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REMARKS

STRUCTURAL CALCULATIONS

for

10 x 10 BOX CULVERT

Old Cross Cut Canal

Drainage Improvements

Indian School Road to McDowell Road

FCD Contract No. 94-24

November, 1994

Registered Professional Engineer (Civil)
CERTIFICATE NO.
10217
WILLIAM STEPHEN
KANTOR, JR.
Date Signed 11/3/94
ARIZONA, U.S.A.

ENTRANCO

A103.808

SPAN "S"	HEIGHT "H"	QUANTITIES CONCRETE CY/LF	QUANTITIES REINF. STEEL LBS/LF	TOP SLAB "T"	BOT SLAB "T2"	aa BAR SIZE	aa SPACING	aa LENGTH	bb BAR SIZE	bb SPACING	bb LENGTH	cc NUMBER *
10'	10'	3.43	435	16"	16"	5	6"	12'-3"	5	12"	15'-3"	42

dd1 TOP BAR SIZE	dd1 TOP SPACING	dd1 TOP LENGTH	dd1 TOP A	dd1 TOP B	dd1 TOP C	ee1 TOP BAR SIZE	ee1 TOP SPACING	ee1 TOP LENGTH	ff1 BAR SIZE	ff1 SPACING	ff1 LENGTH	gg NUMBER **	hh1 BAR SIZE	hh1 SPACING	hh1 LENGTH	hh1 D1
6	12"	23'-7"	7'-9"	5'-0"	1'-1"	5	12"	22'-8"	6	12"	22'-8"	64	5	6	14'-3"	11'-0"

dd2 BOT BAR SIZE	dd2 BOT SPACING	dd2 BOT LENGTH	dd2 BOT A	dd2 BOT B	dd2 BOT C	ee2 BOT BAR SIZE	ee2 BOT SPACING	ee2 BOT LENGTH	ff2 BAR SIZE	ff2 SPACING	ff2 LENGTH	hh2 BAR SIZE	hh2 SPACING	hh2 LENGTH	hh2 D2
6	12"	23'-11"	8'-2"	5'-0"	11"	5	12"	23'-2"	7	12"	23'-2"	6	6"	10'-9"	7'-6"

* TOTAL NUMBER OF #4(CONT.) BARS IN WALLS
** TOTAL NUMBER OF #4(CONT.) BARS IN TOP/BOT SLABS

GENERAL NOTES:

All construction shall conform to the latest MAG Uniform Standard Specifications with applicable Maricopa County and City of Phoenix supplements, and to appropriate Arizona Department of Transportation Standard Specifications for Road and Bridge Construction as required by these plans and the Special Provisions.

Design–AASHTO Standard Specifications for Highway Bridges, 1993 fifteenth Edition.

Loading Class–HS 20–44 and Interstate Alternate Loading.

Internal Pressure: 22' of H_2O. See Thomas–Hartig & Associates, Inc. Geotechnical Report No. 90–0863 dated February 12, 1991 for Soil Data.

All concrete shall be Class"AA" f'c=4,000 psi.

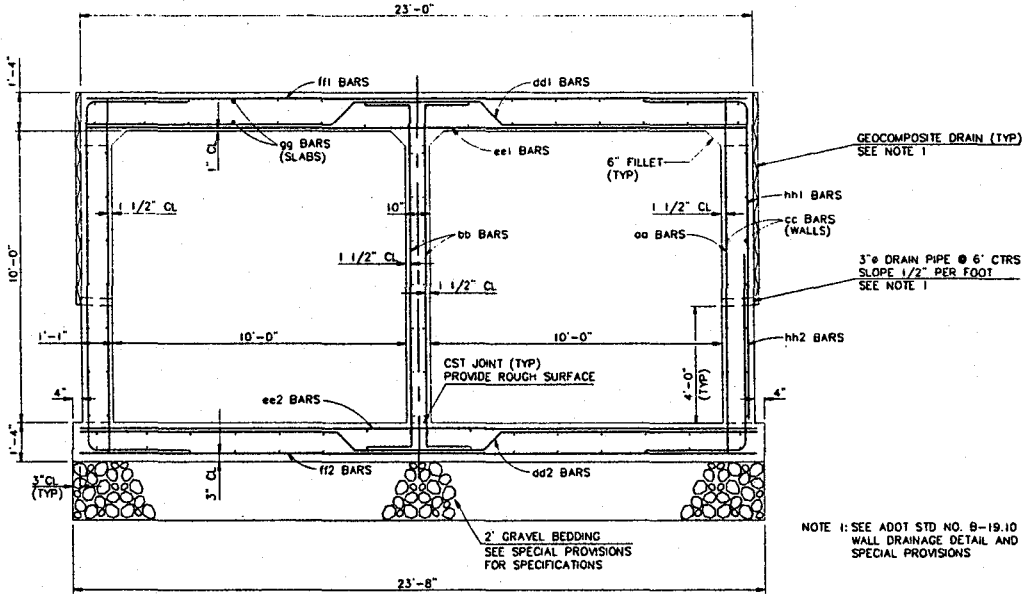
Reinforcing steel shall conform to ASTM Specification A615, Grade 60, fs=24,000 psi.

All bend dimensions for reinforcing steel shall be out to out of bars. All placement dimensions for reinforcing steel shall be to center of bars except as noted.

All reinforcing steel shall have 2" clear cover unless noted otherwise.

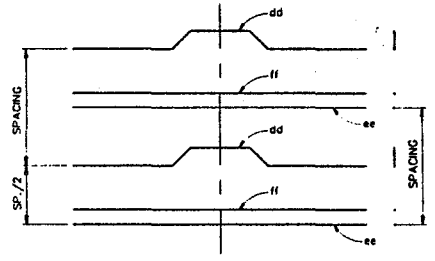
JOINT NOTE:

Construction joint spacing in the walls and top slab shall not exceed 38'-6", and in the bottom slab shall not exceed 50', with reinforcing steel projecting 1'-6" through all the joints. Joints in the slab shall be perpendicular to the culvert centerline. All Stuctures, cast-in-place concrete or pre-cast units, shall have watertight construction joints in the top and bottom slabs and the walls. Refer to these plans and the Special Provisions for waterstop details.

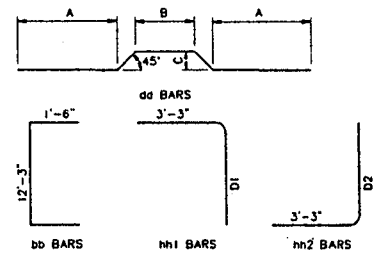


NOTE 1: SEE ADOT STD NO. B-19.10 WALL DRAINAGE DETAIL AND SPECIAL PROVISIONS

TYPICAL SECTION
SCALE: 1/2" = 1'-0"



REINFORCING BAR PLACING DIAGRAM



BENDS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

OLD CROSS CUT CANAL
INDIAN SCHOOL RD TO McDOWELL RD
PROJECT NO. FCD 94-24

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	VA/WSH	06/25/94
DRAWN	TST	06/25/94
CHECKED	WSH	07/08/94

