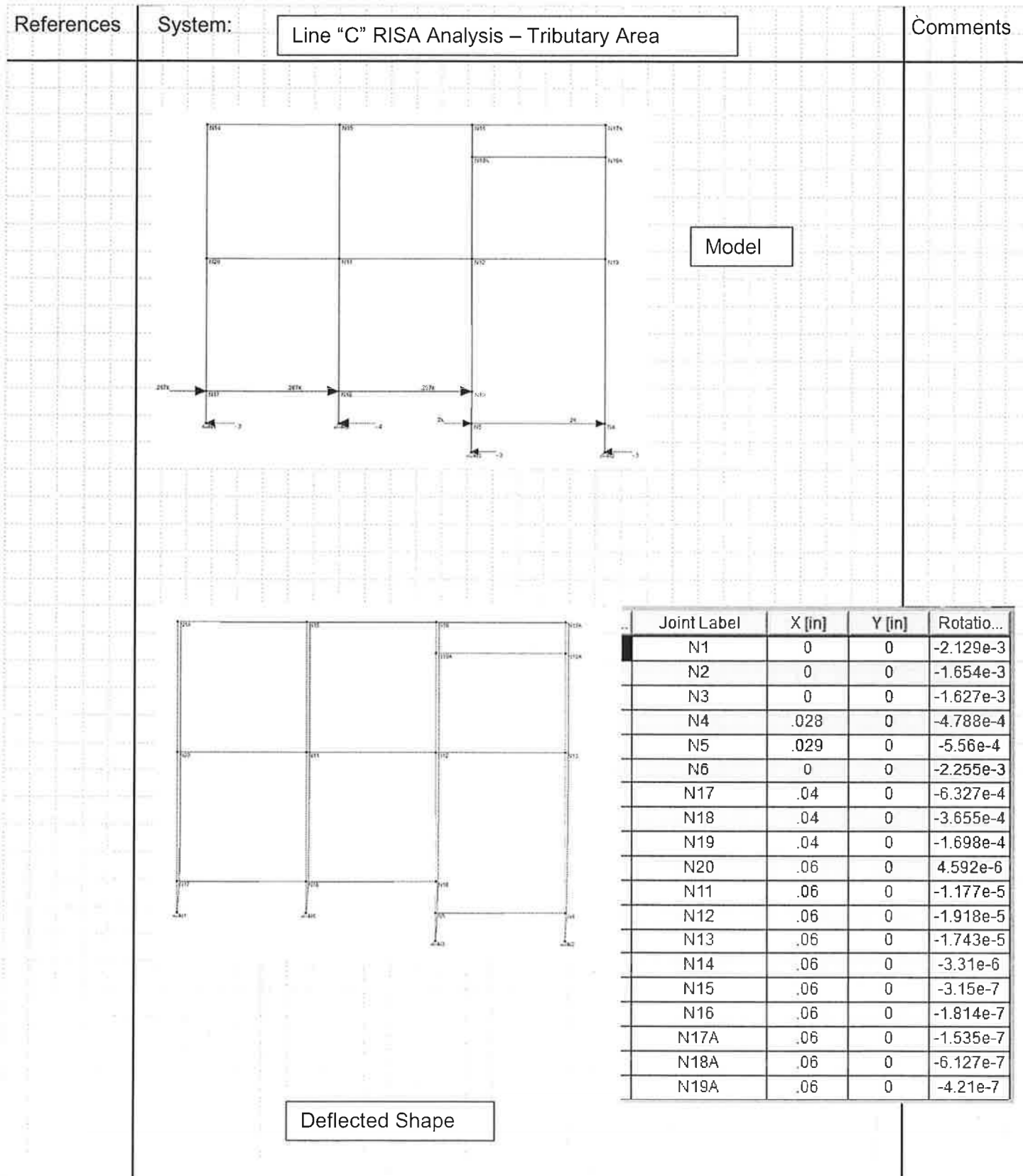


RISA Analysis - Lateral 23

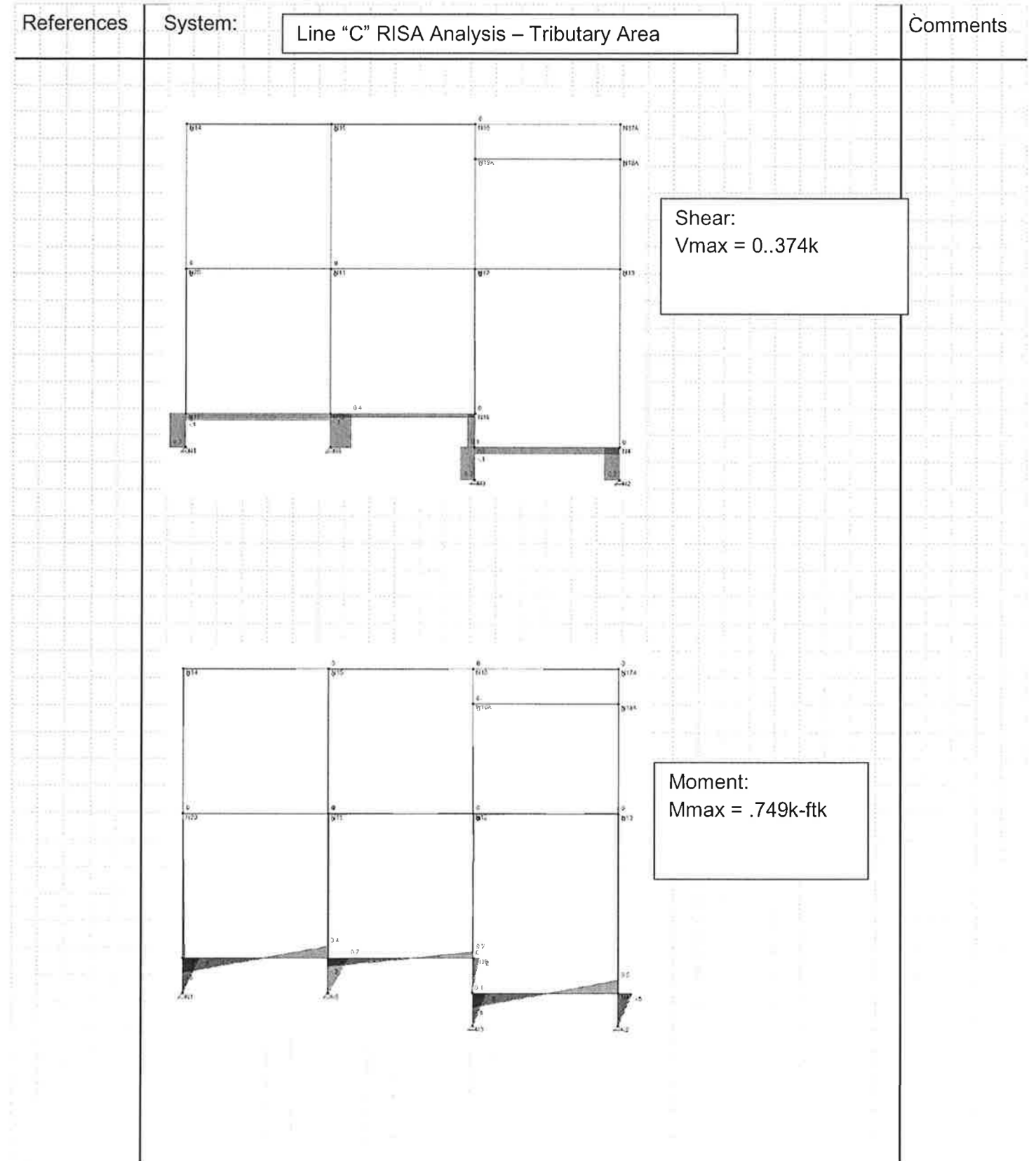
References	System: Modular House Grid B Rigid Diaphragm Analysis	Comments
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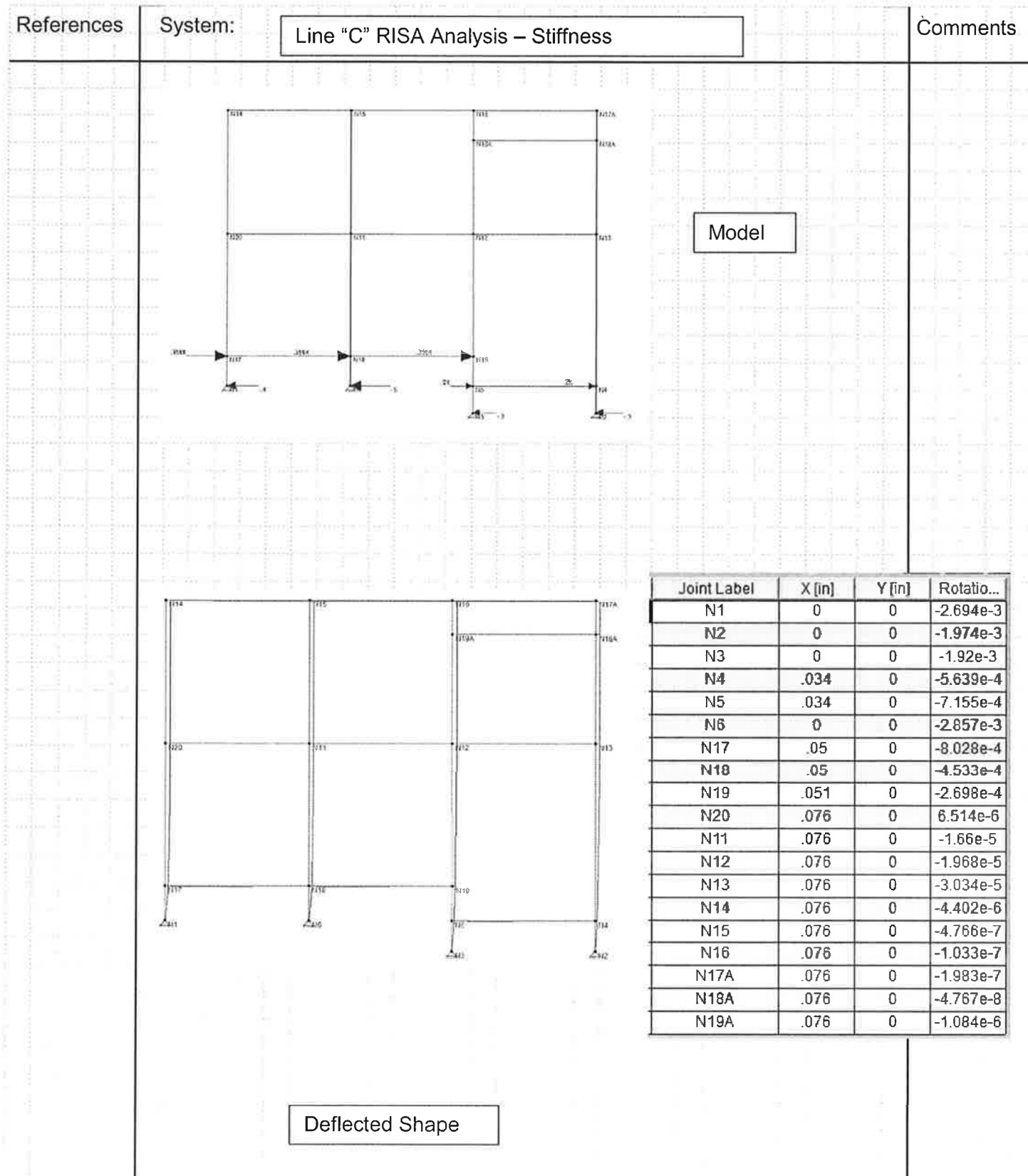
RISA Analysis - Lateral 24



