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Computer program for ultimate strength of longitudinally stiffened panels (small b/t), May 1966

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ERRATA

Page 1 - First paragraph, last sentence
Change; "lengths and panel" to read "lengths a panel".

Page 2 - Second paragraph, second sentence
Change; "completed" to 'completely"
Second paragraph, last sentence
Omit "now"

Page 3 - Program part no. 3
Change to read; Function BC which finds the zero root of a 2nd order parabolic equation by using Newton's Method for Finding Zeros.

Page 5 - Part III, No. 2b
Change; 'exceptable" to 'acceptable"

Page 6 - Variable QIC
Change; "interation" to 'iteration"

Acknowledgements - Change "Marily" to "Marilyn"

Page 3 - Program part no. 3
Change to read; Function VAL which computes a value using a parabolic equation.

Previously read	Should read
P. 9 of 13	
C14 = x(17) + C12 * (C3 - CR * CS)	C14 = x(17) + C12 * (C3 - REL * CS) * CR
x(12) = x(11) - (C2 * (C13 - 0.5 * Q * C2) + C3 * (C14 - 0.5 * C12 * C3))/REL	x(12) = x(11) - C2 * (C13 + .5 * Q * C2) - C3 * (C14/REL + .5 * C12 * C3)
P. 10 of 13	
x (18) = C14 + C12 * CR * CS	x(18) = C14 + C12 * CR * REL * CS
P. 11 of 13	
AL(K) = AL(K - 2) - .5 * C1 * C1/C2	AL(K) = AL(K - 2) - 0.125 * C1 * C1/C2

BUILT-UP MEMBERS IN PLASTIC DESIGN

COMPUTER PROGRAM FOR ULTIMATE STRENGTH OF LONGITUDINALLY STIFFENED PANELS (SMALL b/t)

by

Bruce A. Bott

Jun Kondo

Alexis Ostapenko

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Fritz Engineering Laboratory
Department of Civil Engineering
Lehigh University
Bethlehem, Pennsylvania

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INTRODUCTION

One of the more common ship building elements are the longitudinally stiffened plates of Fig. 1(a).[1] Their frequent use in ships makes a thorough knowledge of their behavior important. Consequently, a computer program was developed for the analysis of such sections subjected to the combined transverse and axial loading shown in Fig. 1(b). The program described in this report is an improved Fortran II version of the program originally written in WIZ* by Jun Kondo. The program analyzes a stiffened plate panel and determines the maximum fixed and simply supported lengths and panel can have under a given loading.

The analysis is basically a two step process. The main program first develops a moment-curvature-thrust curve for the given section. Then the integration subroutine determines the maximum fixed and simply supported lengths allowable for a series of midpoint starting curvatures. Plotting these maximum lengths against the midpoint starting curvatures produces a curve which is concave downward. The peak on this curve is the maximum length the panel can have under the given loading.

In the course of this analysis, the effects of residual stresses and differing yield points in the stiffener and in the plate are considered. There are no limitations imposed on the relative proportions of the cross section other than the requirement

* A GE compiler used at Lehigh University

that the ratio of the stiffener spacing to the plate thickness (b/t) be sufficiently small (less than about 40) to prevent plate buckling.

In the integration procedure used in the program, the section is called upon to resist both positive and negative bending moments. However, it was found that, for hybrid sections (different yield points in plate and stiffeners) subjected to high values of axial load, the moment-curvature curve would shift under varying load until it was completed on one side of the curvature axis (only positive or only negative moments). Such a position indicates that under axial load alone, the section requires the application of some internal moment along its center line in order to maintain equilibrium. The integration cannot be performed for such cases and this is now printed out on the output.

In addition to this alteration, provision has also been made for some identifying run or data set number to be included on the output. This number which is part of the input data, appears on the various pages of the output and aids in correlating results with input data.

The text of this report deals primarily with the preparation of data for the program, technical information about the program and its operation, and an explanation of the output. The appendices include a program listing (the main program, integration subroutine, and two required functions) and a series of example runs. The arrangement of the explanatory text conforms to the standards of Ship Design, Division Instruction 10462 of the Bureau of Ships, U. S. Navy.

PART I - IDENTIFICATION

1. Title: Ultimate Strength of Longitudinally Stiffened Panels (SMALL b/t)

2. Brief Description: On the basis of a computed M-Ø-P curve for the section under analysis, the program makes successive computations of the fixed and simply supported panel lengths corresponding to a given loading for each of a series of mid-point curvatures. By comparing each new set of lengths with those obtained on the last try, the maximum length is determined.

   The program consists of four parts:

   1) The main program which provides the M-Ø-P relationship for the section.

   2) Subroutine INTEG (integration) which determines the simply supported and fixed lengths corresponding to a given combination of axial and lateral load for some midpoint curvature.

   3) Function BC which computes, by parabolic interpolation, the peak value between 3 pts. on a curve.

   4) Function VAL which computes, by parabolic interpolation, the peak value between 3 points on a curve.

   Input data is read directly from cards into the main program. Termination occurs when an END card is read. (The main program will iterate through successive sets of data and within each of these sets, subroutine INTEG will iterate the value of lateral loading).

3. a) Author: Jun Kondo, Bruce A. Bott, and Alexis Ostapenko, Lehigh University.

   b) Date: May, 1966

4. Code: Fortran II

5. Machine: GE 225 (any other machine accepting Fortran II may be used).

6. Security Classification: Unclassified

7. Estimated Running Time:

Punch input data		1.0 min
Run time		2.5 min
	Total	3.5 min

PART II - PURPOSE & METHOD

1. Description of Theory: See "Ultimate Strength of Longitudinally Stiffened Plate Panels Subjected to Combined Axial and Lateral Loading", by Jun Kondo, Fritz Engineering Laboratory Report No. 248.13, Lehigh University, 1965.

2. Assumptions:

   1) No buckling - as a result, the program is applicable only to sections with low b/t ratios.

   2) The edges of the plate are assumed free.

   3) The distribution of the residual stresses in the plate is assumed to be rectangular. The residual stress distribution in the stiffener flange is assumed to be triangular. The residual stresses in the web of the stiffener have small effect and are therefore neglected. (See Fig. 2).

3. References: See report listed in 1) above.

PART III - RESTRICTIONS

1. General Restrictions: None
2. Limitations For Use:
   a) The condition of $G_{FC} = G_{FT} = 0$ (no residual stress in the stiffener flange) will not run. (It results in division by zero).
   b) Ratios of $G_{ST} > 2.0$ do not produce exceptable results in all cases and the output should be closely examined.
3. Nonstandard Hardware & Tapes: None
4. Maximum Array Sizes: 6 Arrays are used: FI (200)
   CM (200)
   EPS (200)
   AL (30)
   X (25)
   B (14)

PART IV - NONSTANDARD MACHINE OPERATING INSTRUCTIONS

1. Special Operating Instructions: None
2. Restart Instructions: None
3. Error Correction: None

PART V - DATA PREPARATION

1. Card Input Form:

Card	Format	Variable Name	Comment
1	I5	IRUN	Label for data set (i.e.-set #15)
2	7F10.4	AST	Nondimensional area of stiffener
		D	Nondimensional depth
		AFF	Nondimensional area of flange
		GRC	Nondimensional residual stress in plate
		GST	Ratio of yield stress in stiffener to yield stress in plate
		GFC	Nondimensional compressive residual stress in stiffener flange
		GFT	Nondimensional tensile residual stress in stiffener flange
3	6F10.4	P	Nondimensional axial load
		QI	Nondimensional initial value of lateral load (for iteration in subroutine)
		QIC	Nondimensional increment of lateral load (for interation in subroutine)
		QMAX	Nondimensional maximum value of lateral load to be run
		DSI	Increment of panel length to be used in subroutine Integ
		FIC	Increment of curvature for subroutine Integ

For additional data sets repeat the above sequence.

Last card - End (1st 3 columns) this terminates the run with an illegal character on a data card.

2. Sample Input:

							Format Comment
55							I5
.3	10.0	.45	0.0	1.0	0.3	0.3	7F10.4
.4	0.0	3.0	3.0	.18	.15		6F10.4

3. Output Form Description:

Page	Comment
1 & 2	Lists input data and run number for checking and later identification. Lists some computed member properties (identified on output). Lists 201 points on the M-Ø-P plot for the given panel.
3(&4)*	Lists values of axial load P and lateral load Q.
	Lists length, lateral midheight deflection, vertical movement of ends, fixed end moment, and end slope for a given midheight curvature. For each value of midheight curvature, this information is produced twice, once for the fixed condition and once for the pinned end condition.
	As a peak of L is passed in each of the plots of PHC vs. L, (fixed end and pinned end) the peak value of L and the corresponding values of other quantities are computed and printed.
5	Summary of results for each combination of axial and lateral load.

4. Symbol List and Definitions:

A	Total area of section divided by area of plate
AF	Area of flange divided by area of plate
AFF	Area of stiffener flange divided by area of stiffener

* Depending on amount of output

AI	Moment of inertia of the section (Nondimensional)
AMPN	Negative plastic moment capacity of the section (Nondimensional)
AST	Stiffener cross sectional area divided by area of plate
AW	Area of web divided by area of plate
B	Matrix which stores the results obtained by the integration subroutine for later printing in the summary of results
BC	Function which establishes equilibrium and compatibility for each length increment
BRC	Total width of compressive residual stress zone in the plate divided by the total plate width
BRT	Width of tensile residual stress zone in plate divided by total plate width
CM	Moment array for the M - Ø - P Plot
CMO	Moment at point zero (see EPSO)
COSF	Cosine function
D	Depth of stiffener divided by plate thickness
D1	Total section depth divided by plate thickness
D3	Distance from elastic neutral axis to the extreme fiber in the stiffener flange divided by the plate thickness
DSI	Increment of length used in the integration subroutine
EPS	Strain in the extreme fiber of the plate
EPSO	In the original language used for this program, dimensioning an array for 200 locations reserved 201 machine locations (0-200 inclusive). In Fortran II, dimensioning for 200 locations reserves exactly 200 locations (1-200 inclusive). Therefore in the Fortran II translation, it was necessary to create the variable EPSO to correspond to the location EPS(0) in the original version.
EY	Yield strain
FI	Curvature array for the M - Ø - P plot
FIC	Increment of curvature in the integration subroutine
FIO	Curvature at point zero (see EPSO)