ENTRANCO

TYPICAL SECTION
10'x 10' DOUBLE BARREL BOX CULVERT

SHEET OF
C.V.-1

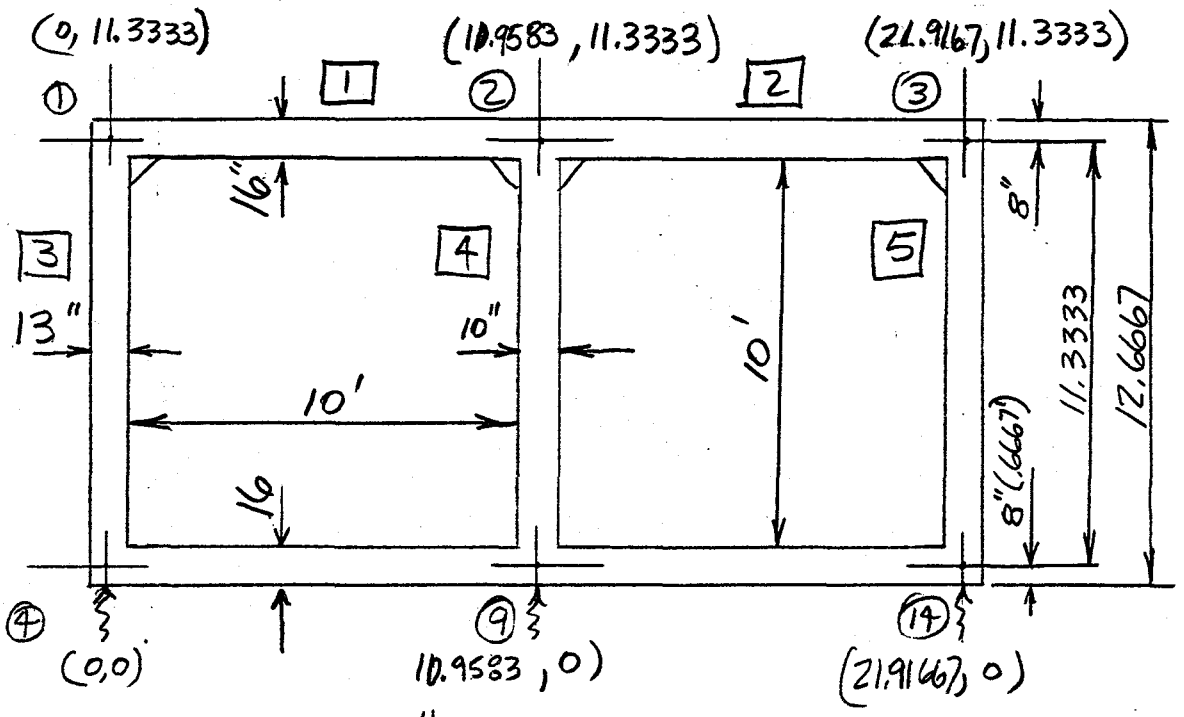
PLOT DATE: 10/24/94 CADD NAME: HDIXIBOX.DWG
SCALE: 1/2" = 1'-0"

PROJECT X-CUT CANAL PLAN DIMENSIONS
SUBJECT DOUBLE 10x10 CBC JOINT COORD / Variables
MADE BY WSK DATE 7/20/92 CHECKED BY VA DATE 7/94

STAAD - III INPUT FOR FINAL RUNS

Joint Coordinates (#) MEMBER [#]

Member Incidences



PROPERTIES $b = 12''$

MEMBER	T	$A_x = bT$	$I_z = T^3 = (bd^3/12)/20\ 7/6$
1	16"	1.3333	.1975 ft⁴
2	16"	1.3333	.1975 ft⁴
3	13"	1.0833	.1059
4	10"	0.8333	.0482
5	13"	1.0833	.1059
6-15	16"	1.3333	.1975

CONSTANTS

$E = 57{,}000\sqrt{f'_c} = 57^K\sqrt{4^K}$ AASHTO 8.7.1

$E = 519{,}119.5$ USE: $520{,}000\ K/ft^2 = (3{,}604{,}996.5\ psi)\left(\frac{K}{1000}\right)\left(\frac{144\ in^2}{ft^2}\right)$

$\gamma_{conc} = 150\ \#/ft^3$

```
STAAD PLANE X-CUT CANAL 2-10X10 CBC
UNIT KIP FEET
JOINT COORDINATES
1 0. 11.3333 ; 2 10.9583 11.3333 ; 3 21.9167 11.3333
4 0. 0. 0. 14 21.9167 0. 0.
MEMBER INCIDENCE
1 1 2 ; 2 2 3 ; 3 1 4 ; 4 2 9 ; 5 3 14 ; 6 4 5 15 1
MEMBER PROPERTIES
1 2 PRISMATIC AX 1.3333 IZ 0.1975
3 5 PRISMATIC AX 1.0833 IZ 0.1059
4 PRISMATIC AX 0.8333 IZ 0.0482
6 TO 15 PRISMATIC AX 1.3333 IZ 0.1975
CONSTANTS
E 520000. ALL
DENSITY 0.15 ALL
SUPPORTS
5 TO 13 FIXED BUT FX MZ KFY 1894.0
4 14 FIXED BUT MZ KFY 1703.0 KFX 100
*============================================================
LOAD 1 DEAD LOAD
SELFWEIGHT Y -1.0
*============================================================
LOAD 2 DRY 15'FILL WT.
MEMBER LOAD
1 2 UNI Y -1.65
*============================================================
LOAD 3 DRY 15'LAT.SOIL
MEMBER LOAD
3 TRAP GX 0.94 1.62
5 TRAP GX -0.94 -1.62
*============================================================
LOAD 13 DRY LAT.SOIL TO TOP OF BOX ONLY
MEMBER LOAD
3 TRAP GX 0.04 0.72
5 TRAP GX -0.04 -0.72
*============================================================
LOAD 4 WET 15'FILL WT.
MEMBER LOAD
1 2 UNI Y -2.10
*============================================================
LOAD 5 WET 15'LAT.SOIL
MEMBER LOAD
3 TRAP GX 1.41 2.43
5 TRAP GX -1.41 -2.43
*============================================================
LOAD 15 WET LAT.SOIL TO TOP OF BOX ONLY
MEMBER LOAD
3 TRAP GX 0.06 1.08
5 TRAP GX -0.06 -1.08
*============================================================
LOAD 10 SYMM LL ON 15'FILL
MEMBER LOAD
1 2 UNI Y -0.15
*============================================================
LOAD 11 UNSYMM LL ON 15'FILL
MEMBER LOAD
1 UNI Y -0.15
*============================================================
LOAD 18 BOUYANT F - HGL 12' MAX ABOVE SOFFIT OF BOX @ BOX BOT
MEMBER LOAD
```

```
6 TO 15 UNI Y 1.456
*==============================================================
LOAD 19 WATER INSIDE   HGL @ CROWN - FLOWING FULL CONDITION
MEMBER LOAD
6 TO 15 UNI Y -0.624
3 TRAP GX  0.000 -0.624
5 TRAP GX 0.000 0.624
*==============================================================
LOAD 20 WATER INSIDE   HGL 12' MAX ABOVE SOFFIT OF BOX
MEMBER LOAD
1 2 UNI Y 0.749
6 TO 15 UNI Y -1.374
3 TRAP GX -0.749 -1.373
5 TRAP GX 0.749 1.373
*==============================================================
*BEGIN LOAD COMBINATIONS FOR ANALYSIS
*==============================================================
*
*LOAD COMB 100 THRU 118 FOR 1/2 LATERAL SOIL PRESSURE INVESTAGATION
*OF TOP AND BOTTOM SLABS - MEMBERS 1,2,AND 6 THRU 24
*
*==============================================================
LOAD COMB 100 SELF DL
            1 1.0
*==============================================================
*START DRY SOIL ANALYSIS WITH 1/2 LATERAL PRESSURES
*==============================================================
LOAD COMB 101 SELF DL + HALF DRY LAT SOIL TO TOP OF BOX
            1 1.0     13 0.5
LOAD COMB 102 SELF DL + DRY 4'FILL + HALF LAT.SOIL
            1 1.0     2 1.0        3 0.5
LOAD COMB 103 SELF DL + DRY 4'FILL + HALF LAT.SOIL + SYMM.LL
            1 1.0     2 1.0        3 0.5           10 1.0
LOAD COMB 104 SELF DL + DRY 4'FILL + HALF LAT.SOIL + UNSYM.LL
            1 1.0     2 1.0        3 0.5           11 1.0
LOAD COMB 105 SELF DL + DRY 4'FILL + HALF LAT.SOIL + SYMM.LL +WATER
            1 1.0     2 1.0        3 0.5           10 1.0    19 1.0
LOAD COMB 106 SELF DL + DRY 4'FILL + HALF LAT.SOIL +UNSYM.LL +WATER
            1 1.0     2 1.0        3 0.5           11 1.0    19 1.0
LOAD COMB 107 SELF DL + DRY 4'FILL + HALF LAT.SOIL + SYMM.LL +WATER
            1 1.0     2 1.0        3 0.5           10 1.0    20 1.0
LOAD COMB 108 SELF DL + DRY 4'FILL + HALF LAT.SOIL +UNSYM.LL +WATER
            1 1.0     2 1.0        3 0.5           11 1.0    20 1.0
*==============================================================
*START SATURATED SOIL ANALYSIS WITH 1/2 LATERAL PRESSURES
*==============================================================
LOAD COMB 111 SELF DL + HALF WET LAT SOIL TO TOP OF BOX
            1 1.0     15 0.5
LOAD COMB 112 SELF DL + WET 15'FILL + HALF LAT.SOIL
            1 1.0     4 1.0        5 0.5
LOAD COMB 113 SELF DL + WET 15'FILL + HALF LAT.SOIL + SYMM.LL
            1 1.0     4 1.0        5 0.5     10 1.0
LOAD COMB 114 SELF DL + WET 15'FILL + HALF LAT.SOIL + UNSYM.LL
            1 1.0     4 1.0        5 0.5      11 1.0
LOAD COMB 115 SELF DL +WET 15'FILL +HALF LAT.SOIL +SYMM.LL +H2O_FUL
            1 1.0     4 1.0       5 0.5    10 1.0  19 1.0  18  0.49
LOAD COMB 116 SELF DL +WET 15'FILL +HALF LAT.SOIL +UNSYM.LL+H2O_FUL
            1 1.0     4 1.0       5 0.5  11 1.0    19 1.0  18  0.49
LOAD COMB 117 SELF DL +WET 15'FILL +HALF LAT.SOIL +SYMM.LL+ H2O_PRE
            1 1.0     4 1.0        5 0.5  10 1.0    20 1.0  18 1.00
```