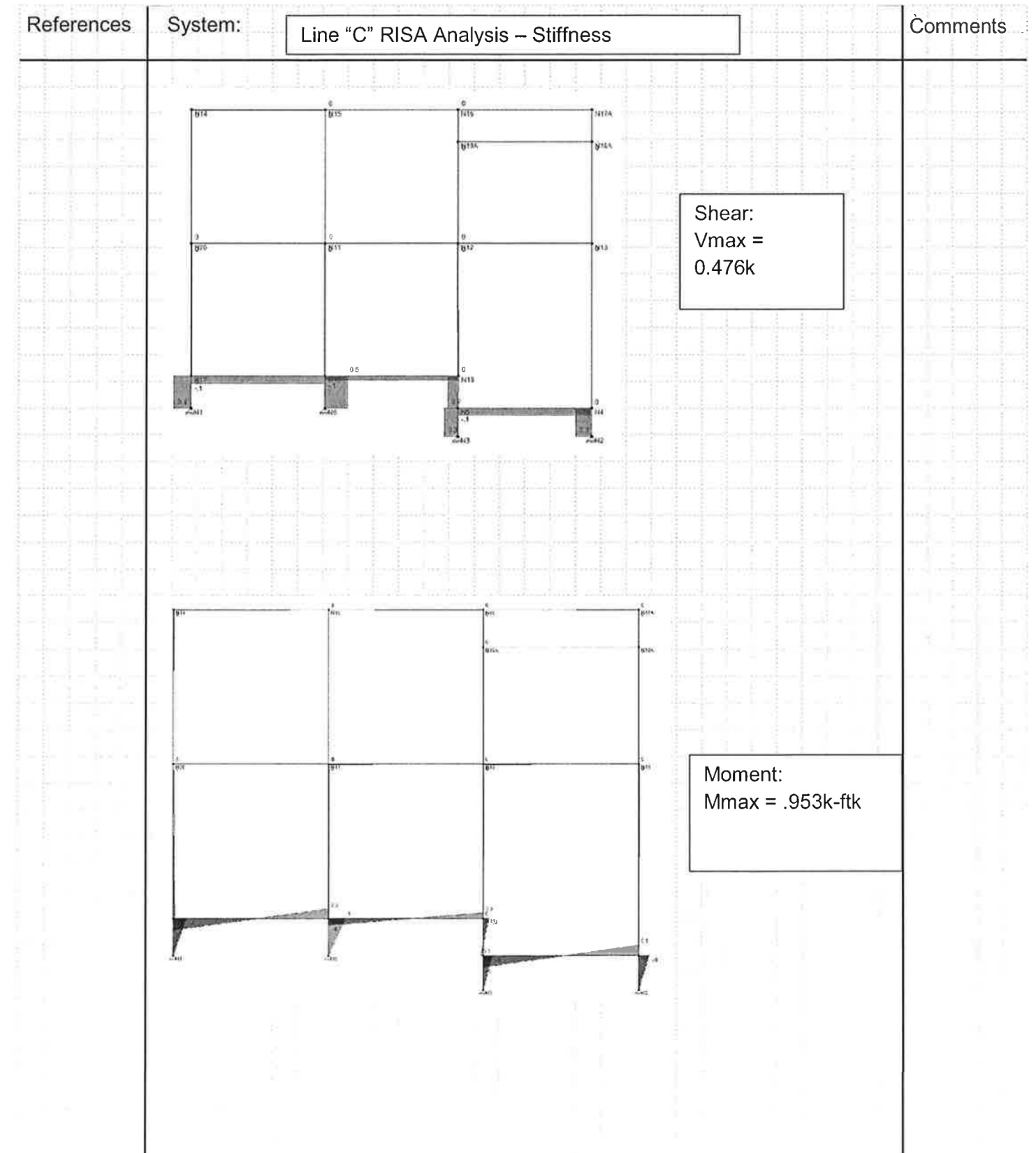
RISA Analysis - Lateral 25



RISA Analysis - Lateral 26

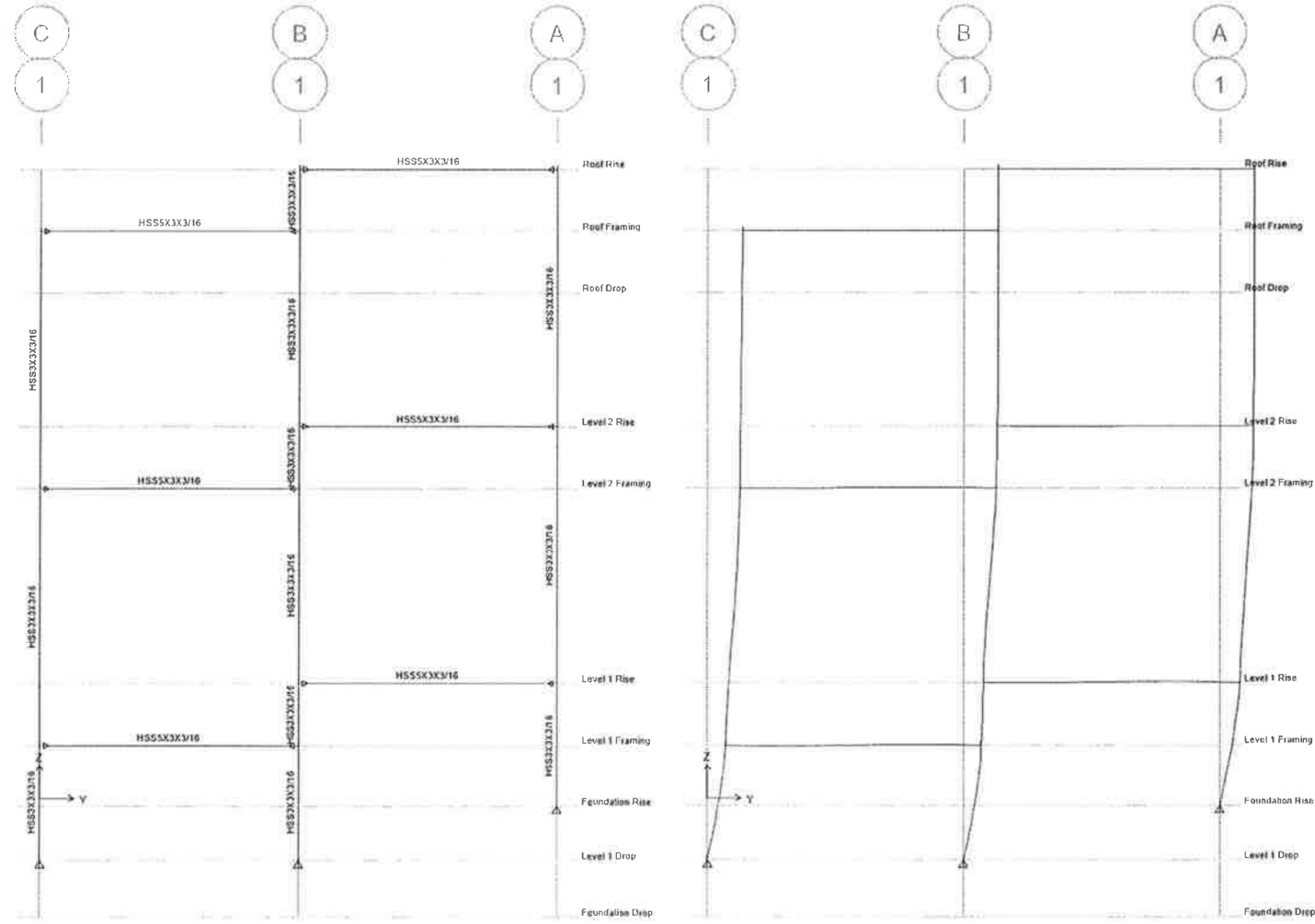


RISA Analysis - Lateral 27



RISA Analysis - Lateral 28

Elevation on Line 1

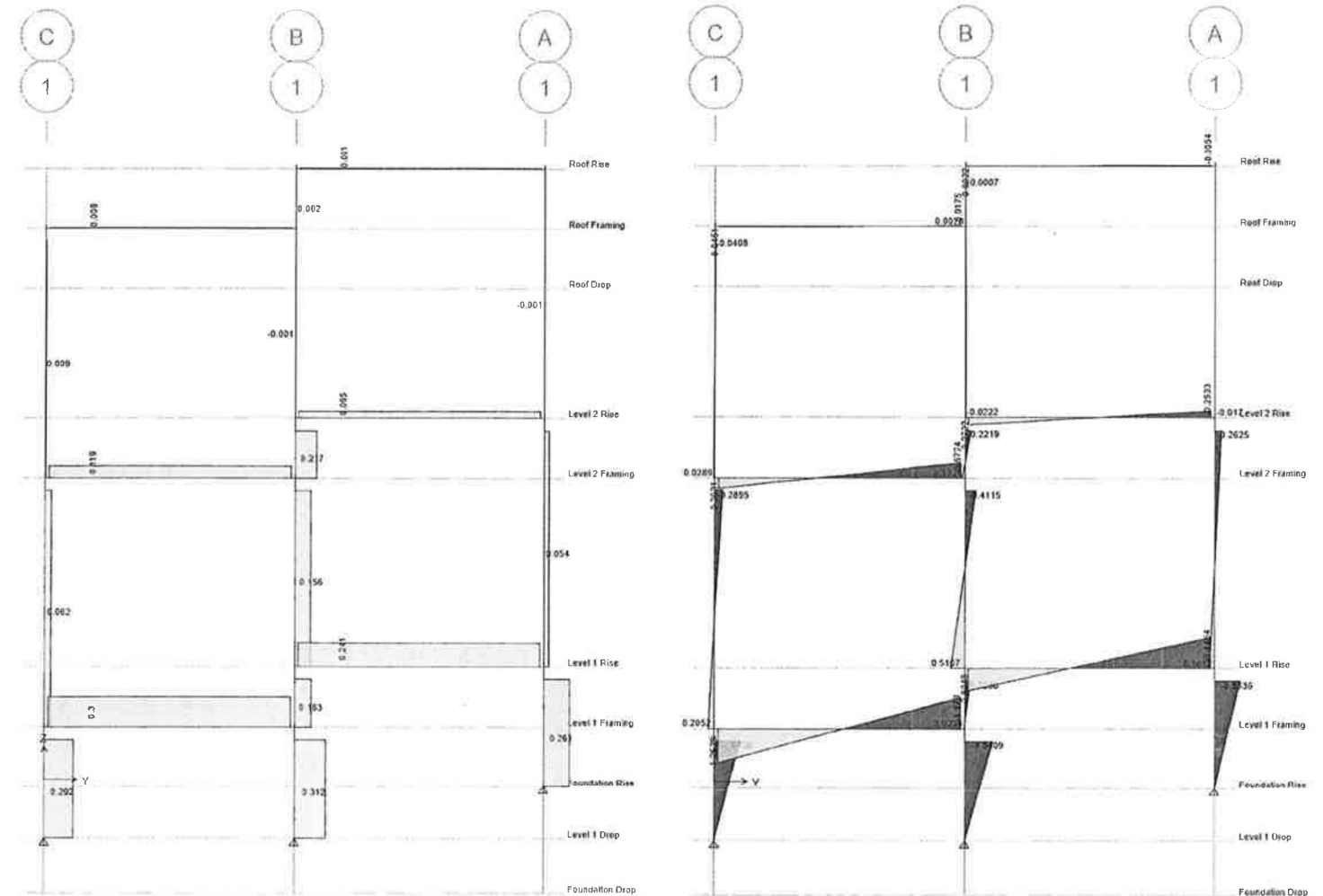


Elevation

Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	0.340
Roof Framing	0.340
Level 2 Rise	0.331
Level 2 Framing	0.316
Level 1 Rise	0.195
Level 1 Framing	0.176
Level 1 Drop	0.000