GFC	Compressive residual stress in the stiffener flange (σ_{fc}) divided by the yield stress of the plate (σ_{yp})*
GFT	Tensile residual stress in the stiffener flange (σ_{ft}) divided by the yield stress of the plate*
GRC	Compressive residual stress in the plate (σ_{rc}) divided by the yield stress of the plate*
GST	Yield point in the stiffener divided by the yield point in the plate
H	Resultant force acting on the cross section in the z-direction
I	Counter
IRUN	Run number or data set number
ISW	Switching parameter
ISWA	Switching parameter
ISWB	Switching parameter
ISWC	Switching parameter
ISWD	Switching parameter
JA	Counter
JB	Counter
K	Counter
N	Counter
P	Nondimensional axial load as a fraction of the yield axial load (P/P_y)**, where P_y = (yield point of plate) x (total panel area)
PHC	Curvature at the midheight of the section
Q	Lateral load (Nondimensional) ($Q=(q)(E)(b)(d)/(\text{yield point of plate})^2$ (total area) where: q = Hydrostatic pressure on section; E = Modulus of elasticity; b = Stiffener spacing; d = Distance from elastic neutral axis to extreme fiber in stiffener flange)

* See Fig. 2

** Note that this quantity can reach a value greater than 1.0 for some sections.

QI	Initial lateral load value to be run
QIC	Increment of lateral load in the integration subroutine
QMAX	Maximum lateral load value to be run
S	Section modulus (Nondimensional)
SINF	Sine Function
SQRTF	Square root function
VAL	Function for parabolic interpolation of curve peaks
W	Thickness of the stiffener web divided by the plate thickness

The following variables and arrays are intermediate and have no general definition:

AL*	C11	F
C1	C12	X*
C2	C13	
C3	C14	

* Array

```
C
C     THIS IS THE BEGINNING OF THE MAIN PROGRAM WHICH COMPUTES THE
C     MOMENT - CURVATURE - THRUST CURVE FOR THE GIVEN SECTION.
C
C     ALL QUANTITIES ARE PLACED IN COMMON SO THAT THEY WILL BE AVAILABLE
C     TO THE SUBROUTINE AND THE FUNCTIONS WHICH ARE REQUIRED.
C
         COMMON I, N, EPS, BRT, X, BRC, FI, C7, QST, EPSO, FIU, QI, F, JA,
        1P, REL, ISWA, ISWB, ISWC, ISWD, ISW, AL, DSI, CM, CMO, AMLI, JB,
        2C1, C2, C3, REY, C11, C12, C13, C14, EY, CR, AMPN, C5, CA, CB, K,
        3FIC, LP, QMAX, QIC, IRUN
C
C     200 POINTS WILL BE COMPUTED ON THE M - PHI - P CURVE
C     HENCE, 200 LOCATIONS ARE DIMENSIONED FOR MOMENT (CM), CURVATURE
C     ( FI ), AND STRAIN IN THE OUTER FIBER OF THE PLATE ( EPS ).
C
         DIMENSION CM(200), FI(200), EPS(200), AL(30), X(25)
C
C     READ IN THE DATA SET NUMBER AND PRINT IT ON THE TOP OF THE FIRST
C     PAGE OF OUTPUT.
C
       1 READ  33, IRUN
      33 FORMAT ( I5 )
         PRINT 200, IRUN
     200 FORMAT ( 9H1DATA SET, I5 )
C
C     READ THE NECESSARY INPUT DATA AND PRINT IT OUT ON THE OUTPUT SHEET
C     SO THAT INPUT CAN BE CORRELATED WITH RESULTS.
C
         PRINT 201
     201 FORMAT (11H0INPUT DATA//)
         READ 20,AST,D,AFF,GRC,GST,GFC,GFT,P   ,QI,QIC,QMAX,DSI,FIC
      20 FORMAT (7F10.4)
         PRINT 31
      31 FORMAT ( 1H0, 5X, 3HAST, 7X, 1HD, 7X, 3HAFF, 6X, 3HGRC, 6X,
        1 3HGST, 6X, 3HGFC, 6X, 3HGFT, 7X, 1HP, 7X, 2HQI, 6X, 3HQIC, 5X,
        2 4HQMAX, 6X, 3HDSI, 6X, 3HFIC, //)
         PRINT 30, AST, D, AFF, GRC, GST, GFC, GFT, P, QI, QIC, QMAX, DSI,
        1 FIC
      30 FORMAT ( 13F9.5)
C
C     COMPLTE SECTION PROPERTIES.
C
         EY = 1.3344595E-3
         REY = 3.6530254E-2
         D1 = D + 1.
         BRT = GRC / (1. + GRC)
         BRC = 1. - BRT
         AF = AFF * AST
         AW = AST - AF
         W = AW / D
         A = 1. + AST
         D2 = D + D1
         CMM = .5 * ( D2 + AW * D)
         EL = CMM / A
         D3 = D1 - EL
```

```
C
      C6 = EL / D3
      C7 = EL / D1
      AI = A * EL * D3 + .5 *(D * 1./3. * AW * D *( 1. + D/3.))
      S = AI / EL
      RR = SQRTF ( AI / A )
      REL = RR / EL
      CR = D3 / RR
      C1 = A * P
      C2 = .5 *( 1. + GST * AST - C1)
      C3 = C1 * EL
      AMPN =(.5*(GST*AW*D+D2)-2.*C2*(D1-.5*C2)-C3)/S
C
C     PRINT OUT THESE SECTION PROPERTIES IN A TABLE.
C
      PRINT 32
   32 FORMAT (19H0SECTION PROPERTIES )
      PRINT 166
  166 FORMAT (1H0,8X,3HAST,13X,1HD,13X,3HAFF,12X,3HGRC,13X,2HRR,13X,2HEL
     1 , 12X, 4HAMPN, 13X, 1HP, //)
      PRINT 167, AST, D, AFF, GRC,RR, EL, AMPN, P
  167 FORMAT ( 8F15.7)
C
C     FOR ANY HYBRID SECTION, HIGH AXIAL LOADS WILL CAUSE THE MOMENT -
C     CURVATURE CURVE TO LIE ALL ON ONE SIDE OF THE CURVATURE AXIS.
C     HENCE, THE FOLLOWING CHECK IS NECESSARY.
C
C     SEE IF THERE IS A NEGATIVE LEG ON THE MOMENT - CURVATURE CURVE.
C     IF NOT, GO ON TO THE NEXT SET OF DATA.
C
      IF ( AMPN ) 34, 35, 35
   35 PRINT 36
   36 FORMAT ( 58H0AXIAL LOAD TOO HIGH (SECTION CANNOT MAINTAIN EQUILIBR
     1IUM))
      GO TO 1
C
C     SET UP THE HEADINGS FOR THE OUTPUT OF THE MOMENT - CURVATURE -
C     STRAIN RELATIONS.
C
   34 PRINT 168
  168 FORMAT ( 1H0, 7X, 1HN, 9X, 5HFI(N), 11X, 5HCM(N), 11X, 6HEPS(N),
     1 10X, 1HN, 9X, 5HFI(N), 11X, 5HCM(N), 11X, 6HEPS(N), ///)
C
C     COMPUTE THE REQUIRED 200 POINTS ON THE CURVE.
C
      X(1) = -BRT
      X(2) = BRT
      X(3) = -BRC
      X(4) = BRC
      X(5) = -W
      X(6) = W
      AL(17) = C1
      AL(19) = D1
      AL(18) = C
      AL(20) = 0
      AL(21) = 0
```

```
C
      AL(22) = 0.
      CA = AF / (GFC + GFT)
      FI(90) = P      + GST - GFT
      C1 = (1. - GRC - P     ) * C6
      C2 = (1. - GRC - GST + GFC) * C7
      IF( FI(90) - C1) 2, 100, 100
  100 FI(90) = C1
    2 IF( FI(90) - C2) 101, 101, 3
  101 FI(90) = .01
    3 AL(30) = -P      * C6
      C1 = P      - GST + GFC
      IF( AL(30) - C1) 102, 102, 4
  102 AL(30) = C1
    4 IF( AL(30) - C2) 5, 103, 103
  103 AL(30) = -.01
    5 N = 91
      ISW = 16
      ISWC = 6
      DEP = -.005
      JA = 10
      GO TO 24
    6 N = 90
      ISWC = 7
      AL(30) = FI(90)
      DEP = .005
      GO TO 24
    7 X(25) = .02
      ISW = 14
      ISWA = 16
      ISWB = 18
      ISWC = 8
      ISWD = 9
      I = 3
    8 N = N - 1
      IF(N) 21, 104, 104
  104 AMLT = (AL(26) - AL(25))/(AL(29) - AL(28))
    9 AL(30) = AL(29) + X(25)
      GO TO 10
   21 N = 91
      ISWA = 16
      ISWB = 18
      ISWC = 22
      ISWD = 23
      X(25) = .02
      AL(29) = FI(91)
      AL(28) = FI(90)
      DEP = -.005
      AL(26) = CM(91)
      AL(25) = CM(90)
      AL(23) = EPS(91)
   22 N = N + 1
      IF(N - 200) 105, 105, 27
  105 AMLT = (AL(26) - AL(25))/( AL(28) - AL(29))
   23 AL(30) = AL(29) - X(25)
      GO TO 10
```

```
C
 24 AL[23] = F     + AL[30]/ C6
 10 IF[ AL[30]] 25, 106, 25
106 AL[30] = .001
 25 F = AL[30] / EL
    C5 = C4 * F
    C8 = P     + F * D3
    DO 107 K = 1, 8
107 AL[K] = 0.
    X[7] = -C5
    X[8] = C5
    X[9] = -2.
    X[10] = -F-2.
    X[11] = GFC - 1.
    X[12] = X[11] - F
    DO 108 K = 17, 20
108 X[K] = X[K-8] + 2.
    X[13] = -F-GST
    X[14] = X[13] - F * D
    X[15] = X[14] + GFC
    X[16] = X[14] - GFT
    DO 109 K = 21, 24
109 X[K] = X[K-8] + 2. * GST
    DO 12 K = 1, 8
    IF[ AL[23] + X[K+8]] 11, 111, 111
111 AL[K] = X[K]
    AL[K+8] = X[K+8]
    GO TO 12
 11 IF[ AL[23] + X[K+16]] 112, 112, 12
112 AL[K] = X[K]
    AL[K+8] = X[K+16]
 12 CONTINUE
    AL[15]=AL[15] - GFC
    AL[16] = AL[16] + GFT
    C1 = 0.
    C2 = A * F
    C3 = -2. * C2 * C8
    C11 = AL[7] * GFC
    C12 = AL[8] * GFT
    C13 = C11 - C12
    C2 = C2 + C13
    C3 = C3 + 2.*[C11*AL[15] - C12* AL[16]]+[C11*GFC+C12* GFT]
    DO 110 K = 1, 7, 2
    C11 = AL[K] + AL[K+1]
    C14 = AL[K] * AL[K+8]
    C15 = AL[K+1] * AL[K+9]
    C12 = C14 + C15
    C13 = C14 * AL[K+8] + C15 * AL[K+9]
    C1 = C1 + C11
    C2 = C2 + C12
110 C3 = C3 + C13
    IF[C2 * C2 - C1 * C3] 26, 113, 113
113 C2 = 2. * C2
    AL[24] =  RC[C1, C2, C3, AL[23]]
    IF[ABSF[1.-AL[24]/AL[23]] - .000001 ] 13, 114, 114
114 JA = JA - 1
```

```
C
      IF( JA ) 13, 115, 115
  115 AL(23) = AL(24)
      GO TO 10
   26 AL(23) = AL(23) + DEP
      GO TO 10
   13 AL(27) = 0.
      DO 116 K = 1, 5, 2
      JB = K + 1
      C3 = 0.
      DO 117 JJ = 1, 2
      C1 = AL(24) + AL(JB+8)
      C2 = AL(JB) * C1 * C1 * (AL(JB+16) - C1 / (3. * F))
      C3 = C3 + C2
  117 JB = JB - 1
  116 AL(27) = AL(27) + C3
      JA = 10
C
C     THE NEXT STATEMENT IS SENSITIVE TO AXIAL LOAD ( SECTION MODULUS S
C     APPROACHES ZERO) AND MAY CAUSE DIVISION BY ZERO FOR HIGH VALUES OF
C     AXIAL LOAD P.
C
      AL(27) = AL(30) +(A*EL*(AL(24)-CB)+.5*AL(27)/F)/S
      LB = ISW
      GO TO 118
   14 C1 = ABSF((AL(26)*AMLT + X(25) ) / AL(27) + 1.)
      IF ( C1 - .001) 15, 130, 130
  130 I = I + 1
      IF(I) 16, 16, 131
  131 LB = ISWA
      GO TO 118
   15 IF( C1 - .000015) 132, 132, 16
  132 I = I + 1
      IF(I) 16, 16, 133
  133 LB = ISWB
      GO TO 118
   16 IF(N) 137, 138, 137
  138 FIC = AL(30)
      CMC = AL(27)
      EPSC = AL(24)
      GO TO 136
  137 FI(N) = AL(30)
      CM(N) = AL(27)
      EPS(N) = AL(24)
  136 I = 3
      DO 134 K = 23, 29
  134 AL(K) = AL(K+1)
      LB = ISWC
      GO TO 118
   17 X(25) = .02
      ISWA = 16
      ISWB = 18
      GO TO 135
   18 X(25) = .1
      ISWA = 17
      ISWB = 19
```

```
C
      GO TO 135
   19 X(25) = .5
      ISWB = 16
      ISWA = 18
  135 LB = ISWD
      GO TO 118
C
C     PRINT OUT THE COMPUTED POINTS AFTER CHECKING TO SEE IF THERE IS A
C     POSITIVE BRANCH ON THE MOMENT - CURVATURE CURVE. ( THIS CHECK IS
C     SIMILAR TO THAT PERFORMED AFTER THE PRINT OUT OF SECTION PROPERT-
C     IES ABOVE.)
C
   27 N = 0
      IF (CMO) 37, 37, 139
   37 PRINT 36
      GO TO 1
  139 PRINT 169, N, FIO, CMO, EPSO
  169 FORMAT (2(7X, I3, 3F16.7))
      DO 142 N = 1, 100
      NN = N + 100
      PRINT 169, N, FI(N), CM(N), EPS(N), NN, FI(NN), CM(NN), EPS(NN)
  142 CONTINUE
C
C     ONCE THE 200 POINTS HAVE BEEN COMPUTED, GO TO THE INTEGRATION STEP
C
      CALL INTEG
C
C     UPON RETURN FROM THE INTEGRATION STEP, GO BACK AND SEE IF THERE IS
C     ANOTHER SET OF DATA.
C
      GO TO 1
C
C     THE NEXT SERIES OF STATEMENTS IS A ROUTINE TO DETERMINE WHERE THE
C     PROGRAM SHOULD BRANCH TO NEXT.  GIVEN THE VALUE OF THE SWITCHING
C     PARAMETER ISW, ISWA, ISWB, ISWC, ISWD, THE ROUTINE PICKS THE
C     STATEMENT NUMBER TO GO TO NEXT.
C
  118 IF(LB-10) 119, 98, 120
  119 LB = LB - 5
      GO TO ( 6, 7, 8, 9 ), LB
  120 IF(LB-20) 121, 98, 122
  121 LB = LB - 13
      GO TO (14, 98, 16, 17, 18, 19), LB
  122 LB = LB - 21
      GO TO (22, 23), LB
C
C     SHOULD AN INDEX IN SOME IF STATEMENT  GET OUT OF BOUNDS, THIS
C     STATEMENT WILL BE CALLED AND THE PROGRAM WILL TERMINATE.
C
   98 PRINT 97
   97 FORMAT (4H0ICB)
   99 CALL EXIT
      END
```

```
      SUBROUTINE INTEG
C
C     SUBROUTINE INTEG IS A PROGRAM WHICH WHEN GIVEN THE MOMENT -
C     CURVATURE RELATION FOR A SECTION, WILL DETERMINE THE MAXIMUM
C     FIXED AND PINNED LENGTH THAT THE SECTION CAN SUSTAIN UNDER A GIVEN
C     LATERAL AND AXIAL LOAD.
C
C
C     THE FOLLOWING QUANTITIES ARE PLACED IN COMMON SO THEY WILL BE
C     AVAILABLE FROM THE MAIN PROGRAM.
C
      COMMON I, N, EPS, BRT, X, BRC, FI, C7, GST, EPSO, FIO, QI, F, JA,
     1P, REL, ISWA, ISWB, ISWC, ISWD, ISW, AL, DSI, CM, CMO, AMLT, JB,
     2C1, C2, C3, REY, C11, C12, C13, C14, EY, CR, AMPN, C5, CA, CB, K,
     3FIC, LB, CMAX, QIC, IRUN
      DIMENSION CM(200), FI(200), EPS(200), AL(30), X(25), B(14)
C
C     STARTING WITH THE ORIGIN, THE POINTS ON THE POSITIVE BRANCH OF THE
C     MOMENT - CURVATURE CURVE ARE CHECKED FOR A POSSIBLE STARTING
C     CURVATURE.  IF NO TRANSVERSE LOAD IS ACTING ON THE SECTION, THIS
C     WILL USUALLY BE CHOSEN AT THE ORIGIN.   ( POINT 90)
C
      N = 90
  102 IF (EPS(N)-1.) 50, 100, 100
  100 IF (EPS(N)+BRT-X(11)+BRC-.99) 50, 50, 51
   50 IF (EPS(N)-FI(N)/C7+GST) 51, 101, 101
    2 IF (EPSO-1.) 3, 4, 4
    4 IF (EPSO+BRT-X(11)+BRC-.99) 3, 3, 5
    3 IF (EPSO-FIO/C7+GST) 5, 101, 101
C
C     FROM STATEMENTS 5 AND 51 BELOW, IT CAN BE SEEN THAT SOME CURVATURE
C     0.4 LESS THAN THAT DETERMINED ABOVE IS USED AS A STARTING POINT
C     TO INSURE THAT THE PEAK OF THE CURVE WILL BE PASSED THROUGH.
C
    5 G = FIO - .4
      GO TO 6
  101 N = N - 1
      IF (N) 1, 2, 102
C
C     IF NO SUITABLE POINT CAN BE FOUND, GO ON TO THE NEXT DATA SET.
C
    1 RETURN
   51 G = FI(N) - .4
    6 Q = QI
C
C     THE NEXT STATEMENTS ARE THE ONES WHICH CHOOSE THE CURVATURE AT THE
C     ORIGIN AS A STARTING POINT IF LATERAL LOAD IS ZERO.
C
      IF (Q) 60, 103, 60
  103 F = FI(90) - .4
      GO TO 61
   60 F = G
   61 PHC = F
      JA = 20
C
```

```
C       SET UP THE TITLES FOR THE INTEGRATION AND LIST THE VALUE OF THE
C       LOADS AT THE TOP OF THE SHEET.
C       IF JXA OR JXB ARE 1, THIS INDICATES THAT CONVERGENCE HAS NOT BEEN
C       OBTAINED YET FOR EITHER THE FIXED OR PINNED END CASE FOR THE
C       PRESENT VALUE OF Q.  WHEN CONVERGENCE IS OBTAINED, THEY WILL BE
C       SET TO ZERO AND THIS WILL CAUSE THE RESULTS TO BE PRINTED ON THE
C       SUMMARY SHEET.
C
            PRINT 409
        409 FORMAT (1H1 )
            PRINT 104, P    , Q
        104 FORMAT ( 17H0AXIAL LOAD (P) =, F7.4, 4X, 18HLATERAL LOAD (Q) =,
           1 F7.4 )
            Q = Q*PEL
            JXA = 1
            JXB = 1
            PRINT 105
        105 FORMAT ( 1H0, 7X, 9HCURVATURE, 8X, 6HLENGTH, 9X, 7HLATERAL, 9X,
           1 8HVERTICAL, 9X, 6H END  , 11X, 3HEND , 11X, 1HH)
            PRINT 10
         10 FORMAT (11X, 2HAT, 26X, 10HDEFLECTION, 7X, 8HMOVEMENT, 9X, 6HMOMEN
           1T, 10X, 5HSLOPE )
            PRINT 11
         11 FORMAT ( 8X, 9HMIDHEIGHT, 21X, 13HAT MIDHEIGHT )
            ISWA = 1
            ISWB = 76
            ISWC = 1
            DO 106 K = 1, 30
        106 AL(K) = 0.
         62 ISW = 1
            ISWD = 1
            X(17) = P
            X(19) = DSI
            DST = DSI
            DO 107 K = 1, 16
        107 X(K) = 0.
            SN = 0.
            CS = 1.
            N = 200
        108 N = N + 1
        300 IF (N) 76, 200, 109
        109 IF (FI(N) - PHC) 108, 110, 110
        200 IF (FIO- PHC) 108, 201, 201
        201 AMLT = (FIO-PHC)/(FIO-FI(1))
            X(11) = CMO-AMLT*(CMO-CM(1))
            GO TO 202
        110 AMLT = (FI(N) - PHC)/(FI(N)-FI(N+1))
            X(11) = CM(N) -AMLT*(CM(N)-CM(N+1))
        202 IF (X(11)) 111, 111, 63
        111 PHC = PHC + .1
            GO TO 300
         63 IF (N) 203, 204, 203
        204 X(21) = EPSO-AMLT*(EPSO-EPS(1))
            GO TO 205
        203 X(21) = EPS(N)-AMLT*(EPS(N)-EPS(N+1))
```