1C

```
LOAD COMB 118 SELF DL +WET 15'FILL +HALF LAT.SOIL +UNSYM.LL+H2O_PRE
            1 1.0     4 1.0        5 0.5  11 1.0    20 1.0  18 1.0
*==============================================================
*BEGIN FULL LATERAL SOIL ANALYSIS FOR ALL -M AREAS & +M  WALL AREAS
*==============================================================
*
*START DRY SOIL ANALYSIS
*==============================================================
LOAD COMB 121 SELF DL + FULL DRY LAT SOIL TO TOP OF BOX
            1 1.0     13 1.0
LOAD COMB 122 SELF DL + DRY 4'FILL + FULL LAT.SOIL
            1 1.0     2 1.0        3 1.0
LOAD COMB 123 SELF DL + DRY 4'FILL + FULL LAT.SOIL + SYMM.LL
            1 1.0     2 1.0        3 1.0           10 1.0
LOAD COMB 124 SELF DL + DRY 4'FILL + FULL LAT.SOIL + UNSYM.LL
            1 1.0     2 1.0        3 1.0           11 1.0
LOAD COMB 125 SELF DL +DRY 4'FILL +FULL LAT.SOIL +SYMM.LL +H2O_FUL
            1 1.0     2 1.0        3 1.0           10 1.0    19 1.0
LOAD COMB 126 SELF DL +DRY 4'FILL +FULL LAT.SOIL +UNSYM.LL +H2O_FUL
            1 1.0     2 1.0        3 1.0           11 1.0    19 1.0
LOAD COMB 127 SELF DL +DRY 4'FILL +FULL LAT.SOIL +SYMM.LL +H2O_PRE
            1 1.0     2 1.0        3 1.0           10 1.0    20 1.0
LOAD COMB 128 SELF DL +DRY 4'FILL +FULL LAT.SOIL +UNSYM.LL +H2O_PRE
            1 1.0     2 1.0        3 1.0           11 1.0    20 1.0
*==============================================================
*START SATURATED SOIL ANALYSIS
*==============================================================
LOAD COMB 131 SELF DL + FULL WET LAT SOIL TO TOP OF BOX
            1 1.0     15 1.0
LOAD COMB 132 SELF DL + WET 15'FILL + FULL LAT.SOIL
            1 1.0     4 1.0        5 1.0
LOAD COMB 133 SELF DL + WET 15'FILL + FULL LAT.SOIL + SYMM.LL
            1 1.0     4 1.0        5 1.0   10 1.0
LOAD COMB 134 SELF DL + WET 15'FILL + FULL LAT.SOIL + UNSYM.LL
            1 1.0     4 1.0        5 0.5  11 1.0
LOAD COMB 135 SELF DL +WET 4'FILL +FULL LAT.SOIL + SYMM.LL +H2O_FUL
            1 1.0     4 1.0        5 1.0  10 1.0    19 1.0  18 0.49
LOAD COMB 136 SELF DL +WET 15'FILL +FULL LAT.SOIL +UNSYM.LL+H2O_FUL
            1 1.0     4 1.0        5 1.0  11 1.0    19 1.0  18 0.49
LOAD COMB 137 SELF DL +WET 15'FILL +FULL LAT.SOIL + SYMM.LL+H2O_PRE
            1 1.0     4 1.0        5 1.0  10 1.0    20 1.0  18 1.0
LOAD COMB 138 SELF DL +WET 15'FILL +FULL LAT.SOIL +UNSYM.LL+H2O_PRE
            1 1.0     4 1.0        5 1.0  11 1.0    20 1.0  18 1.0
*==============================================================
PERFORM ANALYSIS
PRINT ANALYSIS RESULTS LIST
*==============================================================
LOAD LIST 100 TO 118
*==============================================================
PRINT FORCE ENV NSECTION 10 LIST 1
PRINT FORCE ENV NSECTION 10 LIST 2
PRINT FORCE ENV NSECTION 2 LIST 6 7 8 9 10
PRINT FORCE ENV NSECTION 2 LIST 11 12 13 14 15
MSDR ENVELOPE FY MZ LIST 1
MSDR ENVELOPE FY MZ LIST 2
*==============================================================
LOAD LIST 121 TO 138
*==============================================================
PRINT FORCE ENV NSECTION 10 LIST 1
PRINT FORCE ENV NSECTION 10 LIST 2
```

1D

```
PRINT FORCE ENV NSECTION 10 LIST 3
PRINT FORCE ENV NSECTION 10 LIST 4
PRINT FORCE ENV NSECTION 10 LIST 5
PRINT FORCE ENV NSECTION 2 LIST 6 TO 10
PRINT FORCE ENV NSECTION 2 LIST 11 TO 15
MSDR ENVELOPE FY MZ LIST 1
MSDR ENVELOPE FY MZ LIST 2
MSDR ENVELOPE FY MZ LIST 3
MSDR ENVELOPE FY MZ LIST 4
MSDR ENVELOPE FY MZ LIST 5
PLOT DIS FIL
FINISH
```

ENTRANCO

SHEET NO 2 OF 16
PROJECT NO

PROJECT X CUT
SUBJECT 2- 10x10 CBC
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

FILL HEIGHT

15 feet – Varies 8 to 11 feet, 4' added to accomodate mounding in park area

DESIGN SEQUENCE

1. Scan STAAD COMPUTER OUT-PUT FORCE Associated with design point
2. Estimate d using Shear near d from Support.
3. Estimate As using Moment at end of haunch
4. Check Shear stress AASHTO 8.15.5.1 (Eq 8-14) for Slabs and 8.15.5.2 (Eq 8-4) for walls
5. Check bending Stresses
6. Check Serviceability AASHTO 17.6.4.1 (Eq 17-19)
7. Check Reinforcing Ratio ρ/ρ_b=
8. Compare Cracked Section Capacity.

ENTRANCO ENGINEERS, INC.