ETABS Comparison - Lateral 1



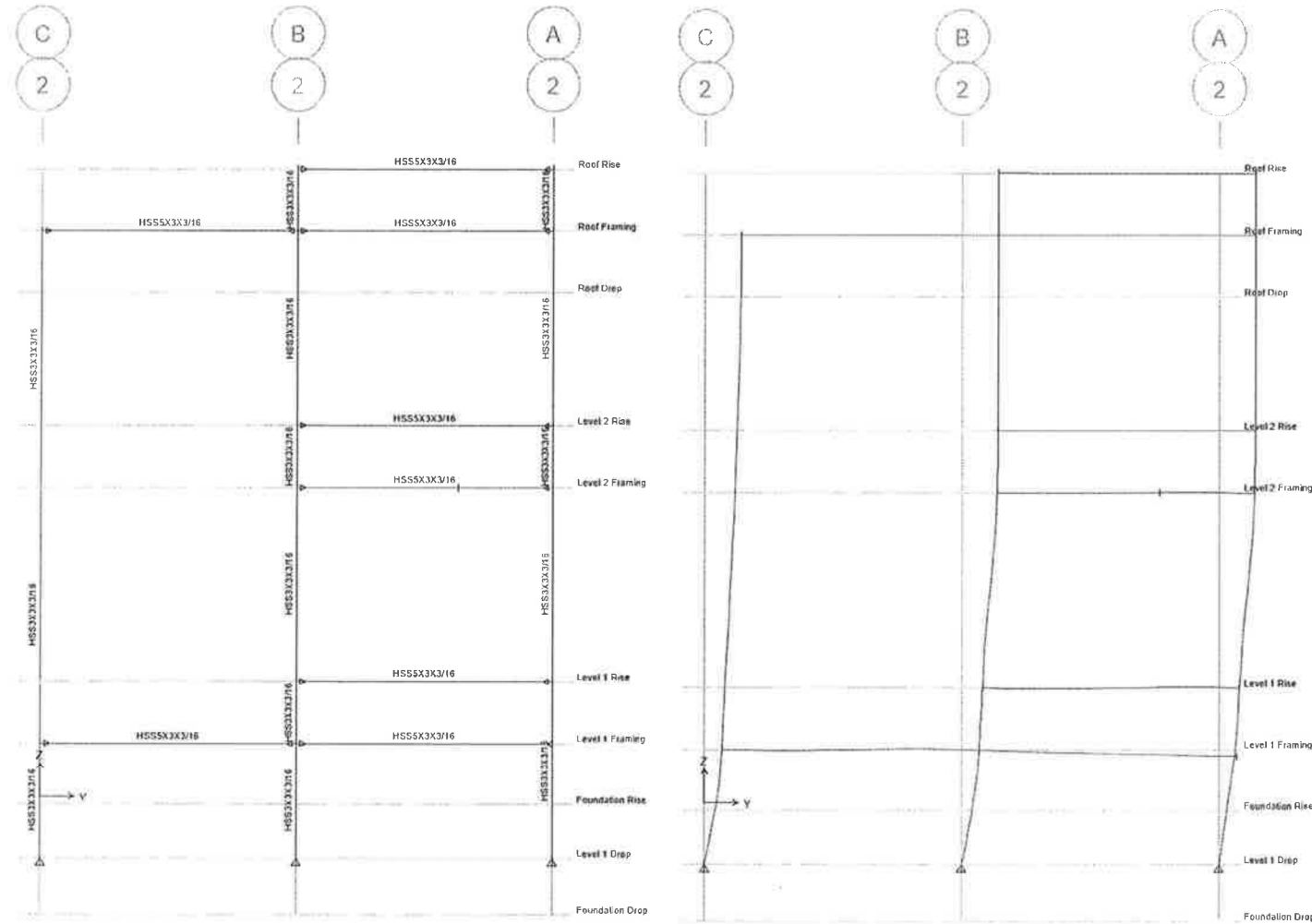
Shear

Moment

	MAX (+)	MIN (-)
Shear	0.87 kips	
Moment	1.18 k-ft	1.25 k-ft

ETABS Comparison - Lateral 2

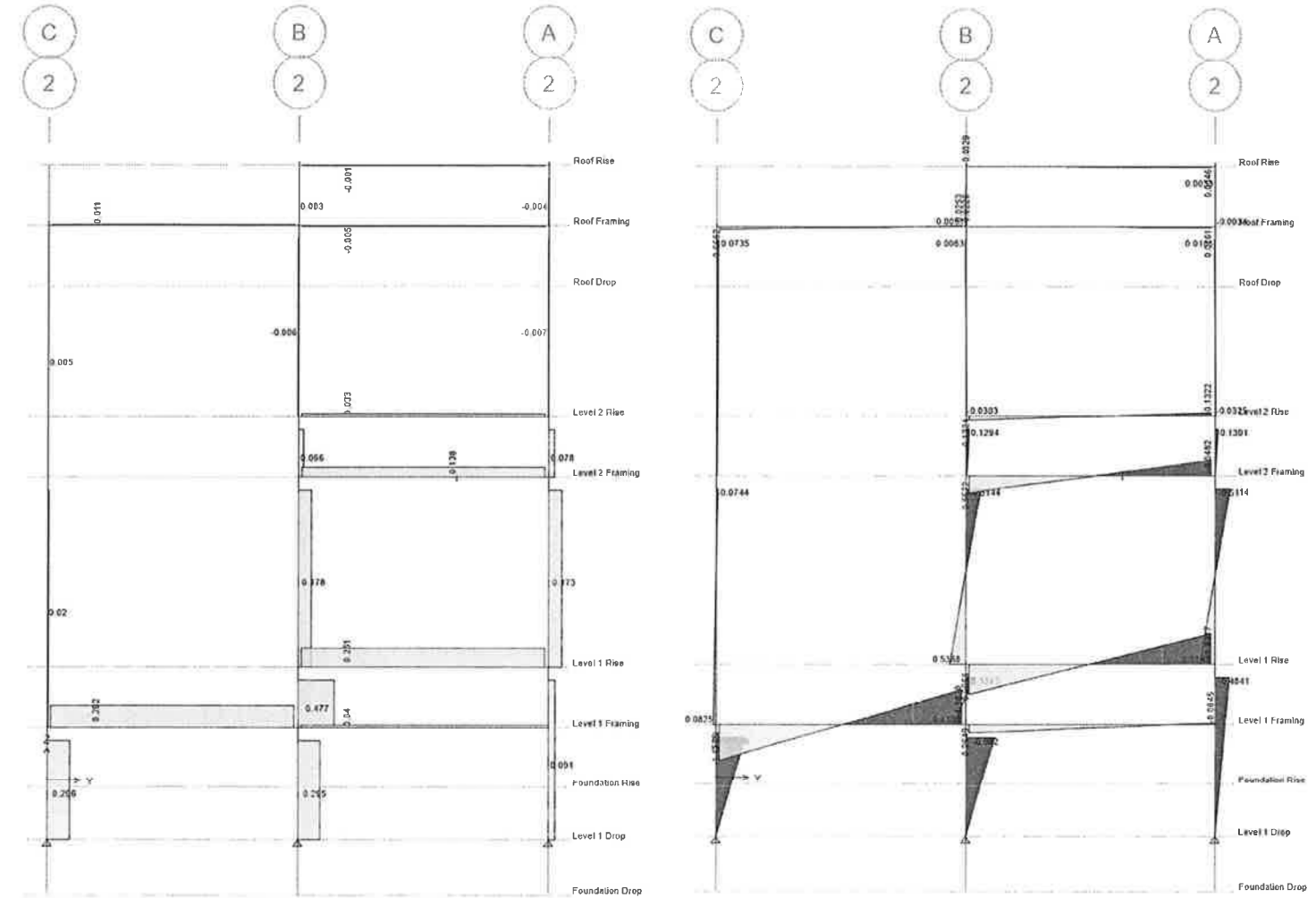
Elevation of Line 2



Elevation

Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	0.340
Roof Framing	0.340
Level 2 Rise	0.331
Level 2 Framing	0.316
Level 1 Rise	0.195
Level 1 Framing	0.176
Level 1 Drop	0.000

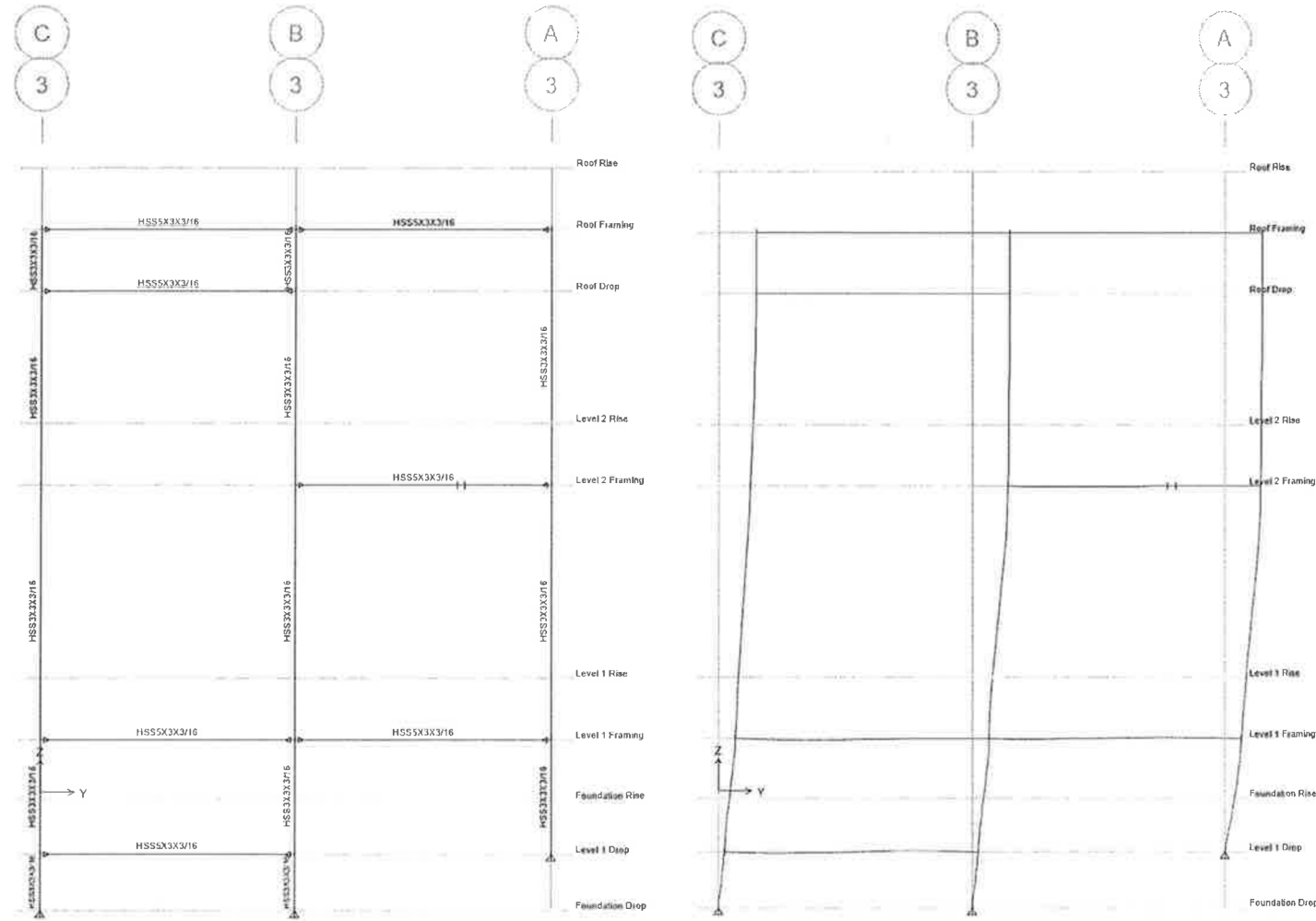


Shear

Moment

	MAX (+)	MIN (-)
Shear	0.68 kips	
Moment	1.18 k-ft	1.18 k-ft

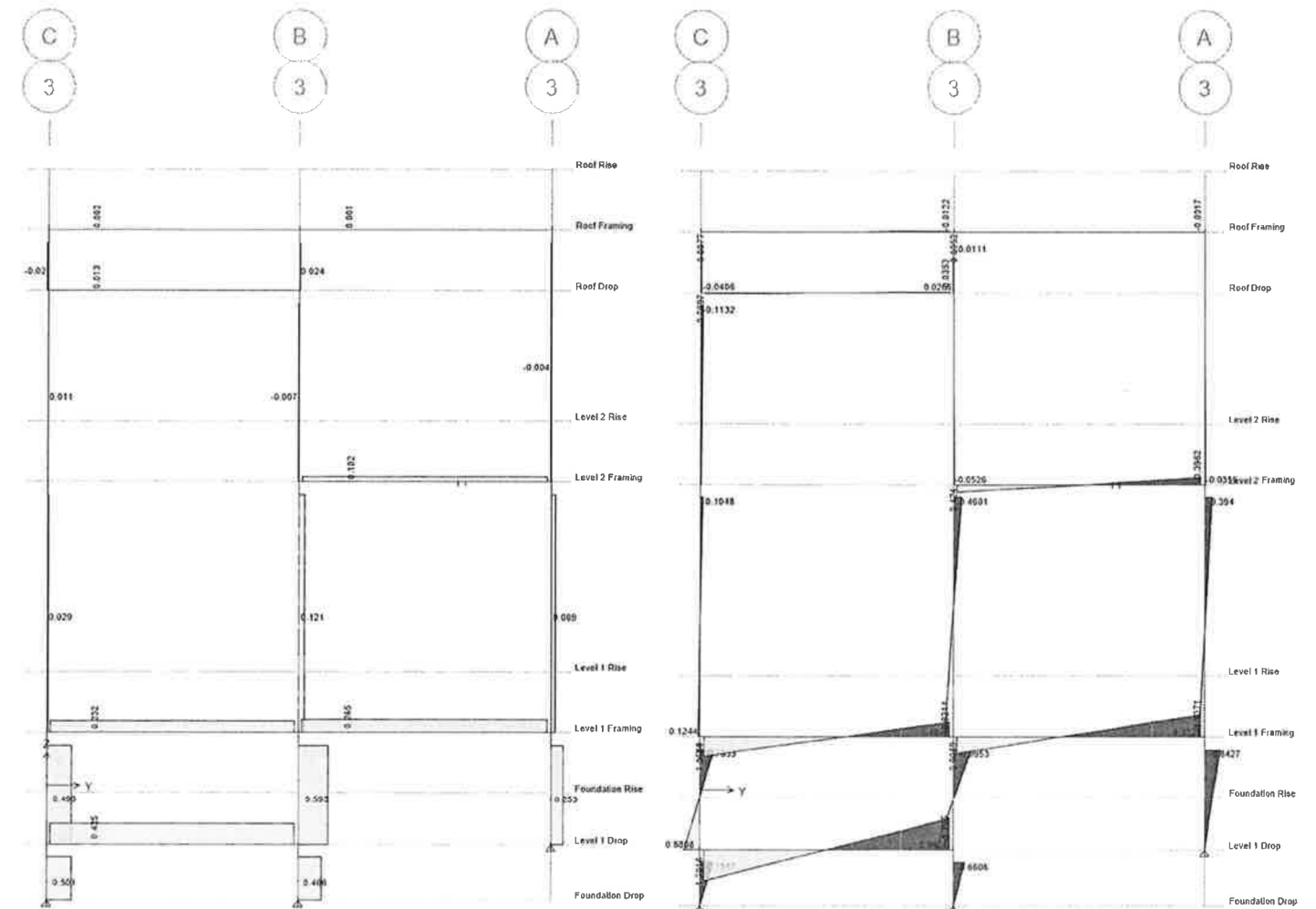
Elevation of Line 3



Elevation

Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	---
Roof Framing	0.367
Level 2 Rise	---
Level 2 Framing	0.355
Level 1 Rise	---
Level 1 Framing	0.168
Level 1 Drop	0.057