9 OF 13

```
205 X[23] = PHO
    JB = 50
131 JB = JB - 1
    IF [JB] 112, 90, 90
112 AL[2] = 1.
    GO TO 95
 90 I = 1
    X[20] = DST
    X[25] = X[23]
113 C1 = [X[23]/3. +X[25]/6.]*REL*X[20]
    C2 = [CS-SN*C1*REY]*X[20]
    C3 = [SN/REY+CS*C1]*X[20]
    C11 = REY*CR
    C13 = X[15] + Q * [C2 + C11 * SN]
    C12 = Q * EY
    C14 = X[17] + C12 * [C3 - CR * CS]
    X[12]=X[11]-[C2*[C13-.5*Q*C2]+C3*[C14-.5*C12*C3]]/REL
115 N = N - 1
    IF [N] 64, 206, 114
206 IF [CMO-X[12]] 115, 116, 116
114 IF [CM[N] - X[12]] 115, 116, 116
116 IF [X[12] - CM[N+1]] 117, 66, 66
117 N = N + 1
    IF [ N-200] 116, 118, 118
118 C1 = X[12] - AMPN
    IF [C1] 119, 119, 120
120 GO TO [65, 67], ISWD
119 C1 = X[11] - AMPN
    X[20] = .5*X[20]*C1/[X[11]-X[12]]
    GO TO 43
 64 C1 = CMO - X[11]
    N = 1
    X[20] = .2 * X[20] * C1/[X[12]-X[11]]
    GO TO 43
 65 X[20] = .1*X[20]
 43 I = I + 1
    IF [I - 15] 113, 113, 69
 66 IF [N] 207, 208, 207
208 AMLT = [CMO-X[12]]/[CMO-CM[1]]
    X[24] = FIO-AMLT*[FIO-FI[1]]
    X[22] = EPSO-AMLT*[EPSO-EPS[1]]
    GO TO 68
207 AMLT = [CM[N] - X[12]]/[CM[N]-CM[N+1]]
    X[24] = FI[N]-AMLT*[FI[N]-FI[N+1]]
    X[22] = EPS[N] -AMLT * [EPS[N] - EPS[N+1]]
    GO TO 68
 67 C4 = [CM[200] - AMPN]/C1
    C5 = C4*C1/[CM[199]-CM[200]]
    X[24] = [C4 + 1.]*FI[200]-SQRTF[ABSF[FI[200] *[FI[200]-FI[199]]*C5
   1]]
    X[22] = [C4+1.]*EPS[200]-SQRTF[ABSF[EPS[200]*[EPS[200]-EPS[199]]*
   1C5]]
 68 IF [ABSF[1.-X[25]/X[24]]-.00001] 69, 121, 121
121 I = I + 1
    IF[I-15] 122, 122, 69
```

```
122 X[25] = X[24]
    GO TO 113
 69 C1 = X[23] + X[24]
    X[14] = X[13] + .5*REY*REL*C1*X[20]
    SN = SINF[X[14]]
    CS = COSF[X[14]]
    X[16] = C13-Q*C11*SN
    X[18] = C14+C12*CR*CS
    X[9] = X[8] + C3
    X[6] = X[5] + 2. * C2
    X[3] = X[2] + 4.*X[20]/[2.*FY*[X[21]+X[22]-C1*REL*CR]]
    C5 = X[24] - X[23]
    CA = X[19]
    CB = X[20]
    GO TO [70, 71],ISW
 70 IF [X[12]] 123, 71, 71
123 C1 = [X[12]-X[11]]*X[19]
    C2 = [X[10]-X[11]]*X[20]
    C4 = [X[19]+X[20]]*X[19]*X[20]
    C3 = [C1 + C2]/C4
    C4 = [C1 * X[19]-C2*X[20]]/C4
    C1 = BC[C3, C4, X[11], 0.]
    AL[29] = X[13] +[X[23]+.5*C1*C5/X[20]]*REY*REL*C1
    AL[23] = 0.
    ISW = 2
    ISWD = 2
    DST = .2*DST
    K = 5
    DO 124 I = 1, 7, 3
    AL[K] = VAL[X[I], X[I+1], X[I+2], C1]
124 K = K + 6
 71 IF [X[14]] 125, 72, 72
125 C1 = .5*C5*REY*REL/X[20]
    C2 = X[23]*REY*REL
    C3 = -X[20]*[C5+X[23]/C5]
    C1 = BC[C1, C2, X[13], C3]
    AL[30] = 0.
    K = 6
    DO 126 I = 1, 10, 3
    AL[K] = VAL[X[I], X[I+1], X[I+2], C1]
126 K = K + 6
 95 K = 30
128 PRINT 127, PHC, AL[K-24], AL[K-18], AL[K-12], AL[K-6], AL[K]
127 FORMAT [1H0, 7F16.8]
    K = K - 1
    IF [K - 28] 129, 129, 128
129 GO TO [73, 75], ISWA
 72 DO 130 I = 1, 23
130 X[I] = X[I+1]
    I = 1
    GO TO 131
 73 IF[AL[6] - AL[4]] 133, 132, 132
132 GO TO [75, 77], ISWC
133 ISWA = 2
    K=6
```

```
      ISWB = ISWB - 1
   74 C1 = AL(K-4) - AL(K)
      C2 = AL(K) - 2.*AL(K-2)+AL(K-4)
      C3 = .5 * FIC * C1/C2
      CA = FIC
      CB = CA
      AL(K) = AL(K-2)-.5*C1*C1/C2
      K = K + 6
  134 AL(K) = VAL(AL(K-4), AL(K-2), AL(K), C3)
      K = K + 6
      IF (K-31) 134, 135, 135
  135 AAA = PHC - FIC  + C3
C
C     PRINT OUT WHETHER THE PINNED END CASE OR THE FIXED END CASE HAS
C     BEEN FOUND, (ACCORDING TO WHETHER THE END MOMENT IS ZERO OR NOT,
C
      IF ( AL(K-6)) 13, 12, 13
   12 PRINT 14
   14 FORMAT ( 15H0FIXED END CASE )
      JX = 8
      JXA = 0
      GO TO 15
   13 PRINT 16
   16 FORMAT ( 16H0PINNED END CASE )
      JX = 1
      JXB = 0
   15 PRINT 127, AAA
      B(JX) = AAA
      AAA = P     + Q*EY*(AL(K-18)+(COSF(AL(K-6))-1.)*CR)
      B(JX + 1) = AL(K-30)
      B(JX+2) = AL(K-24)
      B(JX+3) = AL(K-18)
      B(JX+4) = AL(K-12)
      B(JX+5) = AL(K-6)
      B(JX+6) = AAA
C
C     PRINT OUT THE REQUIRED INFORMATION.
C
      PRINT 136, AL(K-30), AL(K-24), AL(K-18), AL(K-12), AL(K-6), AAA
  136 FORMAT (1H0, 16X, 6F16.8)
      IF(ISWB-65) 137, 137, 138
  137 LB = ISWB - 59
      GO TO (60, 61, 62, 63, 64, 65), LB
  138 IF (ISWB - 70) 139, 139, 140
  139 LB = ISWB - 65
      GO TO (66, 67, 68, 69, 70), LB
  140 LB = ISWB - 70
      GO TO (71, 72, 73, 74, 75, 76), LB
   75 IF (AL(5) - AL(3)) 141, 77, 77
  141 K = 5
      ISWB = ISWB + 1
      ISWC = 2
      GO TO 74
   76 Q = Q/REL
      PRINT 408, IRUN
```

```
      408 FORMAT ( 9H1DATA SET, 1X, I5 )
          PRINT 104, P, Q
          PRINT 400
      400 FORMAT ( 19H0SUMMARY OF RESULTS )
          PRINT 105
          PRINT 10
          PRINT 11
          PRINT 16
          IF (JXB ) 402, 401, 402
      401 PRINT 127, (B(JX), JX = 1, 7)
          GO TO 405
      402 PRINT 406
      406 FORMAT ( 15H0NO CONVERGENCE )
      405 PRINT 14
          IF ( JXA ) 404, 403, 404
      403 PRINT 127, (B(JX), JX = 8, 14)
          GO TO 407
      404 PRINT 406
C
C     INCREMENT THE VALUE OF Q AND CHECK TO SEE IF THE MAXIMUM VALUE HAS
C     BEEN REACHED.  IF IT HAS BEEN EXCEEDED, RETURN TO THE MAIN PROGRAM
C     OTHERWISE, RUN THE NEXT CASE.
C
      407 Q = Q + QIC
          IF (Q - QMAX) 60, 60, 142
      142 RETURN
       77 JA = JA - 1
          PHC = PHC + FIC
          DO 143 K = 1, 27, 2
          AL(K) = AL(K + 2)
      143 AL(K+1) = AL(K+3)
          GO TO 62
          END OF PROGRAM
```

FUNCTION BC

```
      FUNCTION BC(BC1, BC2, BC3, BC4)
      C3 = BC3
      C4 = BC4
      KK = 15
8140  C3 = BC1 * C4 * C4 + BC2 * C4 + BC3
      C4=C4-C3/(2.*BC1*C4+BC2)
      KK=KK-1
      IF(KK)8190,8180,8180
8180  IF(ABSF(C3)-0.000000)8190,8190,8140
8190  BC=C4
      RETURN
      END
```

FUNCTION VAL

```
      FUNCTION VAL[A, B, C, D]
      COMMON I, N, EPS, PRT, X, BRC, FI, C7, GST, FPSO, FIO, QI, F, JA,
     1R, REL, ISWA, ISWB, ISWC, ISWD, ISW, AL, DSI, CM, CMO, AMLT, JB,
     2C1, C2, C3, REY, C11, C12, C13, C14, EY, CR, AMPN, C5, CA, CB, K,
     3FIC, LB, GMAX, QIC
      DIMENSION CM[200], FI[200], EPS[200], AL[30], X[25]
      AA = [C-B]*CA
      BB = CA*CB*[CA+CB]
      CC = [A-B]*CB
      DD = [AA+CC]/BB
      CC = [AA*CA-CC*CB]/BB
      VAL = DD*D*D + CC*D + B
      RETURN
      END
```

DATA SET 50 **1ST SET OF INPUT DATA** **EXAMPLE RUNS**

INPUT DATA

AST	D	AFF	GRC	GST	GFC	GFT	F	QI	QIC	GMAX	DSI	FIC
0.30000	10.00000	0.45000	0.	2.00000	0.30000	0.30000	0.60000	1.00000	2.00000	3.00000	0.18000	0.15000

SECTION PROPERTIES

AST	D	AFF	GRC	KR	EL	AMPN	P
0.3000000	10.0000000	0.4500000	0.	3.6347850	6.7115385	-1.7736882	0.6000000

M-Φ-P POINTS

NOTE: LINES DRAWN BY HAND TO OUTLINE TABLE.