JOB NO. - - - - - - - - -

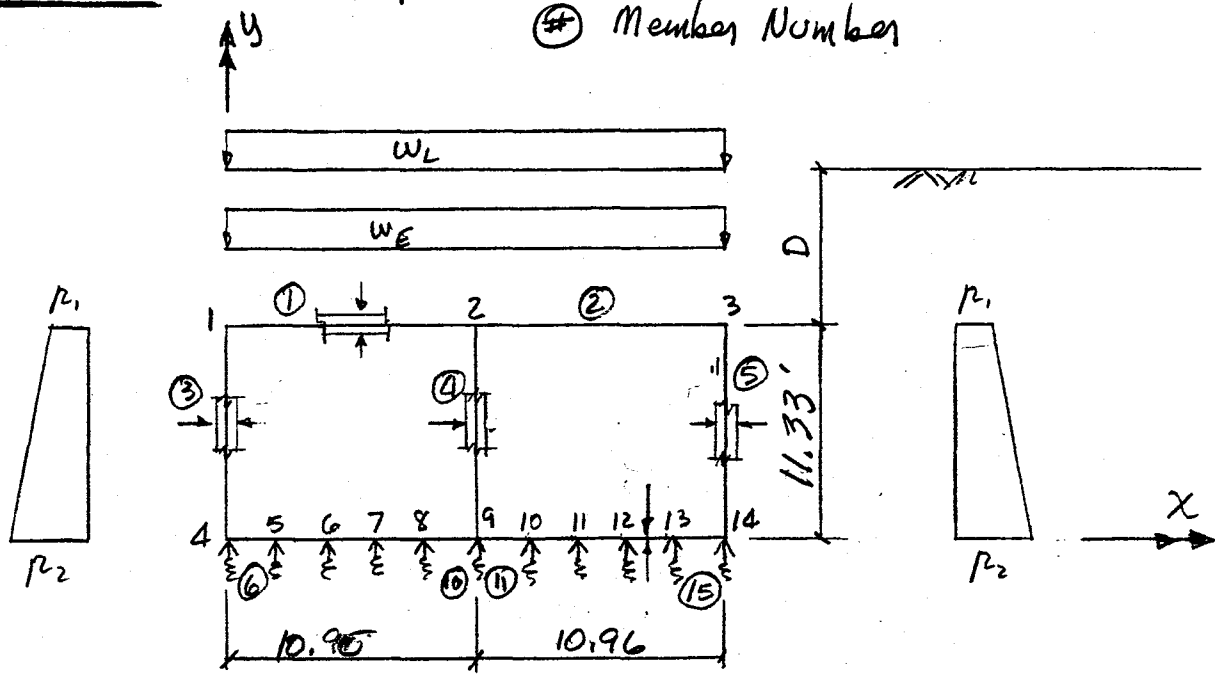
PROJECT X-Cut Canal

CALCULATIONS FOR Double 10×10' STAAD III MODEL DATA

MADE BY AR DATE 10/4/91 CHECKED BY WSK DATE 10/91

Double 10'×10'

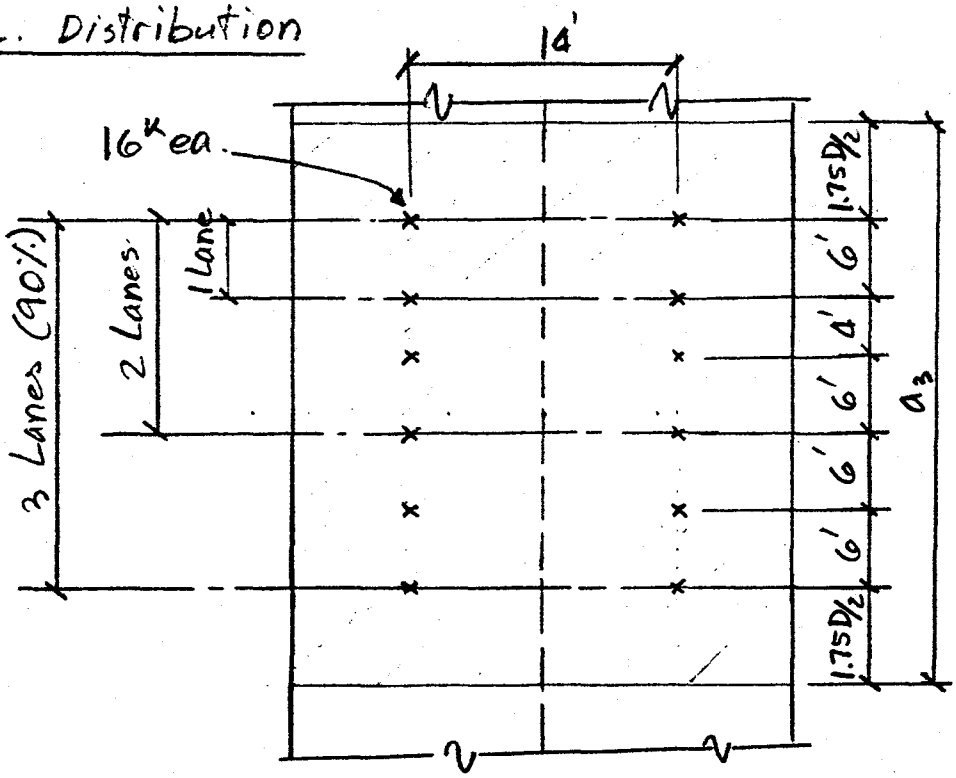
Legend: # Joints Number
(#) Member Number

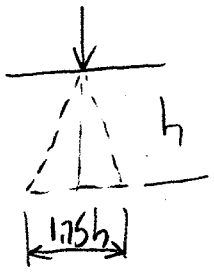


Soil Modulus = 0.5 KCi $(12)^3$ = 864 K/ft³

Spring Const. KFX = 864 × 1' × 10.67'/5 = 1844 K/ft

LL. Distribution





ENTRANCO ENGINEERS, INC.

JOB NO. - - - - - - - - -

PROJECT X-cut Canal

CALCULATIONS FOR Double 10'x10'

MADE BY R DATE 10/4/91 CHECKED BY WSK DATE 10/91

15' Fill

Live Loads

One Lane

$a_1 = 6' + 1.75(15') = 32.25'$

$w_L = 4 \times 16^k / (32.25' \times 21.34) = 0.09$ ksf

Two Lanes

$a_2 = 16' + 1.75(15') = 42.25'$

$w_L = 8 \times 16 / (42.25 \times 21.34) = 0.14$ ksf

Three Lanes

$a_3 = 28' + 1.75(15') = 54.25'$

$w_L = [12 \times 16 / (54.25 \times 21.34)] 0.9 = 0.15$ ksf

controls

Dry Soil Condition

$w_E = 15' \times 0.110$ kcf $= 1.65$ ksf

$p_1 = 15' \times 0.060 = 0.90$ ksf

$p_2 = 25.67' \times 0.06 = 1.54$ ksf

Wet Soil Condition

$w_E = 15' \times 0.140$ kcf $= 2.10$ ksf

$p_1 = 15' \times 0.09 = 1.43$ ksf

$p_2 = 25.67' \times 0.09 = 2.44$ ksf

4' Fill

$a_1 = 6' + 1.75(4') = 13'$

$w_L = 4 \times 16^k / (13' \times 21.34') = 0.23$ ksf

$a_2 = 16' + 1.75(4') = 23'$

$w_L = 8 \times 16 / (23 \times 21.34) = 0.26$ ksf

controls

$a_3 = 28' + 1.75(4') = 35'$

$w_L = [12 \times 16 / (35 \times 21.34)] 0.9 = 0.23$ ksf

$w_E = 4' \times 0.11 = 0.44$ ksf

$p_1 = 4' \times 0.06 = 0.24$ ksf

$p_2 = 14.67 \times 0.06 = 0.88$ ksf

$w_E = 4' \times 0.14 = 0.56$ ksf

$p_1 = 4' \times 0.09 = 0.38$ ksf

$p_2 = 14.67 \times 0.09 = 1.39$ ksf

ENTRANCO

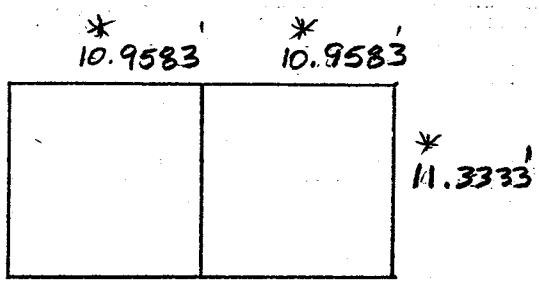
PROJECT X-CUT CANAL
SUBJECT DBL 10X10 CBC
MADE BY WSK DATE 7/20/94 CHECKED BY VA DATE 7/94