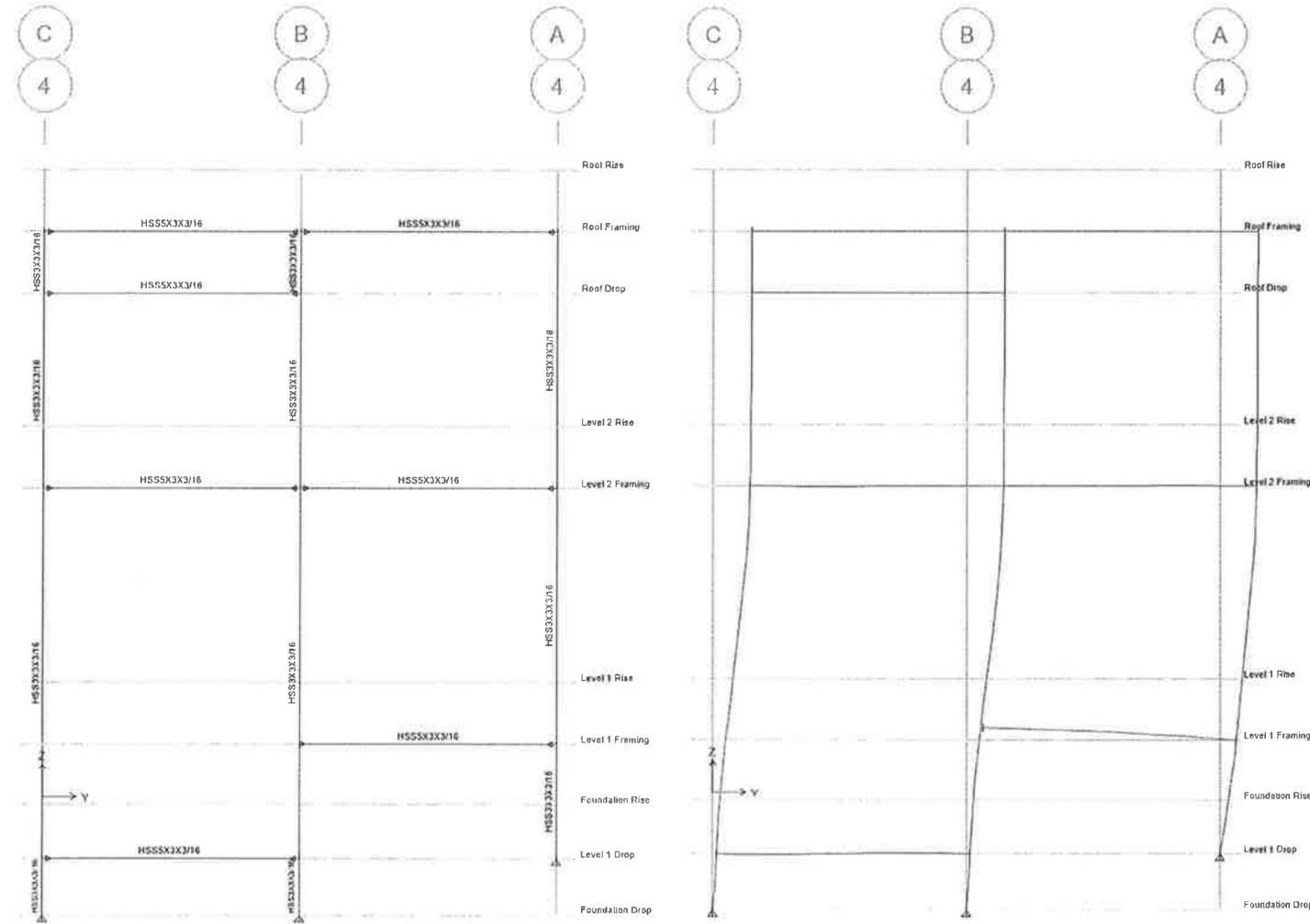


Shear

Moment

	MAX (+)	MIN (-)
Shear	1.22 kips	
Moment	1.70 k-ft	1.74 k-ft

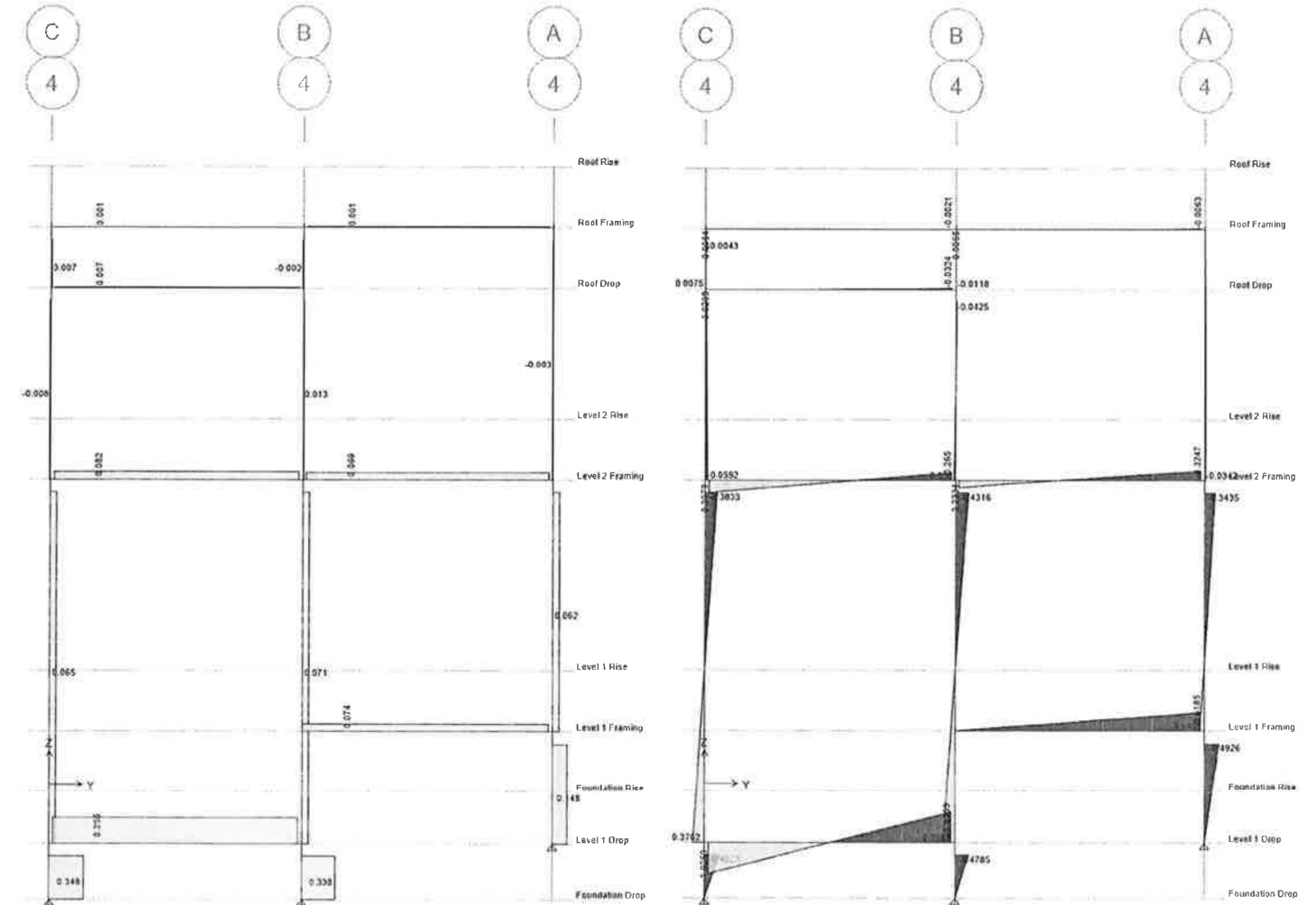
Elevation of Line 4



Elevation

Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	---
Roof Framing	0.378
Level 2 Rise	---
Level 2 Framing	0.364
Level 1 Rise	---
Level 1 Framing	0.163
Level 1 Drop	0.037