N	FI(N)	CM(N)	EPS(N)	N	FI(N)	CM(N)	EPS(N)
0	15.4026888	2.4077529	11.9479303				
1	14.9026888	2.4072660	11.5600780	101	-1.3000000	-1.2793965	0.2620857
2	14.4026888	2.4067272	11.1722259	102	-1.3200000	-1.2949763	0.2576010
3	13.9026888	2.4061292	10.7843743	103	-1.3400000	-1.3101123	0.2531943
4	13.4026888	2.4054635	10.3965226	104	-1.3600000	-1.3247933	0.2488664
5	12.9026888	2.4047186	10.0086703	105	-1.3800000	-1.3390161	0.2446182
6	12.4026888	2.4038617	9.6208178	106	-1.4000000	-1.3527595	0.2404536
7	11.9026888	2.4029371	9.2329658	107	-1.4200000	-1.3658623	0.2364006
8	11.4026888	2.4018658	8.8451135	108	-1.4400000	-1.3782849	0.2324668
9	10.9026888	2.4006439	8.4572609	109	-1.4600000	-1.3900267	0.2286527
10	10.4026888	2.3992410	8.0694091	110	-1.4800000	-1.4010867	0.2249589
11	9.9026888	2.3976206	7.6815565	111	-1.5000000	-1.4114634	0.2213860
12	9.4026888	2.3957350	7.2937046	112	-1.5200000	-1.4211546	0.2179348
13	8.9026888	2.3935227	6.9058524	113	-1.5400000	-1.4301576	0.2146061
14	8.4026888	2.3909039	6.5180005	114	-1.5600000	-1.4384692	0.2114007
15	7.9026888	2.3877724	6.1301481	115	-1.5800000	-1.4460857	0.2083197
16	7.4026888	2.3839652	5.7422962	116	-1.6000000	-1.4530030	0.2053640
17	7.3026888	2.3831330	5.6647257	117	-1.6200000	-1.4592163	0.2025348
18	7.2026889	2.3822450	5.5871553	118	-1.6400000	-1.4647206	0.1998330
19	7.1026889	2.3813191	5.5095849	119	-1.6600000	-1.4695102	0.1972600
20	7.0026889	2.3803534	5.4320143	120	-1.6800000	-1.4737269	0.1947915
21	6.9026889	2.3793456	5.3544440	121	-1.7000000	-1.4777878	0.1923543
22	6.8026889	2.3782926	5.2768735	122	-1.7200000	-1.4817238	0.1899436
23	6.7026889	2.3771924	5.1993032	123	-1.7400000	-1.4855400	0.1875586
24	6.6026889	2.3760419	5.1217328	124	-1.7600000	-1.4892413	0.1851984
25	6.5026889	2.3748379	5.0441624	125	-1.7800000	-1.4928325	0.1828624
26	6.4026889	2.3735769	4.9665920	126	-1.8000001	-1.4963180	0.1805497
27	6.3026889	2.3722554	4.8890215	127	-1.8200001	-1.4997021	0.1782597
28	6.2026889	2.3708695	4.8114511	128	-1.8400001	-1.5029887	0.1759918
29	6.1026889	2.3694150	4.7338807	129	-1.8600001	-1.5061817	0.1737453
30	6.0026889	2.3678672	4.6563103	130	-1.8800001	-1.5092848	0.1715196
31	5.9026889	2.3662609	4.5787399	131	-1.9000001	-1.5123013	0.1693141
32	5.8026889	2.3645911	4.5011695	132	-1.9200001	-1.5152346	0.1671283
33	5.7026889	2.3628116	4.4235991	133	-1.9400001	-1.5180878	0.1649616
34	5.6026889	2.3609358	4.3460287	134	-1.9600001	-1.5208639	0.1628135
35	5.5026890	2.3589568	4.2684583	135	-1.9800001	-1.5235659	0.1606835
36	5.4026890	2.3568671	4.1908878	136	-2.0000001	-1.5261963	0.1585711
37	5.3026890	2.3546579	4.1133175	137	-2.0200001	-1.5287577	0.1564758
38	5.2026890	2.3523201	4.0357470	138	-2.0400001	-1.5312528	0.1543972
39	5.1026890	2.3498436	3.9581767	139	-2.0600001	-1.5336838	0.1523349
40	5.0026890	2.3472171	3.8806063	140	-2.0800001	-1.5360530	0.1502884
41	4.9026890	2.3444282	3.8030359	141	-2.1000001	-1.5383626	0.1482573
42	4.8026890	2.3414632	3.7254654	142	-2.1200001	-1.5406147	0.1462412
43	4.7026890	2.3382641	3.6478075	143	-2.1400001	-1.5428111	0.1442398
44	4.6026890	2.3341905	3.5675264	144	-2.1600001	-1.5449539	0.1422526

45	4.5026890	2.3289915	3.4841780	145	-2.1800001	-1.5470449	0.1402794
46	4.4026890	2.3228031	3.3984828	146	-2.2000001	-1.5490857	0.1383196
47	4.3026890	2.3156894	3.3100476	147	-2.2200001	-1.5510781	0.1363734
48	4.2026890	2.3076808	3.2219464	148	-2.2400001	-1.5530236	0.1344400
49	4.1026890	2.2987835	3.1317659	149	-2.2600001	-1.5549239	0.1325192
50	4.0026890	2.2889851	3.0406325	150	-2.2800001	-1.5567802	0.1306107
51	3.9026890	2.2782701	2.9487667	151	-2.3000001	-1.5585942	0.1287142
52	3.8026890	2.2666458	2.8564582	152	-2.3200001	-1.5603671	0.1268295
53	3.7026891	2.2540652	2.7638351	153	-2.3400001	-1.5621002	0.1249562
54	3.6026891	2.2404658	2.6709982	154	-2.3600001	-1.5637948	0.1230942
55	3.5026891	2.2257736	2.5780400	155	-2.3600001	-1.5654520	0.1212431
56	3.4026891	2.2099025	2.4850463	156	-2.4000001	-1.5670731	0.1194027
57	3.3026891	2.1927526	2.3920988	157	-2.4200001	-1.5686592	0.1175726
58	3.2026891	2.1745926	2.2989141	158	-2.4400001	-1.5702112	0.1157531
59	3.1026891	2.1560724	2.2049131	159	-2.4600001	-1.5717303	0.1139434
60	2.6026891	2.0620307	1.7314649	160	-2.4800001	-1.5732175	0.1121435
61	2.1026891	1.9679632	1.2579550	161	-2.5000001	-1.5746736	0.1103531
62	2.0826891	1.9642005	1.2390146	162	-2.5200002	-1.5760996	0.1085721
63	2.0626891	1.9586625	1.2216787	163	-2.5400002	-1.5774964	0.1068003
64	2.0426891	1.9505650	1.2066423	164	-2.5600002	-1.5788648	0.1050374
65	2.0226891	1.9407451	1.1931379	165	-2.5800002	-1.5802057	0.1032833
66	2.0026891	1.9296515	1.1807553	166	-2.6000002	-1.5815198	0.1015376
67	1.9826891	1.9175580	1.1692445	167	-2.6200002	-1.5828079	0.0998006
68	1.9626891	1.9046467	1.1584396	168	-2.6400002	-1.5840706	0.0980717
69	1.9426891	1.8910462	1.1482236	169	-2.6600002	-1.5853091	0.0963509
70	1.9226891	1.8768511	1.1385104	170	-2.6800002	-1.5865236	0.0946380
71	1.9026891	1.8621337	1.1292344	171	-2.7800002	-1.5922603	0.0861861
72	1.8826891	1.8469505	1.1203442	172	-2.8800002	-1.5974966	0.0779092
73	1.8626891	1.8313467	1.1117987	173	-2.9800002	-1.6022777	0.0697909
74	1.8426891	1.8153592	1.1035643	174	-3.0800002	-1.6066749	0.0618170
75	1.8226891	1.7990185	1.0956172	175	-3.1800002	-1.6107282	0.0539747
76	1.8026891	1.7823500	1.0879221	176	-3.2800002	-1.6144766	0.0462529
77	1.7826891	1.7653753	1.0804713	177	-3.3800002	-1.6179539	0.0386415
78	1.7626891	1.7481130	1.0732437	178	-3.4800002	-1.6211893	0.0311318
79	1.7426891	1.7305787	1.0662247	179	-3.5800002	-1.6242082	0.0237156
80	1.7226891	1.7127862	1.0594016	180	-3.6800002	-1.6270326	0.0163862
81	1.7026891	1.6947475	1.0527631	181	-3.7800002	-1.6296823	0.0091367
82	1.6826891	1.6764731	1.0462993	182	-3.8800002	-1.6321736	0.0019614
83	1.6626891	1.6579719	1.0400016	183	-3.9800002	-1.6345224	-0.0051450
84	1.6426891	1.6392523	1.0338620	184	-4.0800002	-1.6367412	-0.0121871
85	1.6226891	1.6203211	1.0278736	185	-4.1800002	-1.6388420	-0.0191695
86	1.6026891	1.6011848	1.0220301	186	-4.2800002	-1.6408353	-0.0260959
87	1.5826891	1.5818488	1.0163259	187	-4.3800002	-1.6427303	-0.0329701
88	1.5626891	1.5623181	1.0107558	188	-4.4800002	-1.6445355	-0.0397954
89	1.5426891	1.5425970	1.0053152	189	-4.5800002	-1.6462582	-0.0465747
90	1.5226891	1.5226891	1.0000000	190	-4.6800002	-1.6479053	-0.0533110
91	-1.1000000	-1.1000000	0.3110375	191	-4.7800002	-1.6494827	-0.0600067
92	-1.1200000	-1.1198005	0.3058184	192	-4.8800002	-1.6509956	-0.0666642
93	-1.1400000	-1.1391991	0.3006692	193	-4.9800002	-1.6524496	-0.0732856
94	-1.1600000	-1.1581916	0.2955908	194	-5.0800002	-1.6538486	-0.0798734
95	-1.1800000	-1.1767738	0.2905837	195	-5.1800002	-1.6551967	-0.0864269
96	-1.2000000	-1.1949411	0.2856489	196	-5.2800002	-1.6564976	-0.0929541
97	-1.2200000	-1.2126892	0.2807871	197	-5.3800002	-1.6577551	-0.0994505
98	-1.2400000	-1.2300134	0.2759990	198	-5.4800002	-1.6589717	-0.1059197
99	-1.2600000	-1.2469092	0.2712856	199	-5.5800002	-1.6601503	-0.1123631
100	-1.2800000	-1.2633719	0.2666475	200	-5.6800002	-1.6612937	-0.1187820