LOADINGS

Sign Conv (+): Up & Rt (−): Dn & Lt

LOAD 1 DEAD LOAD

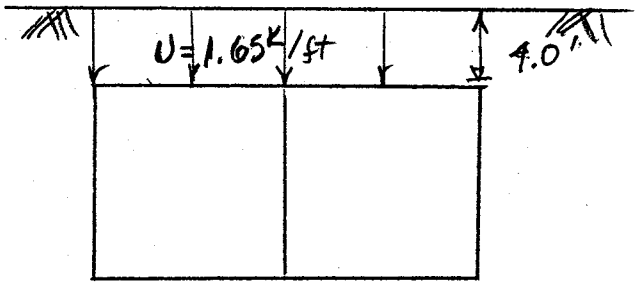
Self wt
Conc = 0.15 K/ft³



*TYPICAL DIMENSIONS

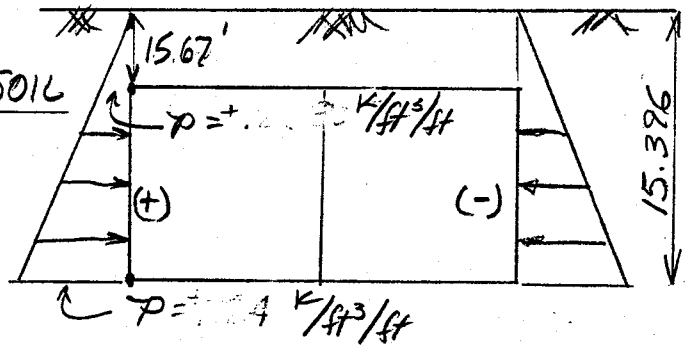
LOAD 2 DRY 15' FILL WT

γ_{dry} = 110 lbs/ft³
See Soils Report



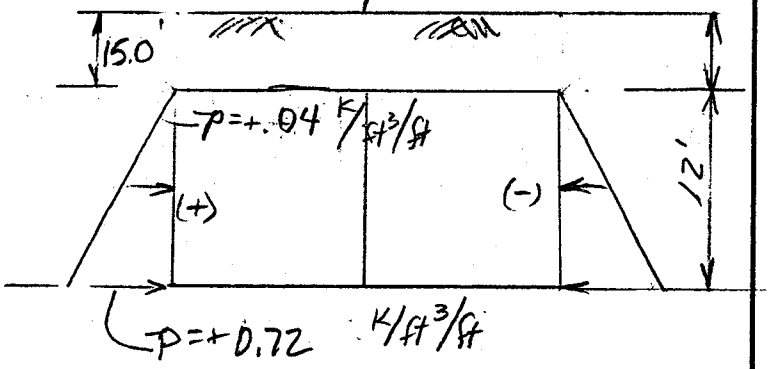
LOAD 3 DRY 15' FILL/ LAT. SOIL

$C_a\gamma_{dry}$ = 60#/ft³
(Equivalent Soil Pressure)
See Soils Report



LOAD 13 DRY 15' Fill/LAT. Soil To to Box only

$C_a\gamma_{wet}$ = 90#/ft³
(Equivalent Soil Pressure)
See Soils Report



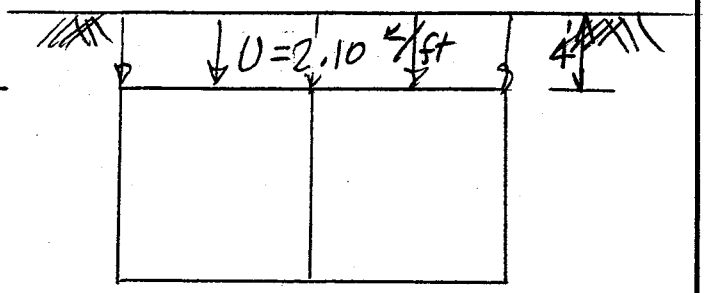
ENTRANCO

PROJECT X-CUT CANAL
SUBJECT DBL 10X10 CBC
MADE BY WSK DATE 7/20/94 CHECKED BY VA DATE 7/94

LOADINGS (Cont.)

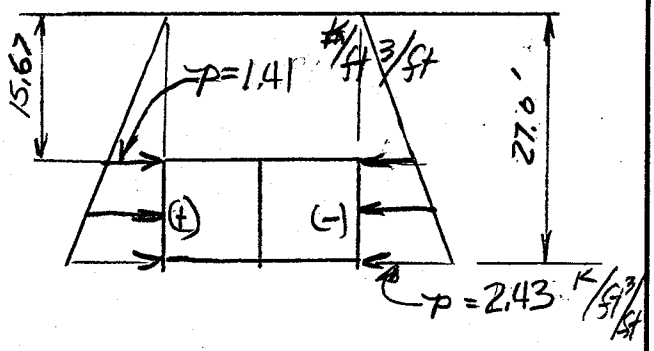
LOAD 4 WET 15' FILL WT

$\gamma_{wet} = 140\ lbs/ft^3$
See Soils Report



LOAD 5 WET 15' LAT. SOIL

$C_a \gamma_{Dry} = 90\#/ft^3$



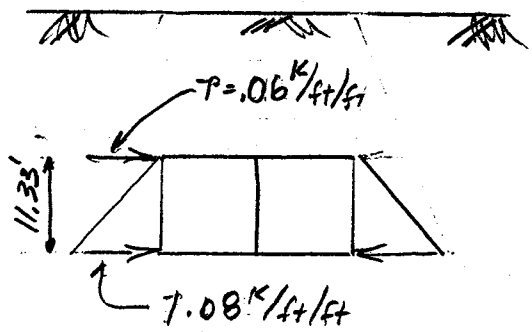
ENTRANCO

PROJECT K-CUT CANAL
SUBJECT DBC 10×10 CBC
MADE BY WSK DATE 7/20/94 CHECKED BY VA DATE 7/94

LOADINGS (CONT)

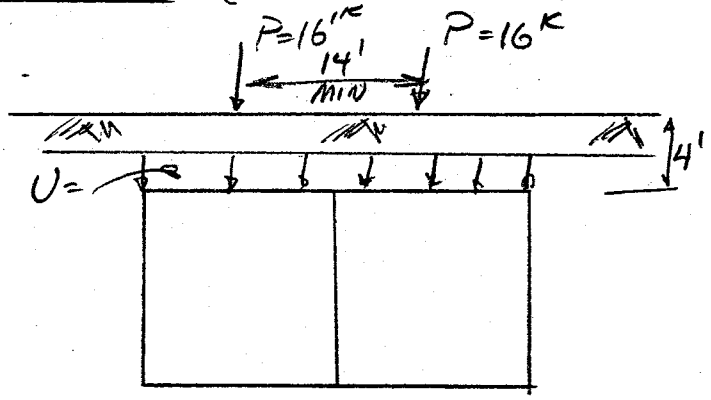
LOAD 15 WET 15' LAT SOIL

$C_a \gamma_{wet} = 90\ \#/ft^3$



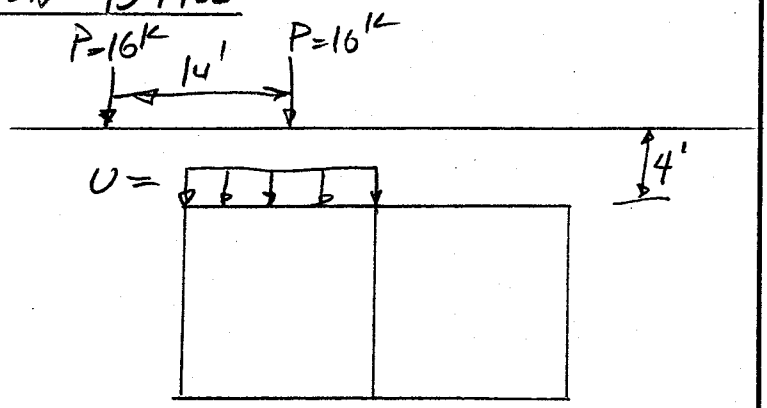
LOAD 10 SYMM LL ON 15' FILL (See Sheets 2 & 3