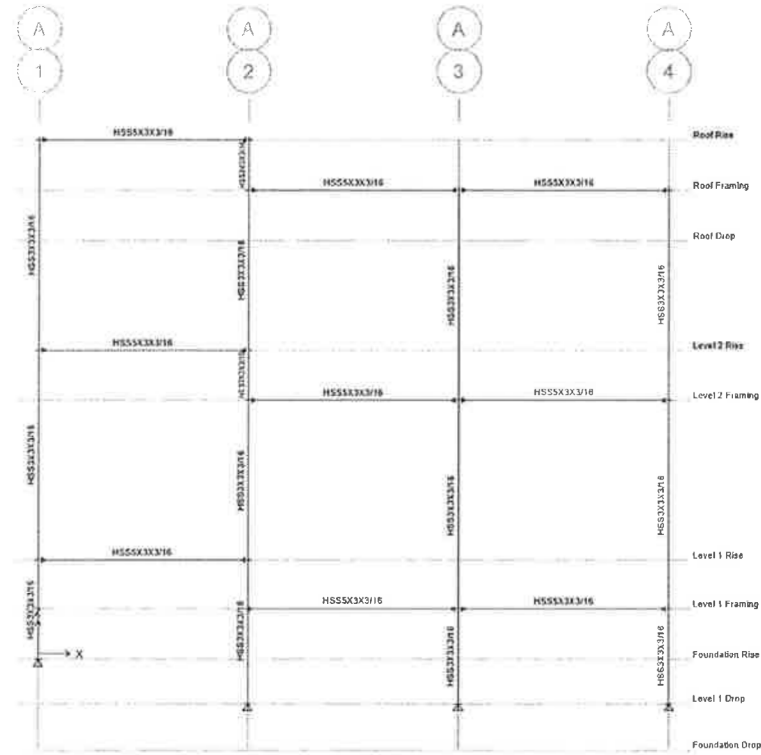


Shear

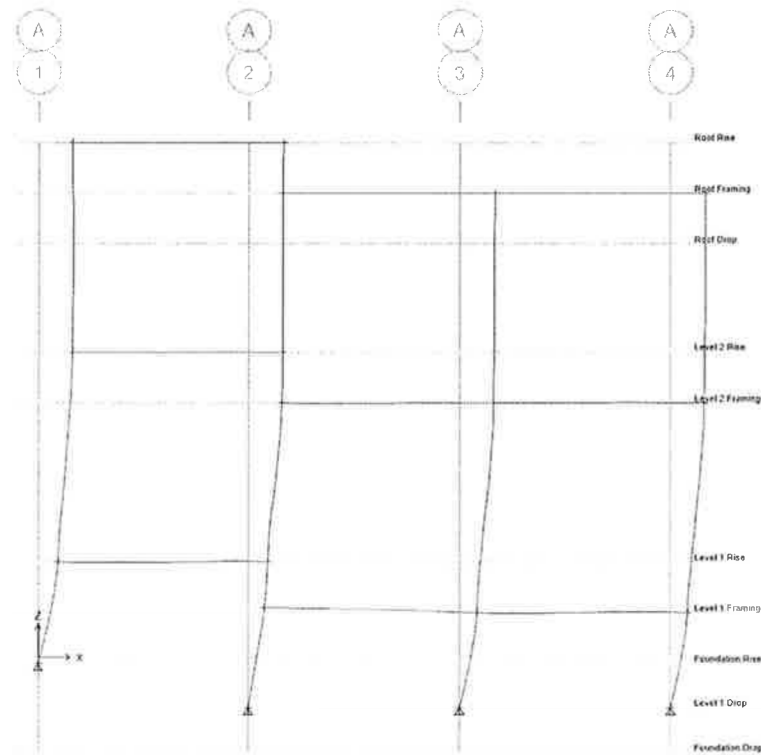
Moment

	MAX (+)	MIN (-)
Shear	0.83 kips	
Moment	1.03 k-ft	1.04 k-ft

Elevation of Line A

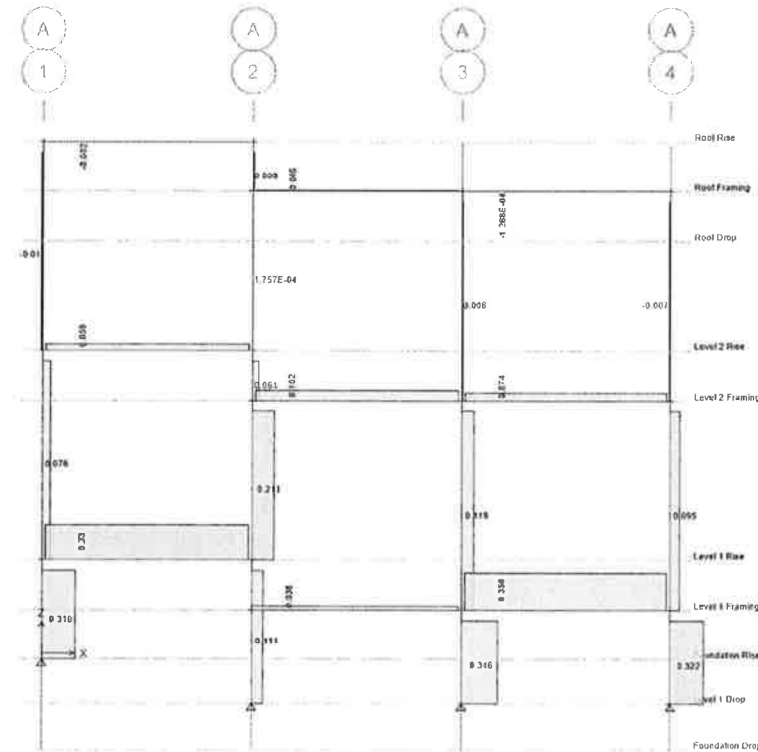


Elevation

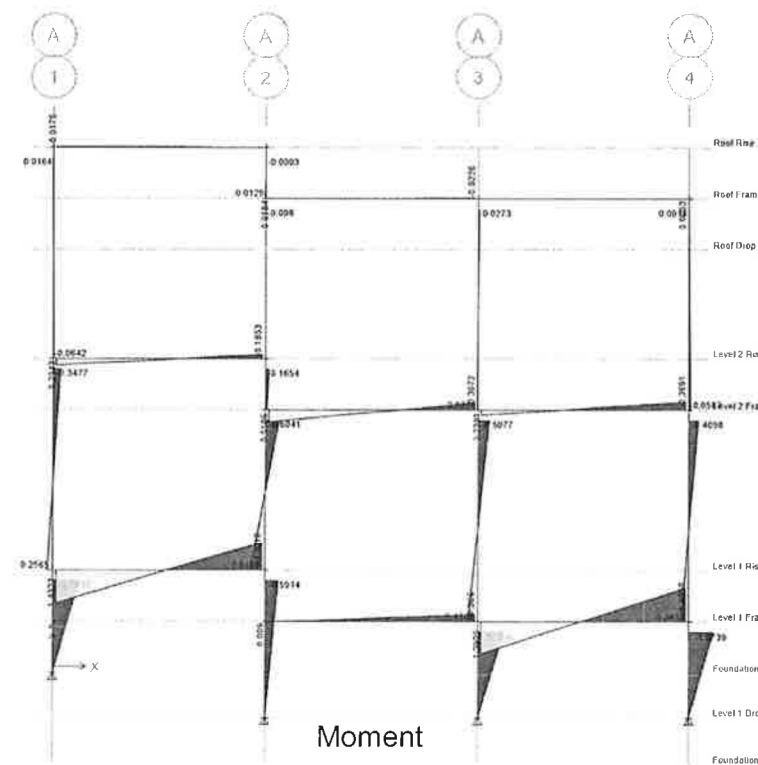


Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	0.412
Roof Framing	0.411
Level 2 Rise	0.408
Level 2 Framing	0.399
Level 1 Rise	0.232
Level 1 Framing	0.199
Level 1 Drop	0



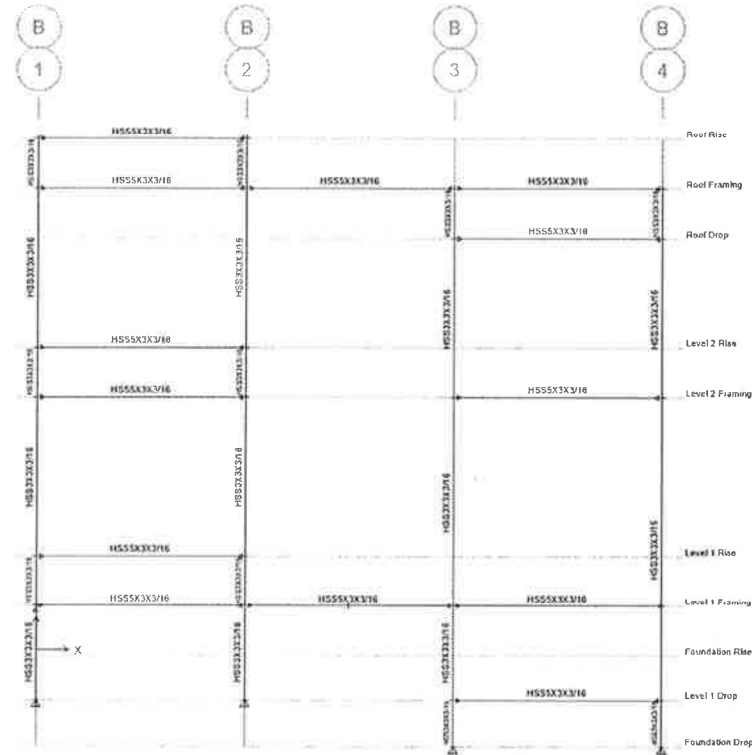
Shear



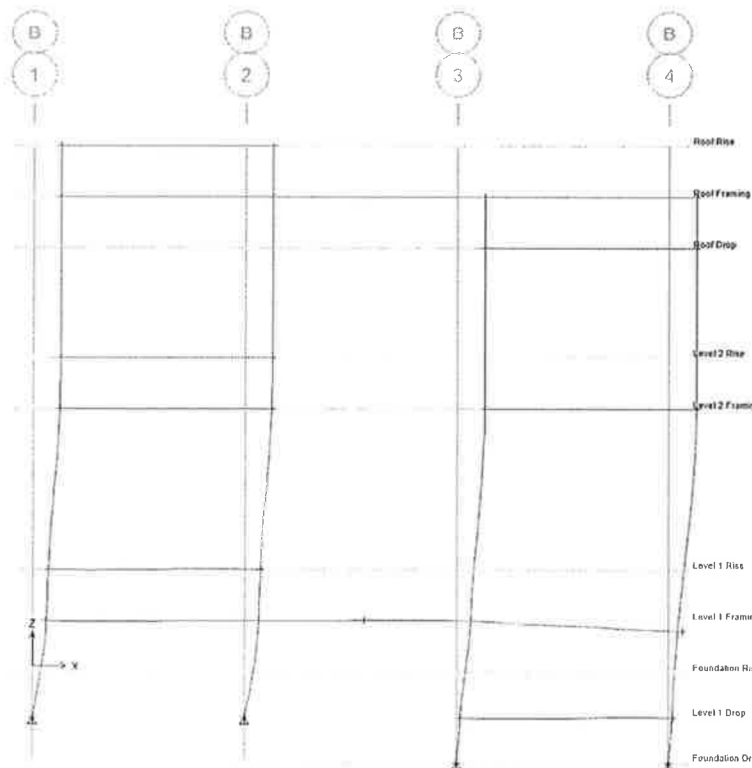
Moment

	MAX (+)	MIN (-)
Shear	1.10 kips	
Moment	1.43 k-ft	-1.49 k-ft

Elevation on Line B

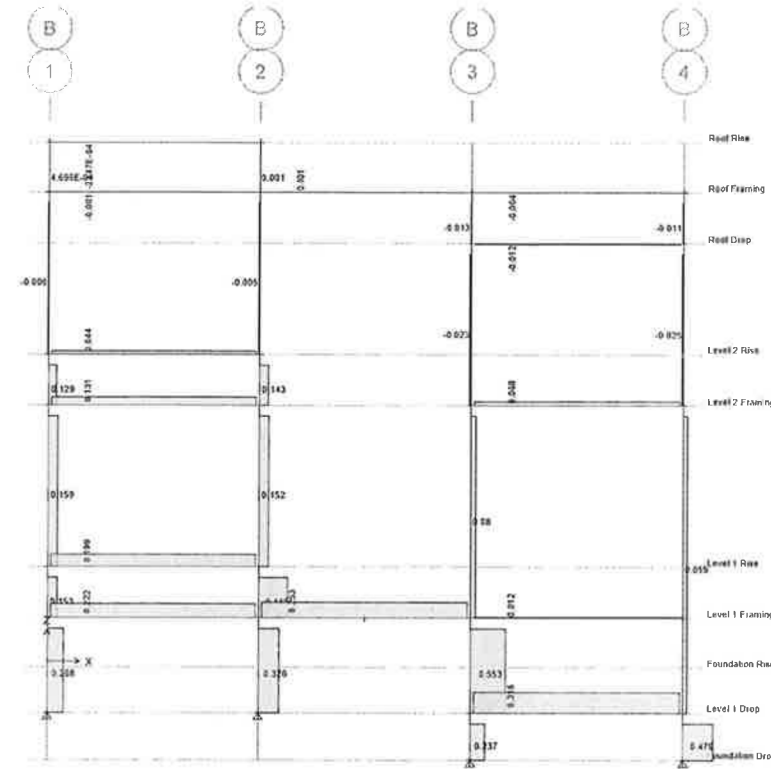


Elevation

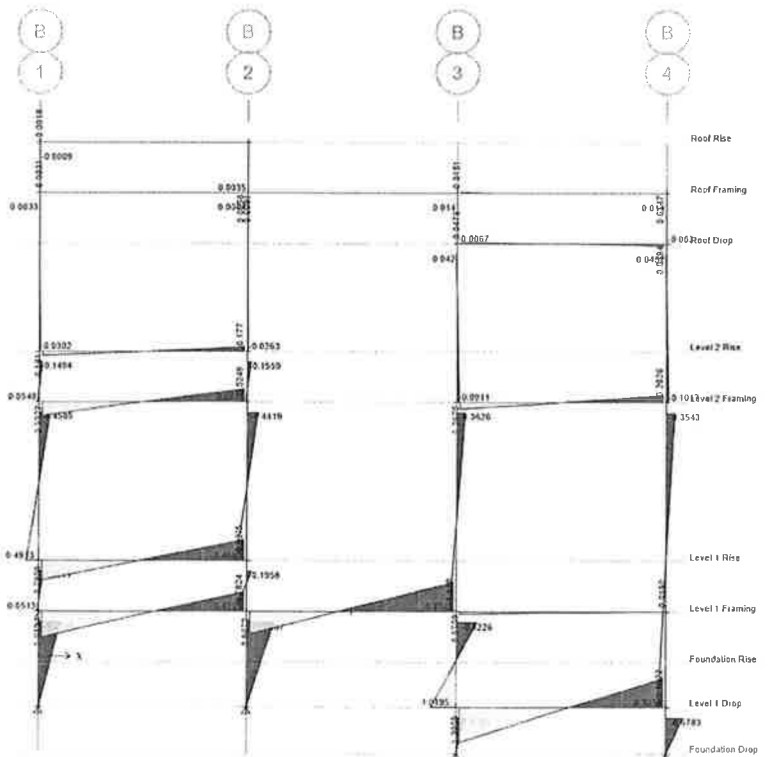


Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	0.324
Roof Framing	0.324
Level 2 Rise	0.320
Level 2 Framing	0.310
Level 1 Rise	0.185
Level 1 Framing	0.162
Level 1 Drop	0.042