INTEGRATION (1ST VALUE OF LATERAL LOAD)

AXIAL LOAD (P) = 0.6000   LATERAL LOAD (Q) = 1.0000

CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	
1.12268908	4.07110956	4.06751471	0.50563630	-1.67226054	0.	
1.12268908	2.40683550	2.40400402	0.27814885	0.	0.01343926	
1.27268908	4.09484308	4.09104732	0.61109844	-1.69790695	0.	
1.27268908	2.51358573	2.50142984	0.34126885	0.	0.01583594	
1.42268908	4.11204668	4.10803633	0.71742250	-1.71822067	0.	
1.42268908	2.53921272	2.58633050	0.40777684	0.	0.01829276	
1.57268908	4.12509719	4.12083846	0.82365271	-1.73477670	0.	
1.57268908	2.66512030	2.66270803	0.47709823	0.	0.02078855	
1.72268907	4.13362832	4.12911963	0.92519191	-1.74866327	0.	
1.72268907	2.72818986	2.72564603	0.54547103	0.	0.02319611	
1.87268907	4.13564405	4.13086783	1.01855362	-1.75840529	0.	
1.87268907	2.77720989	2.77453272	0.60997335	0.	0.02543053	
2.02268907	4.13076895	4.12575119	1.09675057	-1.76402207	0.	
2.02268907	2.80973954	2.80633388	0.66490289	0.	0.02731336	
FIXED END CASE (CONVERGENCE OBTAINED FOR FIXED END CASE)						
1.84156763						
	4.13623729	4.13106951	1.00043005	-1.75672321	0.	0.60055763
2.17268907	4.12206875	4.11691526	1.13202530	-1.76527959	0.	
2.17268907	2.81620870	2.81332542	0.68986462	0.	0.02815713	
2.32268907	4.09926380	4.09401396	1.15497561	-1.74657302	0.	
2.32268907	2.81450250	2.81153647	0.71036223	0.	0.02885095	
PINNED END CASE (CONVERGENCE OBTAINED FOR PINNED END CASE)						
2.21638395						
	2.81759614	2.81364879	0.69629635	0.	0.02837476	0.60038755

DATA SET 50

AXIAL LOAD (P) = 0.6000 LATERAL LOAD (Q) = 1.0000

SUMMARY OF RESULTS

	CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	H
PINNED END CASE							
	2.21638395	2.81759614	2.81364870	0.69429435	0.	0.02837476	0.60038755
FIXED END CASE							
	1.84156763	4.13623729	4.13106951	1.00043005	-1.75672321	0.	0.60055703

INTEGRATION (2ND VALUE OF LATERAL LOAD)

AXIAL LOAD (P) = 0.6000 LATERAL LOAD (Q) = 3.0000

CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	
1.12268908	2.57083684	2.56858224	0.21410266	-1.65885421	0.	
1.12268908	1.59169997	1.59039629	0.12131562	0.	0.00890010	
1.27268908	2.60217483	2.59815178	0.26475942	-1.63891266	0.	
1.27268908	1.67727686	1.67588962	0.15284842	0.	0.01063506	
1.42268908	2.67276283	2.67023901	0.31797853	-1.70779007	0.	
1.42268908	1.75532001	1.75385062	0.18747496	0.	0.01244694	
1.57268908	2.72667642	2.72399172	0.37481162	-1.74879178	0.	
1.57268908	1.82690435	1.82535298	0.22466957	0.	0.01432229	
1.72268907	2.75874868	2.75590469	0.42822104	-1.75042445	0.	
1.72268907	1.88937145	1.88773904	0.26214709	0.	0.01615997	
1.87268907	2.79123848	2.78821967	0.48240130	-1.76912137	0.	
1.87268907	1.94101678	1.93930295	0.29859413	0.	0.01769190	
2.02268907	2.80962516	2.80646301	0.52691236	-1.76978623	0.	
2.02268907	1.97886271	1.97706879	0.33070243	0.	0.01938175	
2.17268907	2.80627318	2.80300452	0.54616036	-1.74979470	0.	
2.17268907	1.99084859	1.98899973	0.34646101	0.	0.02009267	
FIXED END CASE						
2.07455093						
	2.81482425	2.80772179	0.53642651	-1.76520953	0.	0.00089600
2.32268907	2.81221478	2.80888032	0.56450032	-1.76030774	0.	
2.32268907	1.99771252	1.99581259	0.35901549	0.	0.02065196	
2.47268907	2.81368395	2.81025218	0.58405119	-1.76308859	0.	
2.47268907	2.00327366	2.00131012	0.37291964	0.	0.02127471	
2.62268906	2.80536355	2.80177368	0.60675195	-1.74966753	0.	
2.62268906	2.00581774	2.00376004	0.38999625	0.	0.02205115	
2.77268906	2.81047643	2.80655424	0.63472511	-1.77173433	0.	
2.77268906	2.00829611	2.00614318	0.40713416	0.	0.02282921	
2.92268906	2.80782801	2.80396684	0.65918546	-1.77325447	0.	

2.92268906	2.01070845	2.00845912	0.42433872	0.	0.02360927	
3.07268906	2.80486144	2.80085946	0.68359204	-1.77361226	0.	
3.07268906	2.01305130	2.01070435	0.44161385	0.	0.02439169	
3.22268906	2.80185528	2.79770909	0.70771922	-1.77390546	0.	
3.22268906	2.01523170	2.01278707	0.45876549	0.	0.02516766	
3.37268906	2.79879633	2.79450598	0.73099353	-1.77413283	0.	
3.37268906	2.01708852	2.01454851	0.47537403	0.	0.02591872	
3.52268906	2.79564367	2.79121209	0.75253704	-1.77426860	0.	
3.52268906	2.01836653	2.01573656	0.49078962	0.	0.02661514	
3.67268905	2.79299571	2.78850663	0.77237551	-1.77587318	0.	
3.67268905	2.01902921	2.01631508	0.50497994	0.	0.02725631	
3.82268905	2.78947544	2.78486383	0.79077797	-1.77574892	0.	
3.82268905	2.01910828	2.01631442	0.51818722	0.	0.02785472	
3.97268905	2.78721121	2.78246110	0.80440108	-1.77353224	0.	
3.97268905	2.01853893	2.01566842	0.53055271	0.	0.02841863	
PINNED END CASE						
3.76597961						
	2.01929363	2.01639054	0.51329301	0.	0.02763251	0.60085696

DATA SET 50

AXIAL LOAD (P) = 0.6000 LATERAL LOAD (Q) = 3.0000

SUMMARY OF RESULTS

CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	[illegible]
PINNED END CASE						
3.76597961	2.01929363	2.01639054	0.51329301	0.	0.02763251	0.60085698
FIXED END CASE						
2.07455993	2.81482425	2.80772179	0.53642651	-1.76520953	0.	0.60009665

DATA SET 51 **2nd SET OF INPUT DATA**

INPUT DATA

AST	D	AFF	GRC	GST	GFC	GFT	P	QI	QIC	UMAX	DSI	FIC
0.30000	10.00000	0.45000	0.12500	1.00000	0.30000	0.30000	0.70000	1.00000	1.00000	2.00000	0.18000	0.15000