$U = -0.15\ K/ft/ft$
See Shts 1 & 2



LOAD 11 UNSYMM LL ON 15' FILL

$U = -0.15\ K/ft/ft$
See Sheets 1 & 2

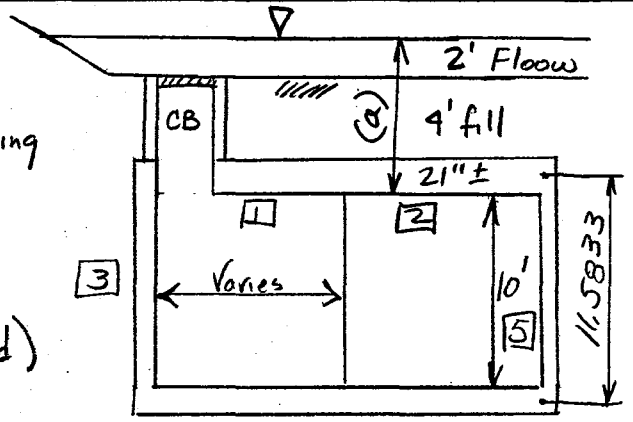


ENTRANCO

SHEET NO 8 OF 16
PROJECT NO

PROJECT
SUBJECT
MADE BY DATE CHECKED BY DATE
REVISED BY DATE RECHECKED BY DATE

LOADS 18, 19, 20
Box Culvert Under Pressure



Balanced Pressure on Middle Wall Ø Loading

Internal Pressure on Side Walls

depth varies (a) USE 10'
(See Memo's from Greiner - attached)

∴ pressure @ Top of Walls

$12' \times 62.4\ \#/ft^3/ft \times 1^K/1000^\# = .749^K/ft^2/ft$ USE $+.624^K/ft$

USE $-0.749^K/ft$ on Mem. #3; $+0.749^K/ft$ on Mem. #5

& pressure on Top Slab from inside
USE $-0.749^K/ft$ on Mem #1 & #2 (Top Slap)
This is same force as at Top of wall but acting upward (-)

& Pressure on Bottom Slab @ Bot of Walls

$22' \times 62.4 \times 1/1000 = 1.373\ ^K/ft$ USE − on 3
+ " 5
(22' = 12' above soffit + 10' box height)

* Dont forget additional 4'± of Water wt above 4' of Saturated Soil (add DL of $4 \times 62.4/1^K = 0.25^K/f$ on 1 & 2

LOAD 18

BOUYANT FORCE ON BOT OF BOT SLAB

$F\uparrow = 23.33' \times .0624 = 1.456\uparrow$

Proportion to $0.490\uparrow$ if Ground water to Top of box only

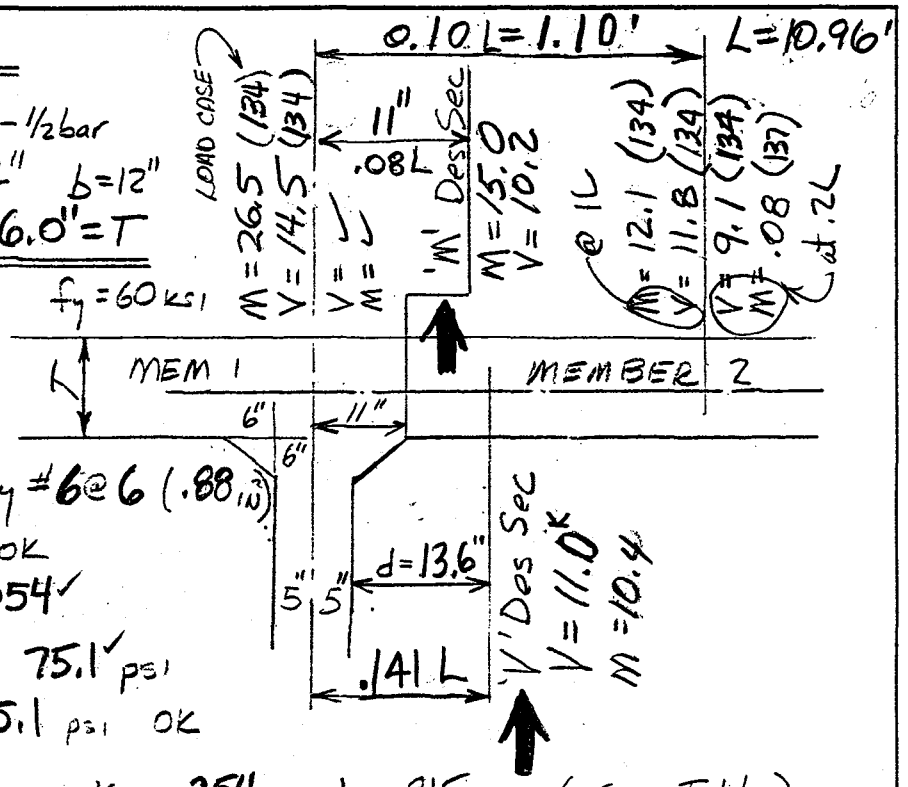
ENTRANCO

SHEET NO 9 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10x10 CBC TOP SLAB
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

TOP SLAB @ INT WALL

Proportion T d = T − 2" − ½bar
d = V^K/12" × 70± psi = 13.2" b = 12"
T = 13.2 + 2.5 = 15.7 + USE = 16.0" = T
d = 13.6" f'c = 4ksi fy = 60ksi



DES. FORCES

M = 15.0 '-K V = 11.0^K
As ≅ .56 M/d = .62 in² Try #6@6 (.88 in²)
∴ d = 16.0 − 2 − .37 = 13.6" OK
ρ = .88 in²/12 × 13.6 = .0054 ✓
$v_c = \sqrt{f'c} + 2200\,\rho\,(\cancel{Vd/M})^{1.0} = 75.1$ psi ✓
v = 11.0/bd = 67.4 ✓ < 75.1 psi OK

Check bending Stresses

K = .254 J = .915 (See Table)

Reinf: fs = 16,437 psi ✓ < 24ksi OK
Conc fc = 698 psi ✓ < 1600 psi OK

Check Serviceability

AASHTO Eq 8-61 & 17-19

$f_s = Z/(d_c A)^{1/3}$ Z = 98 dc = 2.37 A = 28.44 ∴ $98/(d_c^2 \times 12)^{1/3}$
fs = 24.08 psi > 16,437 and < .6Fy = 36ksi OK

Check Reinf Ratio "ρ" (rho)

See Ref. #2, COE

ρ = .0054 ρb = .029 AASHTO 8.16.3.2 Eq 8-18
ρ/ρb = .19 ✓ < .375 max allowed (.25 recommended)

Check Cracked Section

fr = 7.5√f'c = .474 psi yT = T/2 = 8 Ig = 4096
Mcr = fr T²/6 = 20.2 '-K ≥ 16.8 '-K OK 'ρ' and serviceability OK and minor water exposure

* USE T = 16" & #6 @ 6" (dd) (#6 @12") bars
(ff) (#6 @12) bars

ENTRANCO

SHEET NO 10 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10x10 BOT SLAB
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

BOT SLAB @ INT WALL (V & -M)

Proportion T $d = T - 3 - \frac{1}{2}$ bar

$d = 11^k / 12'' \times 70^{\pm}$ psi $= 13.1$ $b = 12''$

$T = 13.1 + 3.5 = 16.6^{\pm}$ USE 16.0"