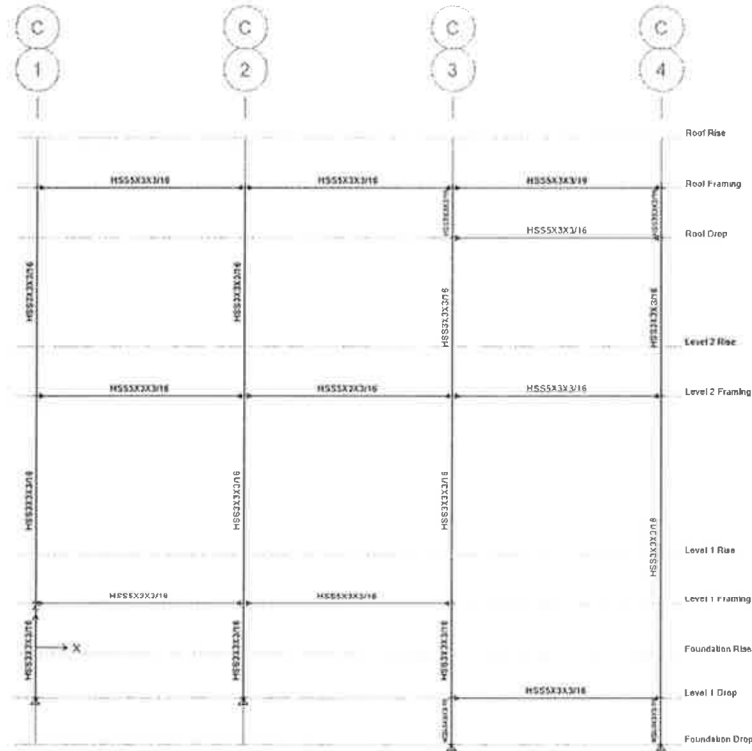
Shear



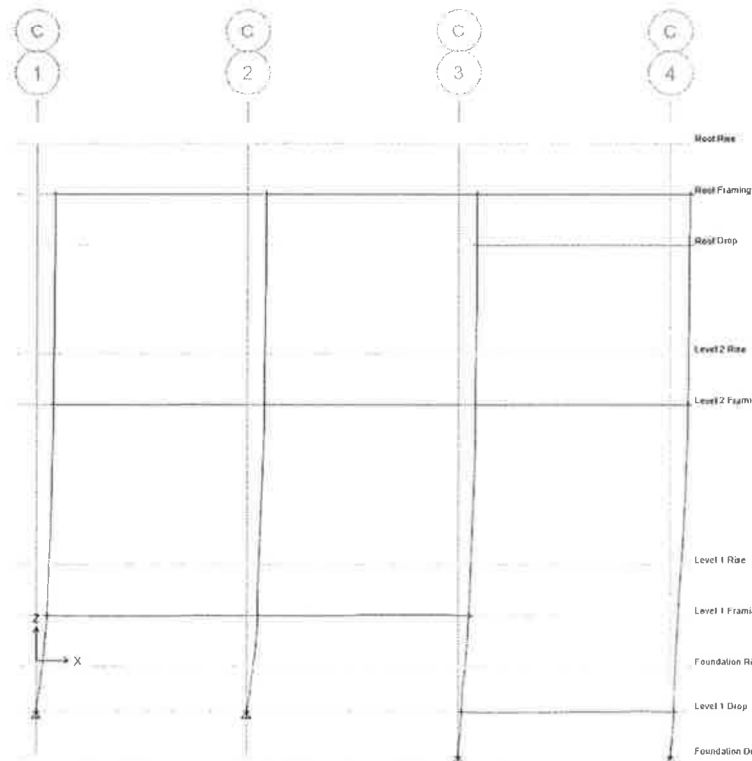
Moment

	MAX (+)	MIN (-)
Shear	1.10 kips	
Moment	1.40 k-ft	1.18 k-ft

Elevation on Line C

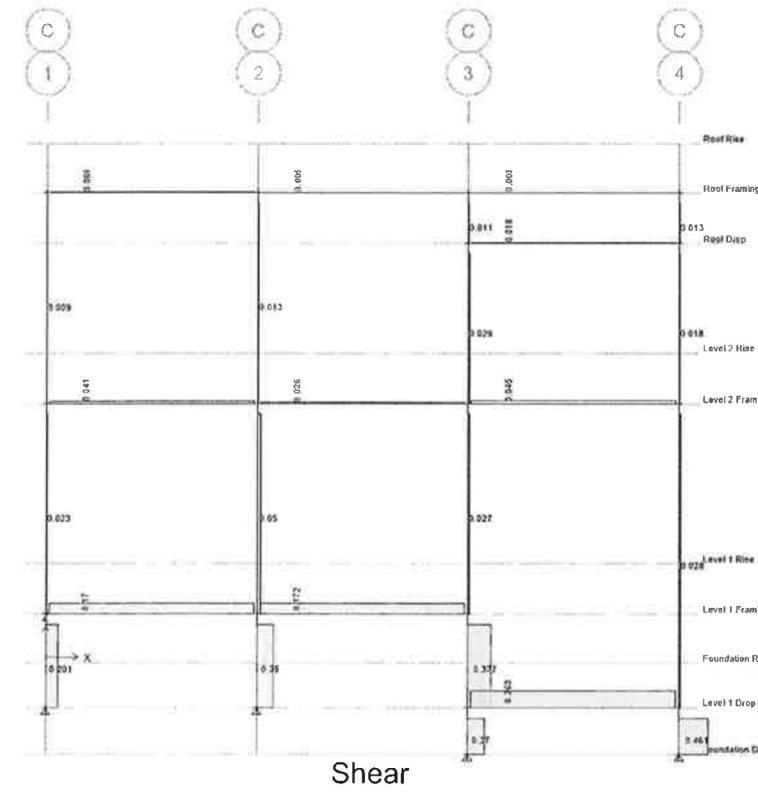


Elevation

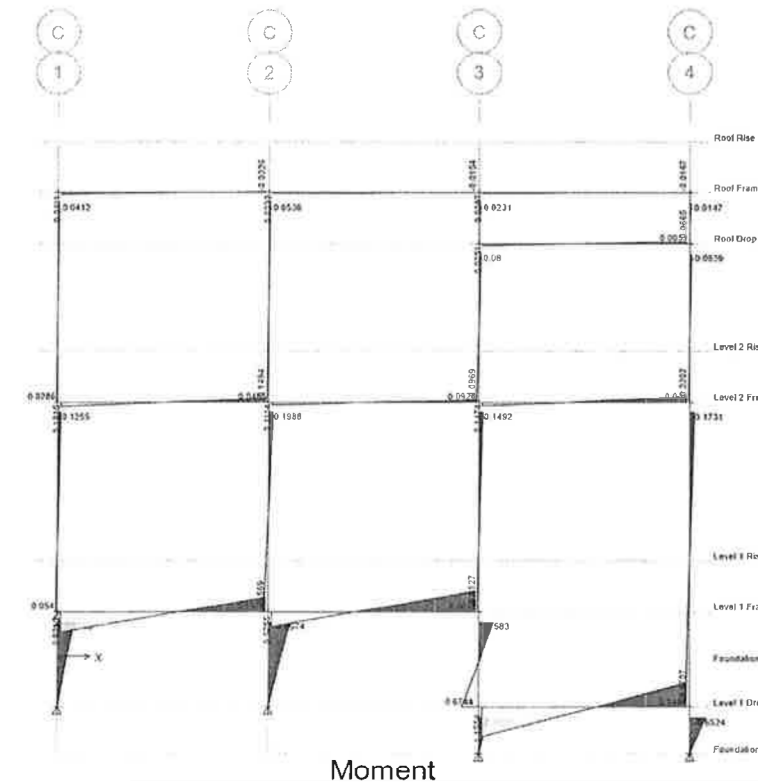


Deformed Shape

LEVEL	Displacement (inches)
Roof Rise	---
Roof Framing	0.226
Level 2 Rise	---
Level 2 Framing	0.204
Level 1 Rise	---
Level 1 Framing	0.125
Level 1 Drop	0.039



Shear

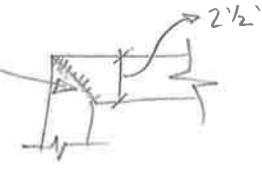


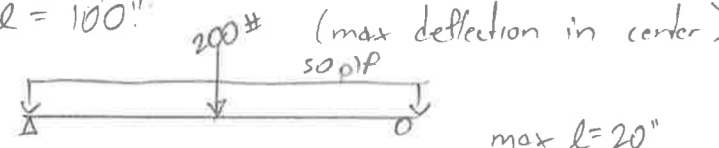
Moment

	MAX (+)	MIN (-)
Shear	1.19 kips	
Moment	1.16 k-ft	0.97 k-ft

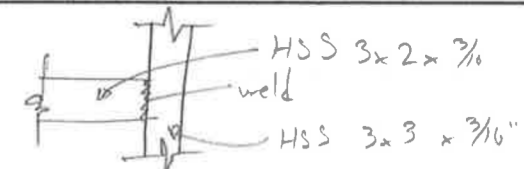
Detail 2: S.3.10

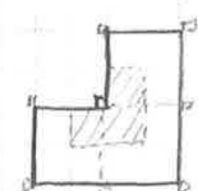
References	System: Panel Connections (capacities)	Comments
	<p>HSS \rightarrow C 3x5x2" : A36 $l_w = 10"$ min weld = $\frac{1}{8}"$ E60 electrode \rightarrow 60 ksi</p> <p>Shear strength weld metal $\phi R_n = 0.75(0.6)(60 \text{ ksi})(.707)(\frac{1}{8})(10") = \underline{24 \text{ kips}} \leftarrow \text{GOV}$</p> <p>Base metal: $\phi R_n = 0.9(0.6)(36 \text{ ksi})(\frac{3}{16})(10") = \underline{33.5 \text{ kips}}$</p> <p>C 3x5x2" \rightarrow L 2 1/2 x 1 1/2 x 3/16 : $\frac{1}{2}" \text{ } \phi \text{ Bolt A325}$</p> <p>Bolt shear = $R_n = F_u A_b$ $\phi R_n = (0.75)(54 \text{ ksi})(.196 \text{ in}^2) = \underline{8 \text{ kips}}$</p> <p>Bearing on plate = $\phi R_n = \phi [1.2 l_t F_u \leq 2.4 d F_u]$ tearout = $0.75 [1.2 (.75")(\frac{3}{16})(58 \text{ ksi})] = \underline{7.3 \text{ kips}}$ bearing = $0.75 [2.4)(\frac{1}{2})(\frac{3}{16})(58 \text{ ksi})] = \underline{9.8 \text{ kips}}$</p> <p>Shear yielding: $R_n = 0.60 F_y A_g$ $\phi R_n = (1.0)(0.60)(36 \text{ ksi})(1\frac{1}{2} \times \frac{3}{16}) = \underline{6 \text{ kips}}$</p> <p>Shear rupture: $R_n = 0.60 F_u A_n$ $\phi R_n = (0.75)(0.60)(58 \text{ ksi})(1.5 - .5)(\frac{3}{16}) = \underline{4.5 \text{ kips}} \leftarrow \text{GOV}$</p> <p>Tensile yielding: $R_n = F_y A_g$ $\phi R_n = (0.9)(36 \text{ ksi})(2" \times \frac{3}{16}) = \underline{12.2 \text{ kips}}$</p> <p>Tensile rupture: $R_n = F_u A_e$ $A_e \rightarrow A_n = (2 - .5)(\frac{3}{16}) = 0.28 \text{ in}^2$ $0.25(A_g) = 0.25(2 \times \frac{3}{16}) = 0.32 \text{ in}^2$ $\phi R_n = (0.75)(58 \text{ ksi})(0.32 \text{ in}^2) = \underline{13.4 \text{ kips}}$</p>	

References	System: Panel Connections (capacities)	Comments
	<p>Block Shear = $(J4-5) \quad (0.75)[0.6(58 \text{ ksi})(1\frac{1}{2} - .5)(\frac{3}{16}) + (58 \text{ ksi})(2 - .5)(\frac{3}{16})] = \underline{17 \text{ kips}}$ $0.75[0.6(36 \text{ ksi})(1\frac{1}{2})(\frac{3}{16}) + (58 \text{ ksi})(2 - .5)(\frac{3}{16})] = \underline{17 \text{ kips}}$</p> <p>Angle corner weld $l_w = 3.5" \times 2 = 7"$ min weld = $\frac{1}{8}"$ weld metal: $\phi R_n = 0.75(0.6)(60 \text{ ksi})(.707)(\frac{1}{8})(7") = \underline{16.7 \text{ kips}} \leftarrow \text{GOV}$</p> <p>Base metal: \angle $\phi R_n = 0.9(0.6)(36 \text{ ksi})(\frac{3}{16})(7") = \underline{25.5 \text{ kips}}$</p> 	

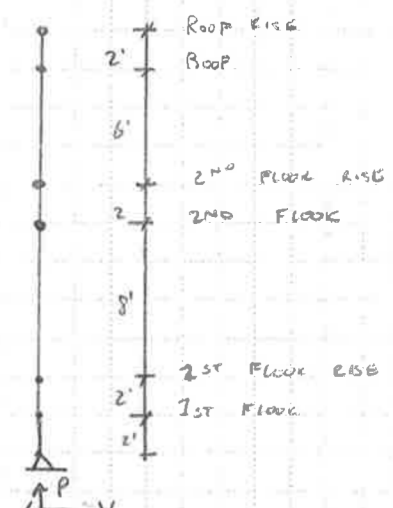

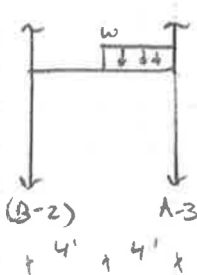
References	System: <u>Guard Rail Deflection</u>	Comments
	<p>HSS 3' x 2 x 3/16 $l = 100"$  $\Delta_{max} = \frac{Pl^3}{48EI}$ or $\Delta_{max} = \frac{5wl^4}{384EI}$ $I_x = 1.77 \text{ in}^4$ $I_y = 0.932 \text{ in}^4$ $\Delta_{max p} = \frac{(200\#)(24")^3}{48(29,000,000 \text{ psi})(1.77)} = 0.0011"$ $\Delta_{max w} = \frac{(50 \text{ plf})(5)(24")^4(12)}{384(29,000,000 \text{ psi})(1.77 \text{ in}^4)} = 0.05"$ $\Delta_{max p} = 0.0011" \times \frac{1.77"}{0.932"} = 0.0021"$ $\Delta_{max w} = 0.05" \times \frac{1.77"}{0.932"} = 0.096"$</p>	