SECTION PROPERTIES

AST	D	AFF	GRC	HR	EL	AMPN	P
0.3000000	10.0000000	0.4500000	0.1250000	3.6349850	8.7115385	-0.4334045	0.7000000

M-φ-P POINTS

N	FI(N)	CM(N)	EPS(N)	N	FI(N)	CM(N)	EPS(N)
0	3.8261764	1.5981435	3.2341474				
1	3.7261764	1.5973569	3.1496400	101	-0.2000000	-0.1793965	0.6510482
2	3.6261764	1.5965043	3.0681127	102	-0.2200000	-0.1949783	0.6465635
3	3.5261764	1.5955782	2.9805852	103	-0.2400000	-0.2101123	0.6421567
4	3.4261764	1.5945697	2.8960578	104	-0.2600000	-0.2247933	0.6378288
5	3.3261764	1.5934690	2.8115304	105	-0.2800000	-0.2390161	0.6335807
6	3.2261764	1.5922643	2.7270031	106	-0.3000000	-0.2527005	0.6294264
7	3.1261764	1.5909422	2.6424756	107	-0.3200000	-0.2651741	0.6254873
8	3.1061764	1.5906599	2.6255561	108	-0.3400000	-0.2764092	0.6217760
9	3.0861764	1.5903490	2.6085020	109	-0.3600000	-0.2865317	0.6182754
10	3.0661764	1.5900059	2.5912955	110	-0.3800000	-0.2956353	0.6149722
11	3.0461764	1.5896316	2.5739482	111	-0.4000000	-0.3037903	0.6118558
12	3.0261764	1.5892275	2.5564694	112	-0.4200000	-0.3110492	0.6089179
13	3.0061764	1.5887943	2.5388686	113	-0.4400000	-0.3174517	0.6061519
14	2.9861764	1.5883329	2.5211537	114	-0.4600000	-0.3230274	0.6035524
15	2.9661764	1.5878438	2.5033322	115	-0.4800000	-0.3277983	0.6011153
16	2.9461764	1.5873278	2.4854110	116	-0.5000000	-0.3317800	0.5988374
17	2.9261764	1.5867853	2.4673963	117	-0.5200000	-0.3349836	0.5967164
18	2.9061764	1.5862167	2.4492940	118	-0.5400000	-0.3374163	0.5947504
19	2.8861764	1.5856224	2.4311093	119	-0.5600000	-0.3390818	0.5929383
20	2.8661764	1.5850025	2.4128472	120	-0.5800000	-0.3403086	0.5912213
21	2.8461764	1.5843575	2.3945124	121	-0.6000000	-0.3414310	0.5695394
22	2.8261764	1.5836873	2.3761090	122	-0.6200000	-0.3424614	0.5678896
23	2.8061764	1.5829923	2.3576409	123	-0.6400000	-0.3434105	0.5662689
24	2.7861764	1.5822722	2.3391122	124	-0.6600000	-0.3442875	0.5646751
25	2.7661764	1.5815273	2.3205261	125	-0.6800000	-0.3451003	0.5631058
26	2.7461764	1.5806475	2.3021110	126	-0.7000000	-0.3458557	0.5615591
27	2.7261764	1.5794304	2.2842589	127	-0.7200000	-0.3465597	0.5600333
28	2.7061764	1.5778886	2.2669057	128	-0.7400000	-0.3472176	0.5785268
29	2.6861764	1.5760353	2.2499894	129	-0.7600000	-0.3478338	0.5770381
30	2.6661764	1.5738801	2.2334590	130	-0.7800000	-0.3484125	0.5755660
31	2.6461764	1.5714299	2.2172723	131	-0.8000000	-0.3489571	0.5741093
32	2.6261764	1.5686893	2.2013937	132	-0.8200000	-0.3494706	0.5726670
33	2.6061764	1.5656611	2.1857933	133	-0.8400000	-0.3499564	0.5712380
34	2.5861764	1.5623471	2.1704454	134	-0.8600000	-0.3504163	0.5698216
35	2.5661764	1.5587476	2.1553282	135	-0.8800000	-0.3508527	0.5684168
36	2.5461764	1.5548621	2.1404228	136	-0.9000000	-0.3512677	0.5670230
37	2.5261764	1.5506892	2.1257130	137	-0.9200000	-0.3516629	0.5656396
38	2.5061764	1.5462272	2.1111846	138	-0.9400000	-0.3520400	0.5642657
39	2.4861764	1.5414734	2.0968252	139	-0.9600000	-0.3524005	0.5629010
40	2.4661765	1.5364247	2.0826239	140	-0.9800000	-0.3527456	0.5615448
41	2.4461765	1.5310778	2.0685713	141	-1.0000000	-0.3530764	0.5601967
42	2.4261765	1.5254287	2.0546588	142	-1.0200000	-0.3533941	0.5588563
43	2.4061765	1.5194735	2.0408797	143	-1.0400000	-0.3536997	0.5575230
44	2.3861765	1.5132219	2.0272462	144	-1.0600000	-0.3539939	0.5561966

45	2.3661765	1.5066768	2.0137601	145	-1.0800000	-0.3542776	0.5546767
46	2.3461765	1.4998352	2.0004154	146	-1.1000000	-0.3545515	0.5535628
47	2.3261765	1.4927944	1.9870970	147	-1.1200000	-0.3548164	0.5522548
48	2.3061765	1.4856685	1.9736811	148	-1.1400000	-0.3550727	0.5509523
49	2.2861765	1.4784593	1.9601703	149	-1.1600000	-0.3553211	0.5496550
50	2.2661765	1.4711687	1.9465675	150	-1.1800000	-0.3555621	0.5483628
51	2.2461765	1.4637982	1.9328752	151	-1.2000000	-0.3557961	0.5470752
52	2.2261765	1.4563496	1.9190962	152	-1.2200000	-0.3560237	0.5457923
53	2.2061765	1.4488242	1.9052329	153	-1.2400000	-0.3562451	0.5445136
54	2.1861765	1.4412234	1.8912877	154	-1.2600000	-0.3564606	0.5432391
55	2.1661765	1.4335487	1.8772629	155	-1.2800000	-0.3566711	0.5419684
56	2.1461765	1.4258012	1.8631607	156	-1.3800000	-0.3576523	0.5356687
57	2.1261765	1.4179820	1.8489835	157	-1.4800000	-0.3585382	0.5294451
58	2.1061765	1.4100924	1.8347332	158	-1.5800000	-0.3593515	0.5232830
59	2.0861765	1.4021333	1.8204119	159	-1.6800000	-0.3601086	0.5171734
60	2.0661765	1.3941057	1.8060217	160	-1.7800000	-0.3608215	0.5111063
61	2.0461765	1.3860106	1.7915646	161	-1.8800000	-0.3614992	0.5050754
62	2.0261765	1.3778486	1.7770423	162	-1.9800000	-0.3621484	0.4990756
63	2.0061765	1.3696206	1.7624568	163	-2.0800000	-0.3627745	0.4931023
64	1.9861765	1.3613273	1.7478098	164	-2.1800000	-0.3633814	0.4871521
65	1.9661765	1.3529694	1.7331032	165	-2.2800000	-0.3639725	0.4812220
66	1.9461765	1.3445473	1.7183387	166	-2.3800001	-0.3645502	0.4753095
67	1.9261765	1.3360618	1.7035179	167	-2.4800001	-0.3651166	0.4694125
68	1.8261765	1.2928269	1.6287816	168	-2.5800001	-0.3656735	0.4635292
69	1.7261765	1.2491532	1.5541393	169	-2.6800001	-0.3662222	0.4576583
70	1.6261765	1.2051988	1.4798896	170	-2.7800001	-0.3667636	0.4517982
71	1.5261765	1.1608981	1.4060959	171	-2.8800001	-0.3672994	0.4459480
72	1.5061765	1.1519892	1.3913985	172	-3.3800001	-0.3699094	0.4160146
73	1.4861765	1.1430623	1.3767231	173	-3.8800001	-0.3724464	0.3876221
74	1.4661765	1.1341166	1.3620705	174	-4.3800001	-0.3749416	0.3589231
75	0.9661765	0.9024613	1.0043033	175	-4.8800001	-0.3773639	0.3302779
76	0.9461765	0.8930169	0.9901717	176	-5.3800001	-0.3795074	0.3027790
77	0.9261765	0.8832963	0.9762963	177	-5.8800001	-0.3814059	0.2763840
78	0.9061765	0.8716493	0.9641933	178	-6.3800001	-0.3831117	0.2509402
79	0.8861765	0.8584339	0.9535061	179	-6.8800001	-0.3846634	0.2265222
80	0.8661765	0.8440758	0.9438272	180	-7.3800001	-0.3860943	0.2024106
81	0.8461765	0.8288199	0.9349235	181	-7.8800001	-0.3874264	0.1791205
82	0.8261765	0.8128177	0.9266466	182	-8.3800001	-0.3886760	0.1563844
83	0.8061765	0.7961773	0.9188953	183	-8.8800001	-0.3898561	0.1341451
84	0.7861765	0.7789724	0.9115971	184	-9.3800001	-0.3909771	0.1123535
85	0.7661765	0.7612577	0.9046977	185	-9.8800001	-0.3920473	0.0909678
86	0.7461765	0.7430743	0.8981556	186	-10.3800001	-0.3930737	0.0699514
87	0.7261765	0.7244535	0.8919383	187	-10.8800001	-0.3940626	0.0492726
88	0.7061765	0.7054190	0.8860199	188	-11.3800001	-0.3950167	0.0289034
89	0.6861765	0.6859889	0.8803795	189	-11.8800001	-0.3959425	0.0080190
90	0.6661765	0.6661765	0.8750000	190	-12.3800001	-0.3968435	-0.0110094
91	-0.0000000	-0.0000000	0.7000000	191	-12.8800001	-0.3977129	-0.0306339
92	-0.0200000	-0.0198005	0.6947809	192	-13.3800001	-0.3985590	-0.0500722
93	-0.0400000	-0.0391991	0.6896317	193	-13.8800001	-0.3993854	-0.0693363
94	-0.0600000	-0.0581916	0.6845532	194	-14.3800001	-0.4001920	-0.0884369
95	-0.0800000	-0.0767738	0.6795462	195	-14.8800001	-0.4009819	-0.1073842
96	-0.1000000	-0.0949411	0.6746114	196	-15.3800001	-0.4017566	-0.1261869
97	-0.1200000	-0.1126892	0.6697495	197	-15.8800001	-0.4025177	-0.1448535
98	-0.1400000	-0.1300134	0.6649615	198	-16.3800001	-0.4032607	-0.1633917
99	-0.1600000	-0.1469092	0.6602480	199	-16.8800001	-0.4040051	-0.1818086
100	-0.1800000	-0.1633719	0.6556100	200	-17.3800001	-0.4047329	-0.2001104

INTEGRATION (1ST VALUE OF LATERAL LOAD)

AXIAL LOAD (P) = 0.7000 LATERAL LOAD (Q) = 1.0000

CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	H
1.82617646	2.72442954	2.72035838	0.47388004	-0.42650939	0.	
1.82617646	2.30511181	2.30228012	0.37881113	0.	0.01804234	
1.97617645	2.72357570	2.71929364	0.51822278	-0.42795795	0.	
1.97617645	2.31663970	2.31363557	0.41024652	0.	0.01953338	
FIXED END CASE						
1.90112946						
	4.08536409	3.06000485	0.54763976	-0.48036580	0.	0.70030692
2.12617645	2.72158591	2.71709727	0.55116718	-0.42927768	0.	
2.12617645	2.32976163	2.32260954	0.44341017	0.	0.02096694	
2.27617645	2.71782564	2.71315076	0.58844623	-0.42727406	0.	
2.27617645	2.33226548	2.32897178	0.47508439	0.	0.02233871	
2.42617645	2.71337361	2.70851181	0.61877997	-0.42943830	0.	
2.42617645	2.33564932	2.33222425	0.50412717	0.	0.02360952	
2.57617645	2.70658723	2.70159398	0.64339913	-0.43093823	0.	
2.57617645	2.33439902	2.33087361	0.52553103	0.	0.02456223	
PINNED END CASE						
2.46070611						
	2.33614045	2.33232119	0.50973113	0.	0.02385701	0.70028371

DATA SET 51

AXIAL LOAD (P) = 0.7000 LATERAL LOAD (Q) = 1.0000

SUMMARY OF RESULTS

	CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	I
PINNED END CASE							
	2.46070611	2.33614145	2.33232119	0.50973115	0.	0.02385701	0.70028571
FIXED END CASE							
	1.90112946	4.00536409	3.06000485	0.54763976	-1.48036580	0.	0.70030492

INTEGRATION (2nd VALUE OF LATERAL LOAD)