$d = 12.6''$ ±

DES FORCES

$M = 21.8^k$ @ Face of Support

$V = 11.5^k$ @ 'd' from Face

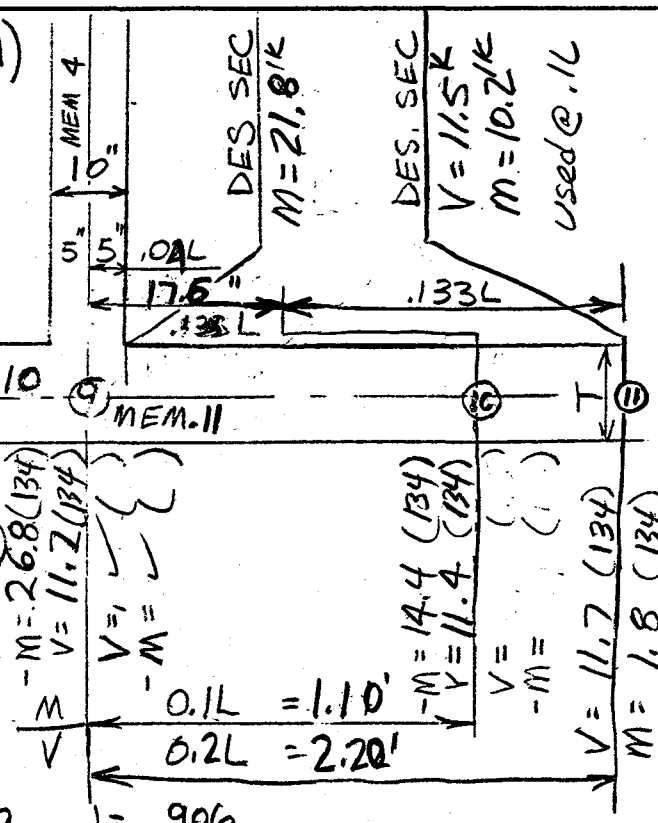
$A_s \cong .56 M/d = .97$ in²/ft Try #6 @ 12" (7 @ 12") ($A_s = 1.04$ in²/ft)

∴ $d = 16 - 3'' - .40'' \cong 12.6''$

$\rho = 1.04/bd = .0069$ ✓

$v_c = \sqrt{4\text{ksi}} + 2200\rho(Vd/M) \cong 78.4$ psi ✓

$v = 11.5/bd = 76.1$ psi < 78.4 psi OK



Check bending Stresses $K = .282$ $J = .906$

Reinf: $f_s = M/A_s jd = 22{,}035 < 24$ksi OK ✓

Conc: $f_c = 1075 < 1600$ psi OK ✓

Check Serviceability AASHTO Eq 8-61 & 17-19 Cover = 2" max

$f_s = Z/(d_c A)^{1/3}$ where $Z = 98$ $d_c = 2.40'$ $A = 2 \times 2.40 \times 12/2 = 28.8$

$f_s = 23\,880 < .6F_y = 36$ ksi for Spacing / # of bars OK

$\geq 22{,}035$ psi from bending

Check Reinf Ratio "ρ" (rho) See Reference #2 COE

$\rho = .0069$ $\rho_b = .029$ AASHTO 8.16.3.2, Eq 8-18

$\rho/\rho_b = .24 < .375$ max allowed (.25 recommended) OK

Check Cracked Section $f_r = 7.5\sqrt{f'_c} = 474$ psi ; $y_T = 8$ $I_g = 4096$ in⁴

$M_{cr} = f_r I_g / y_T = (474_{psi} \times 4096^{in}/8)^{\#-in}/12000 = 20.2^{1-k} \geq 19.7$ OK

* USE T = 16" & #6 @ 12" (dd₂ bars) & #7 @ 12" (ff₂ bars)

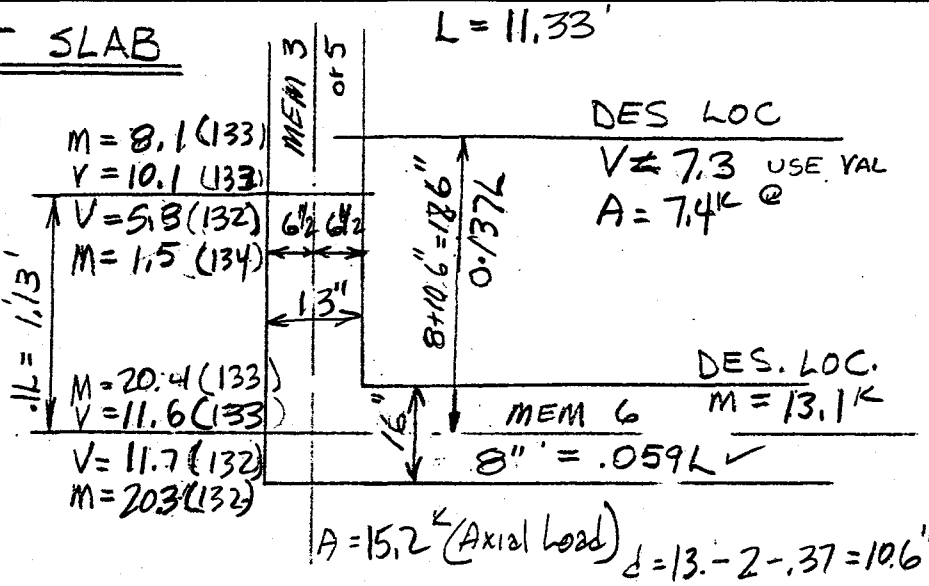
ENTRANCO

SHEET NO 11 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10x10 CBC
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

SIDE WALL @ BOT SLAB

L = 11.33'



-M (NEG MOMENT)

Proportion W

Cover = 2" ½bar ≤ .5"

$v_c \cong 60$

$d_{min} = \Sigma V / 12 \times v_c =$

T = 8.6" + 2.5" = 11.1"

T: USE 13"

d = USE 10.6 ±

Check As Needed

$A_s = .56M/d = .69$ Try #6 @ 6" = .88 IN²/ft d (now) = 10.6"

$d = 13. - 2 - .37 = 10.6"$

DESIGN FORCES

M = 13.1'-K $\rho = .0069$ $v = 7.3K/12 \times 10.6 = 57.4$ psi

V = 7.3K (7.4'K) $v_c = .9(1 + .0006 N/A_g)\sqrt{f'_c} = 60.2 > 57.4$ OK

Axial = 15.2K

Check bending K = .282 J = .906

Reinf.: f_s = 18,601 < 24 ksi OK

Conc.: f_c = 913 < 1600 psi OK

Check Reinf. Ratio 'ρ' (rho)

$\rho = .0069$ $\rho_b = .029$

$\rho/\rho_b = .24 \cong .25$ recommended < .375 max allowed OK

Check Serviceability $d_c = 2.37"$ $A = 2 \times 2.37 \times 12/2 = 28.44$ ✓

$f_s = Z/(d_c \times A)^{1/3} = 93/(2.37 \times 28.4)^{1/3} = 24.09 > 18.6$ ksi OK

Check Cracked Section $f_r = .474$ psi $y_T = 6.5$ $I_g = 2197$ in⁴

$M_{cr} = 13.4 > 12.3$ OK

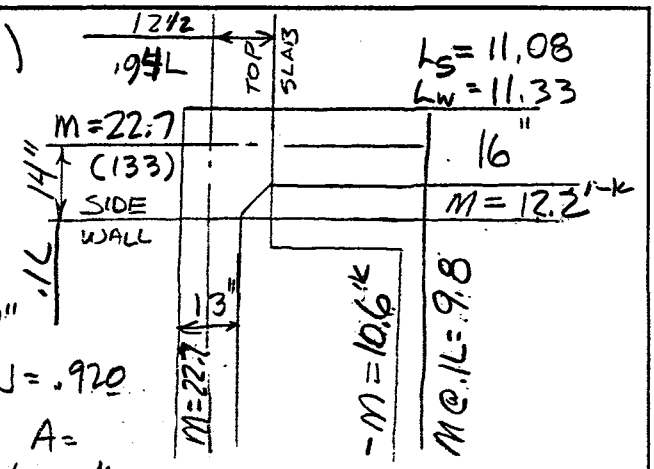
* USE T = 13" & #6 @ 6" (hh 2 bars)