Detail 4: S.3.10

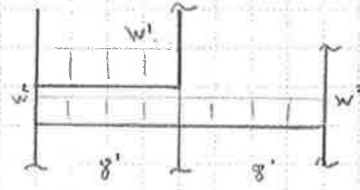
References	System: <u>Guardrail Connections</u>	Comments
	<p> A 36 E60 \rightarrow 60 ksi $l_w = 10"$ min weld = $\frac{1}{2}"$ Weld metal shear strength: $\phi R_n = 0.75(0.6)(60 \text{ ksi})(.707)(\frac{1}{8}")(10") = 24 \text{ kips}$ Base metal: $\phi R_n = 0.9(0.6)(36 \text{ ksi})(\frac{3}{16}")(10") = 37.5 \text{ kips}$</p>	

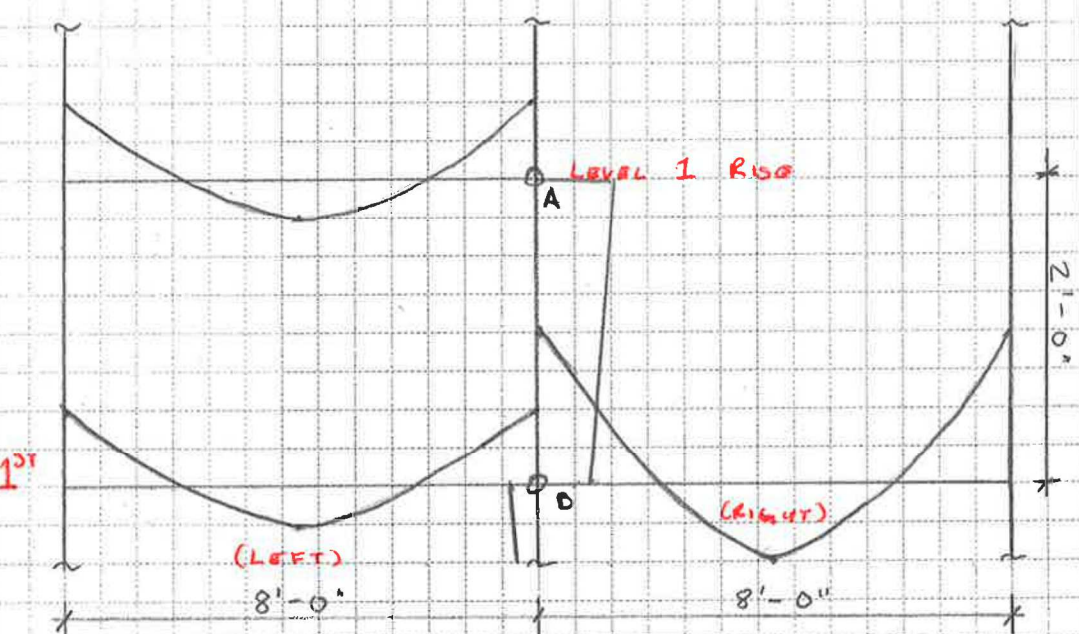
References	System: FRAME ANALYSIS	Comments
	<p>AXIAL ON COLUMN CONT.</p> <p>1st FLOOR</p>  <p>T.A = 3(4x4) = 48sf $P_o = 1.25k$ $P_L = 4.8k$</p> <p>$\Sigma P_o = 2.15k$ $\Sigma P_L = 8.25k$</p> <p>From RISA Maximum Axial = 1k → Load Combos $1.2D + 1.6L = 1.2(2.15k) + 1.6(8.25k) = 15.78k$ $0.9D + 1.0E = 0.9(2.15k) + 1.0(1k) = 2.93k$ $1.2D + 1.0E + 0.5L = 0.9(2.15k) + 1.0k + 0.5(8.25k) = 7.06k$ $15.78k < 86.4k \checkmark$ (Beam) $< 63.3k \checkmark$ (Col)</p> <p>From RISA (LATERAL) MAX SHEAR = 1.5k < 23k (COLUMN) ✓ MAX MOMENT = 26 k-ft</p> <p>BEAM LOADING (DEAD + LIVE WORSE CASE) → 1st FLOOR LINE B</p> <p>$w_o = 26.1 \text{ psf} (8') = .21 \text{ klf}$ $w_L = 100 \text{ psf} (8') = .8 \text{ klf}$</p> <p>$M = \frac{wl^2}{12}$ w/l = 8' $M_o = 1.12 \text{ k-ft}$ $M_L = 4.3 \text{ k-ft}$</p> <p>$V = \frac{wl}{2}$ w/l = 8' $V_o = .84 \text{ k}$ $V_L = 3.2 \text{ k}$</p> <p>LOAD COMBOS (BEAMS) SHEAR → 1.2D + 1.6L, EARTHQUAKE MINIMAL, V = 6.13k $6.13k < 19.5k$ (BEAM) ✓ $< 8k$ (CONNECT) ✓</p>	

Limit States 1

References	System: FRAME ANALYSIS	Comments
	<p>AXIAL ON COLUMNS LARGEST BEARING @ B-2</p>  <p>AXIAL FROM = 2nd Rise</p>  <p>T.A = 4'x4' = 16sf DEAD = 26.1 psf $P_o = .417k$ LIVE = 100 psf $P_L = 1.6k$</p> <p>• 2ND FLOOR</p>  <p>$w_o = 26.1 \text{ psf} (4') = 104.4 \text{ plf}$ $w_L = 100 \text{ psf} (4') = 400 \text{ plf}$</p> <p>$V_{B-2} = \frac{Pb^2}{l^2} (3a+b)$, a = 6', b = 2', P = w(4) $V_o = P_o = .0653k$ $V_L = P_L = .25k$</p> <p>1ST FLOOR RISE SAME AS 2ND FLOOR RISE $P_o = .417k$ $P_L = 1.6k$</p>	

Limit States 2

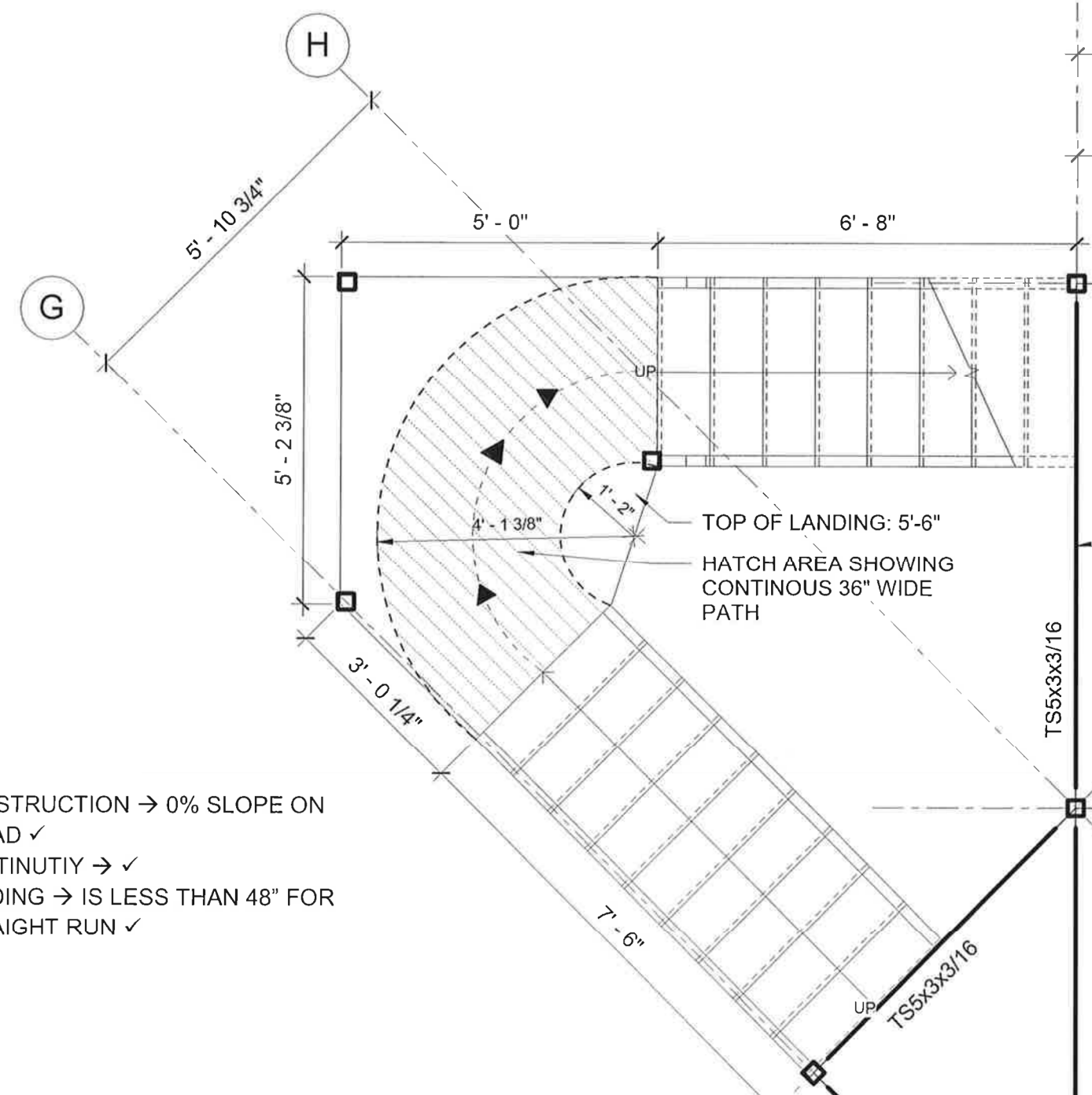
References	System: FRAME ANALYSIS	Comments
	<p>MOMENT COMBOS</p> $1.2 D + 1.6 L = 1.2(1.12) + 1.6(4.3) = 8.33 \text{ k-ft}$ $1.2 D + 1.0 E + 0.5 L = 1.2(1.12) + 1.0(2.6) + 0.5(4.3) = 6.09 \text{ k-ft}$ $0.9 D + E = 0.9(1.12) + 2.6 = 3.61 \text{ k-ft}$ <p>$8.33 \text{ k-ft} < 16.24 \text{ k-ft}$ (Beam) $< 11.1 \text{ k-ft}$ (Mom. Connect)</p> <p>POINTS OF INTEREST → ELEVATION OF LINE B</p>  <p>$w_1 = \text{psf}(4')$ $w_2 = \text{psf}(4')$ $w_3 = \text{psf}(8')$</p> <p>$w_1 \rightarrow w_{o1} = 26 \text{ psf}(4') = 104.4 \text{ plf}$ $w_{L1} = 100 \text{ psf}(4') = 400 \text{ plf}$</p> <p>$w_2 \rightarrow w_{o2} = 104.4 \text{ plf}$ $w_{L2} = 400 \text{ plf}$</p> <p>$w_3 \rightarrow w_{o3} = 26.1 \text{ psf}(8') = 208.8 \text{ plf}$ $w_{L3} = 200 \text{ psf}(8') = 1600 \text{ plf}$</p> <p>$M_{\text{beam}} = \frac{wL^2}{12}$</p> <p>END MOMENTS</p> <p>FIRST FLOOR RISE: DEAD = .56 k-ft LIVE = 2.13 k-ft</p> <p>FIRST FLOOR (LEFT): DEAD = .56 k-ft LIVE = 2.13 k-ft</p> <p>FIRST FLOOR (RIGHT): DEAD = 1.11 k-ft LIVE = 4.27 k-ft</p>	

References	System: FRAME ANALYSIS	Comments
	<p>MOMENT DIAGRAMS</p>  <p>AXIAL AT POINT A (DEAD)</p> $P = V_{\text{BEAM}} = \frac{wL}{2} = \frac{104.4 \text{ plf}(8')}{2} = 417.6 \text{ k}$ <p>INFLECTION → $M_{\text{beam}} = \frac{2.23 \text{ k-ft}}{P} = 5.31 \text{ ft}$ $6.31 \text{ ft} - 2 \text{ ft} = 3.31 \text{ ft}$ $3.31 \text{ ft} / 5.31 \text{ ft} = .6233$</p> <p>@ 2' (Level 1 Rise Dead) = .56(.6233) = .3491 k-ft</p> <p>∴ $\Sigma M_{\text{col}} = M_{\text{right}} - M_{\text{left}} - LIR - M_{\text{col}}$</p> <p>$M_{\text{col}} = M_{\text{c}} - M_{\text{c}} - LIR$</p> <p>DEAD $1.11 - .56 - .35 = .19 \text{ k-ft}$ LIVE $4.27 - 2.13 - 2.13(.6233) = .81 \text{ k-ft}$</p> <p>COMBOS @ B</p> $1.2 D + 1.6 L = 1.52 \text{ k-ft}$ $1.2 D + 1.0 E + 0.5 L = 3.23 \text{ k-ft} < 7.69 \text{ k-ft}$ $0.9 D + 1.0 E = 2.77 \text{ k-ft}$	