AXIAL LOAD (P) = 0.7000   LATERAL LOAD (Q) = 2.0000

CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	H
1.82617646	2.20269113	2.19952009	0.30255146	-0.42384951	0.	
1.82617646	1.87451370	1.87222364	0.24846919	0.	0.01455644	
1.97617645	2.21281248	2.20943468	0.33728325	-0.42869707	0.	
1.97617645	1.83575292	1.89334303	0.27497327	0.	0.01593851	
2.12617645	2.22019017	2.21659661	0.37012072	-0.43085532	0.	
2.12617645	1.91297653	1.91043634	0.30155917	0.	0.01737565	
2.27617645	2.22625429	2.22242532	0.39968967	-0.43008033	0.	
2.27617645	1.92766224	1.92499349	0.32712704	0.	0.01870494	
2.42617645	2.23235133	2.22838954	0.42650303	-0.43107132	0.	
2.42617645	1.93923618	1.93644920	0.35071536	0.	0.01989653	
2.57617645	2.23455493	2.23043693	0.44639527	-0.43159782	0.	
2.57617645	1.94515393	1.94227928	0.36828586	0.	0.02076947	
2.72617644	2.23306170	2.22885144	0.45888060	-0.43188793	0.	
2.72617644	1.94576422	1.94283301	0.37922508	0.	0.02130319	
FIXED END CASE						
2.59058812						
	2.23462318	2.23044235	0.44791647	-0.43163596	0.	0.70049679
2.87617644	2.22944840	2.22526711	0.46505799	-0.43237573	0.	
2.87617644	1.94258801	1.93962483	0.38458925	0.	0.02155318	
PINNED END CASE						
2.67535293						
	1.94663361	1.94306676	0.37614309	0.	0.02115414	0.70041671

DATA SET 51

AXIAL LOAD (P) = 0.7900 LATERAL LOAD (Q) = 2.0000

SUMMARY OF RESULTS

CURVATURE AT MIDHEIGHT	LENGTH	LATERAL DEFLECTION AT MIDHEIGHT	VERTICAL MOVEMENT	END MOMENT	END SLOPE	H
PINNED END CASE						
2.67535293	1.94663361	1.94306676	0.37614309	0.	0.02115414	0.70041871
FIXED END CASE						
2.59058812	2.23462318	2.23044235	0.44791647	-0.43163596	0.	0.70049879

DATA SET 16

3RD SET OF INPUT DATA

INPUT DATA

AST	D	AFF	QRC	QST	QFC	QFT	P	QI	QIC	UMAX	DSI	FIC
0.30000	10.00000	0.45000	0.	2.00000	0.30000	0.30000	1.20000	1.00000	2.00000	3.00000	0.18000	0.15000

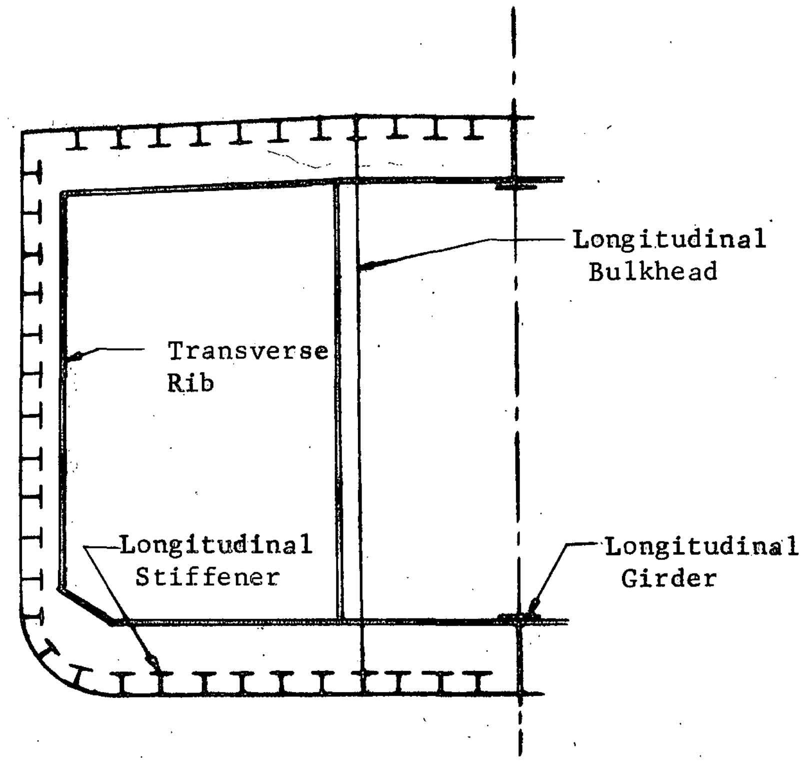
SECTION PROPERTIES

AST	D	AFF	QRC	RR	EL	AMPN	P
0.3000000	10.0000000	0.4500000	0.	3.6347850	8.7115385	-0.9533657	1.2000000
N	FI(N)	CM(N)	EPS(N)	N	FI(N)	CM(N)	EPS(N)

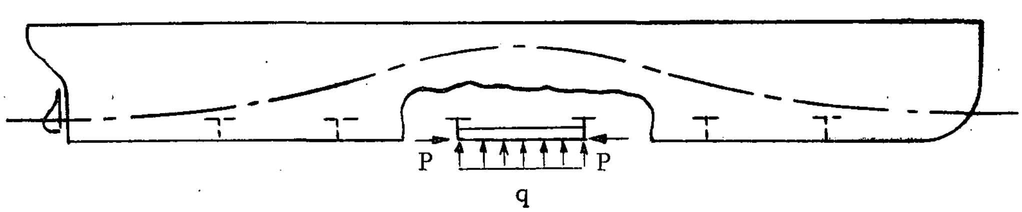
AXIAL LOAD TOO HIGH (SECTION CANNOT MAINTAIN EQUILIBRIUM) – (HALT COMPUTATIONS ON THIS DATA SET.)

– – –

NO ADDITIONAL DATA SETS. THEREFORE THE RUN TERMINATES.



(a) TYPICAL MID-SHIP CROSS SECTION



(b) LOADING ON THE SHIP BOTTOM PANEL DUE TO WAVE ACTION-HOGGING

Fig. 1 LONGITUDINALLY STIFFENED PLATE PANELS IN THE SHIP BOTTOM STRUCTURE.

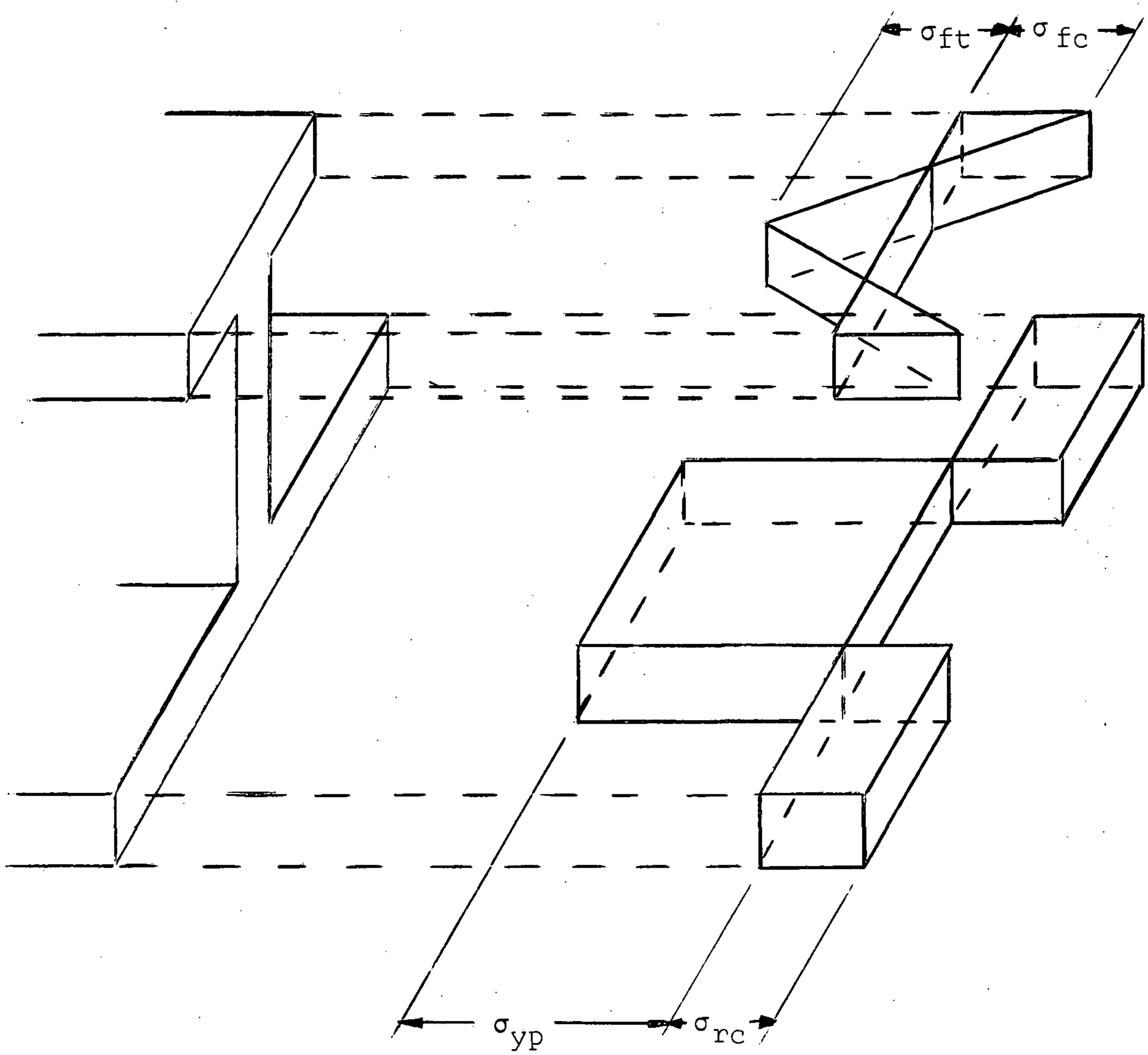


Fig. 2 Typical Cross Section With Simplified Residual Stress Distribution

REFERENCES

1. Kondo, J.
ULTIMATE STRENGTH OF LONGITUDINALLY STIFFENED PLATE PANELS SUBJECTED TO COMBINED AXIAL AND LATERAL LOADING, Fritz Engineering Laboratory Report No. 248.13, Lehigh University, 1965

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