References	System: Phase 2 Stairs Code Compliance	Comments
1011.7	Construction → Stair shall not be more than a 2% → Water shall not accumulate on landing	
1011.6	Vertical Rise → Flight shall not be less than the stairs between Floor/ Landing	
	Landings → Shall not be less than the stairs → Where stairway has a straight run the depth need not exceed 48 in	
1011.3	Headroom → Clearance not less than 80 in	
1011.5.2	Riser Height → max: 7 in, min: 4 in	
	Tread Run → min: 11 in	
1014.3.2	Handrails → Section 1014	
1014.2	→ Height 34" to 38"	
	→ Graspability: Type 2	
	→ Continuity: Continuous (no exceptions)	
1015.2	Guards → Required	

Phase 2 Stairs 1

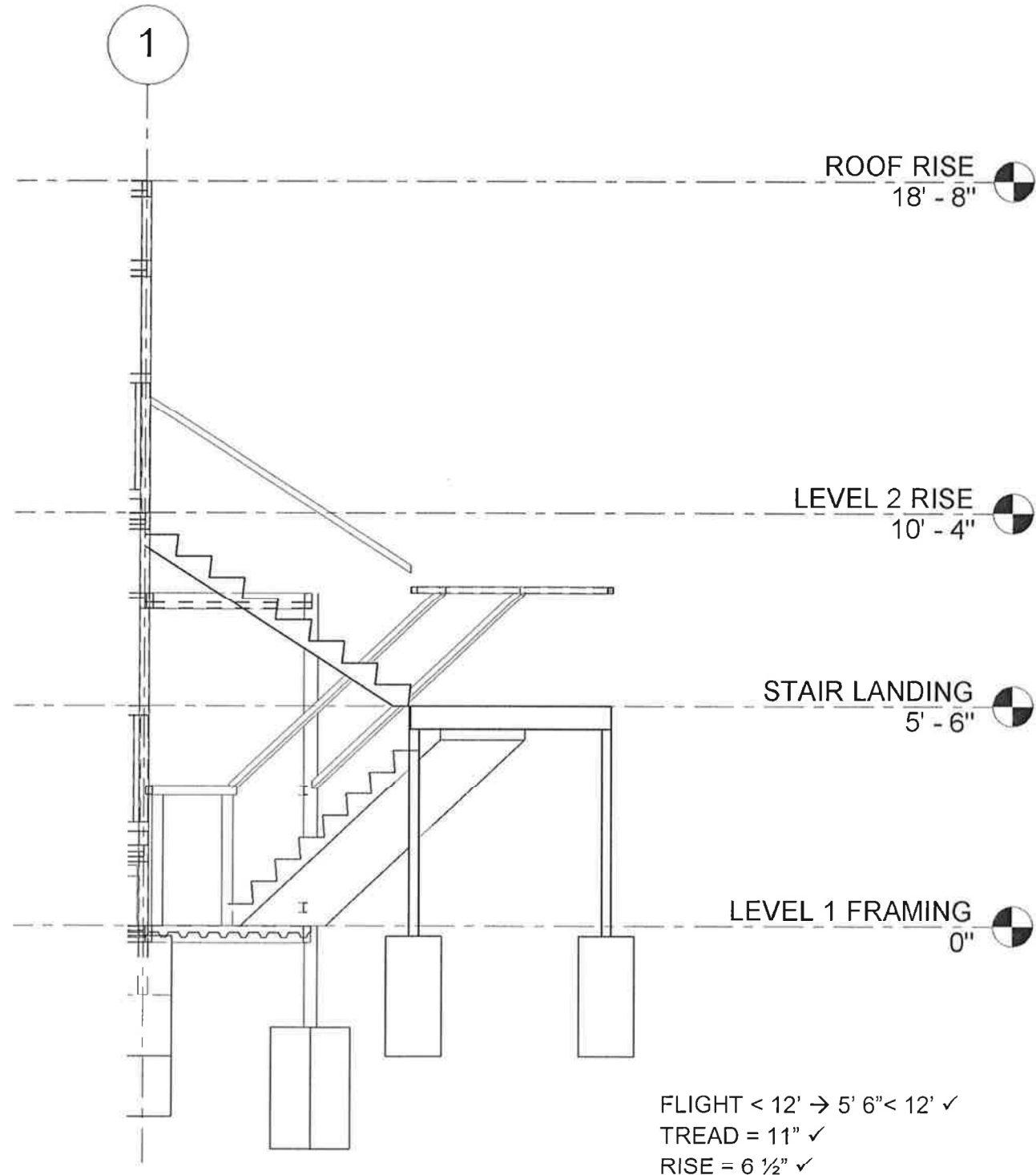
References	System:	Comments
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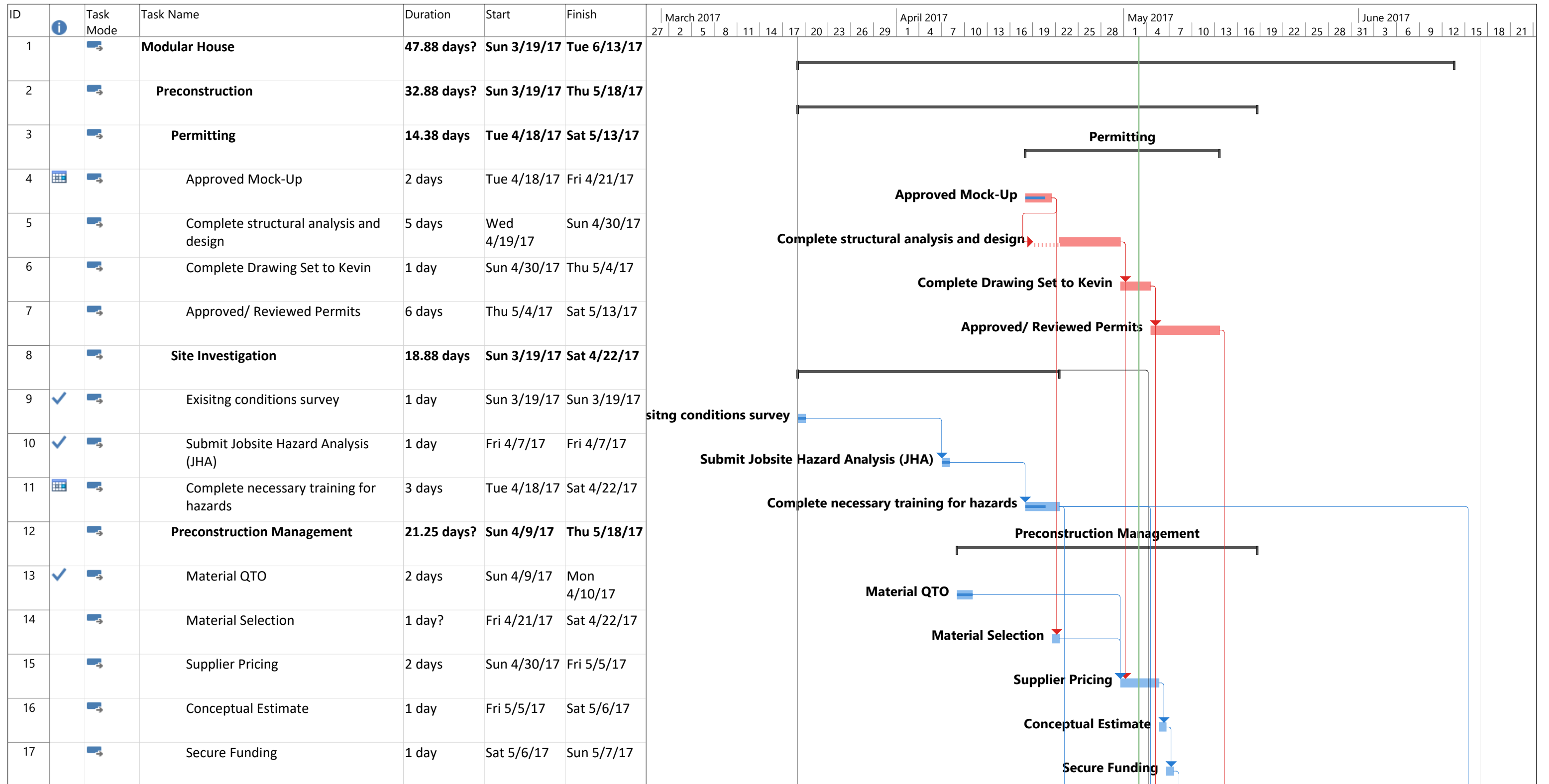
CONSTRUCTION → 0% SLOPE ON TREAD ✓
CONTINUTY → ✓
LANDING → IS LESS THAN 48" FOR STRAIGHT RUN ✓

Phase 2 Stairs 2

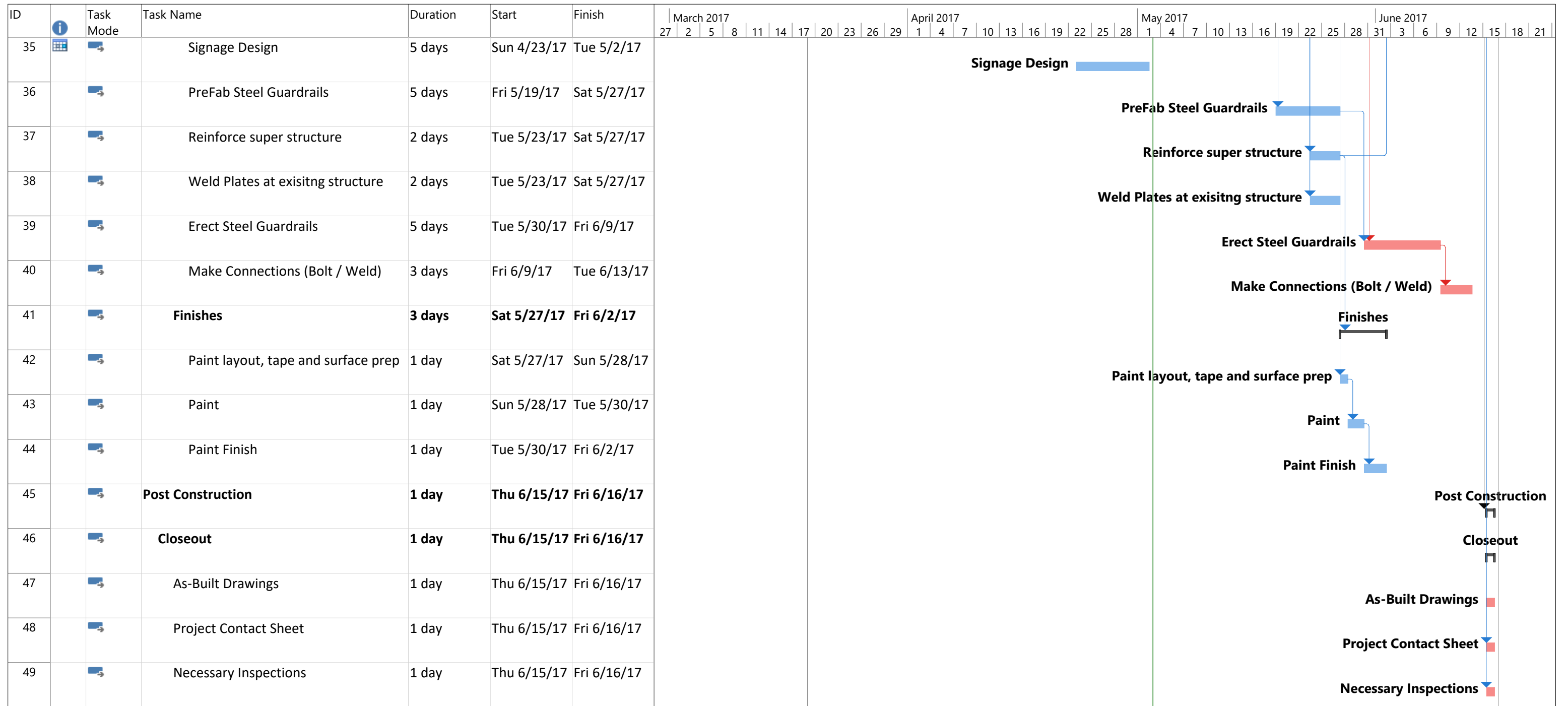
References	System:	Comments
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Phase 2 Stairs 3



Project: Modular House Workin Date: Wed 5/3/17	Task		Inactive Task		Manual Summary Rollup		External Milestone		Manual Progress
	Split		Inactive Milestone		Manual Summary		Deadline		
	Milestone		Inactive Summary		Start-only		Critical		
	Summary		Manual Task		Finish-only		Critical Split		
	Project Summary		Duration-only		External Tasks		Progress		



Project: Modular House Workin Date: Wed 5/3/17	Task		Inactive Task		Manual Summary Rollup		External Milestone		Manual Progress	
	Split		Inactive Milestone		Manual Summary		Deadline			
	Milestone		Inactive Summary		Start-only		Critical			
	Summary		Manual Task		Finish-only		Critical Split			
	Project Summary		Duration-only		External Tasks		Progress			