ENTRANCO

SHEET NO 12 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10x10 CBC
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

OTHER DESIGN SECTIONS (-M)



SIDE WALL @ TOP SLAB

V < @ BOT T = 13" OK

$-M = 12.2'^{-k}$ $A_s = .56 M/d = .64$

Try #5@6" $A_s = .62 in^2/ft$ d = 10.7"

Check ↑ $\rho = .0048$ K = .241 J = .920

f_s = 23,987 OK d_c = 2.31 A =

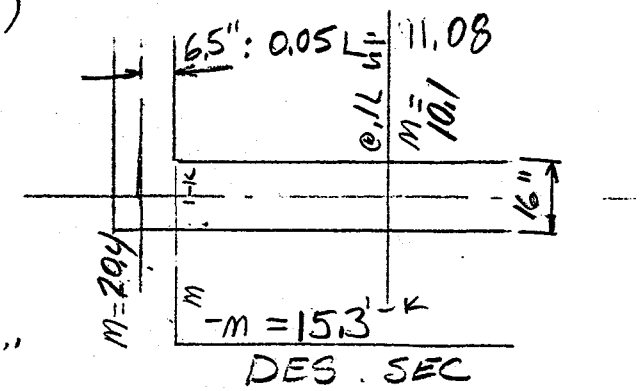
f_c = 961 psi OK $f_s = 98/(d_c A)^{1/3} = 27.7$

ρ/ρ_b = .17 OK f_s (Serviceability) = 24.496 ksi > 23987 psi OK

M_{cr} = 13.4'-k > 12.2'-k OK

* USE T = 13" & #5@6" (hh1 bars)

BOT SLAB @ EXT WALL (-M)



V < @ ℄ Wall T = 16.0"

#6@6" from Side Wall d = 12.6"

A_s = .88 ρ = .0058 K = .262

J = .913

$-M_c = 20.2'^{-k} > 15.3'^{-k}$ OK

ρ/ρ_b = .20 OK d_c = 2.37"

f_s (serviceability) = 24.08 ksi OK

$M_{cr} = 20.2'^{-k} > 15.3$ OK

* USE T = 16" & #6@6" (hh2 bars)

ENTRANCO

SHEET NO 13 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10x10 CBC
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

TOP SLAB @ EXT WALL (-M) USE #5@6 for Wall

V < @ ℄ Wall ok T = 16" See Sketch previous sht.

Design Force -M = 10.6 1-K ← see previous sht d = 16 - 2 - .31 (for #5s) = 13.7"

As = .56 M/d = .43 in² Try #5 @ 6 in As = .62 in²

ρ = .0038 ✓ K = .218 J = .927

Check stresses

fs = 16,155 psi < 24 ksi OK

fc = 559 psi < 1600 OK

Serviceability dc = 2.31 fs = 98/(dc² 12)^1/3

24.5 ksi OK by inspection

Reinf Ratio

ρ = .0038 ρ/ρb = .13 OK

Cracked Section fr = .474 ksi

Mcr = fr T²/6 = 20.2 1K > 8.7 1K OK

USE #5@6" (hh1 bars); T = 16"

OTHER DESIGN SECTIONS +M (inside-water face)

MID-SPAN WALLS ✓ ok

$+M = 10.3^{1-k}$ $T = 13''$ $d = 11.7''$ for #5@6 (#5 = .31 in²)

$A_s = .56M/d = .44$ Try #5@6.

$A_s = (\#5@6'' \,\&\, \#\ @1'')\ .62\ in^2$

$\rho = .0044$ $k = .232$ $j = .923$

Check Stresses

$f_s = 18460 < 24\,ksi$ ok

$f_c = 703 < 1600$

Serviceability $d_c = 2 + (.31 + .31)/2 = 2.31$ $A =$ $\times 2 \times 12/2 =$

$f_s = 98/(d_c^2 12)^{1/3} = 24{,}496 > 18460$ psi OK

Reinf Ratio

$\rho = .0044$ $\rho_b = .029$ $\rho/\rho_b = .15 < .25$ reccomended
$< .375$ max allow.

Cracked Section

$T = 13''$ $I_g = T^3\ in^4$ $f_r = .474\,ksi$ $M_{cr} = f_r I_g / y_T$ $y_T = T/2$

$M_{cr} = f_r T^2/6 = 13.4^{1k} > 10.3$ OK

* #5@6" (aa bars)

MID SPAN WALLS −M (outside-dirt face)

$-M = 1.4^k$ $T = 13$ $d = 13 - 2 - .31$ (hhl bars) $= 10.7''$

Extend (hhl bars) #5@6" to bot of wall

ENTRANCO

SHEET NO 15 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10 x 10 CBC
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

OTHER DESIGN SECTIONS +M (POS MOMENT)

MID-SPAN TOP SLAB ✓ OK 1" cover @ Top Slab

$M = 16.7$ 1-K $T = 16''$ $d = 14.6''$ for #5@12" + #6@12" (#6 = .44 in²)

$A_s = .56M/d = .64$ in² Try #5@12 6# @12" Top bar bent to match with #6

$A_s = (\#5@12'' + \#6@12'')$ .75 in²

$\rho = .0043$ $k = .230$ $j = .923$

Check Stresses $d = 14.6''$

$f_s = 19{,}828$ psi < 24 ksi OK

$f_c = 738$ psi < 1600

Serviceability $d_c = 1 + (.31 + .37)/2 = 1.34$ $A = 1.34 \times 2 \times 12/2 = 29.3$

$f_s = 98/(d_c^2 12)^{1/3} = 35.2$ ksi > 19,828 psi OK

< .6 F_y OK

Reinf Ratio

$\rho = .0043$ $\rho_b = .029$ $\rho/\rho_b = .15$ < .25 reccomended < .375 max allow.

Cracked Section

$T = 16$ $I_g = T^3$ in⁴ $f_r = .474$ ksi $M_{cr} = f_r I_g / y_T$

$M_{cr} = f_r T^2/6 = 20.2$ 1K < 15.0 OK since Servic & ρ OK

* USE T = 16" & #5@12" alt. w/ #6@12"
(ee, bar) (dd, bar)

ENTRANCO

SHEET NO 16 OF 16
PROJECT NO

PROJECT X-CUT
SUBJECT 2-10x10 CBC
MADE BY WSK DATE 7/94 CHECKED BY VA DATE 7/94
REVISED BY DATE RECHECKED BY DATE

OTHER DESIGN SECTIONS +M

MID-SPAN BOT. SLAB ✓ ok 2" cover

$M = 14.9$ 1-k $T = 16''$ $d = 13.6''$ for #6@6 (#6 = .44 in²)

$A_s = .56M/d = .60$ Try #5@12 & #6 bar bent to match with #6 dd₂

$A_s = (\#5@12'' \,\&\, \#6@12'')$ .75 in²

$\rho = .0046$ $k = .239$ $j = .921$ $d = 13.6$

Check Stresses

$f_s = 19{,}033 < 24$ ksi ok

$f_c = 732 < 1600$

Serviceability $d_c = 2\,(.31 + .37)/2 = 2.34$ $A =$ $\times 2 \times 12/2 =$

$f_s = 98/(d_c^2 12)^{1/3} = 24.29_{ksi} > 19{,}033$ psi OK

Reinf Ratio

$\rho = .0046$ $\rho_b = .029$ $\rho/\rho_b = .16$ ≤ .25 reccomended < .375 max allow.

Cracked Section

$T = 16$ $I_g = T^3$ in⁴ $f_r = .474$ ksi

$M_{cr} = 2 f_r T^2/12 = 20.2^{'k} < 11.3$ OK since Servic & ρ OK

* USE #5 (ee₂ bars) at 12" alt w/ #6 dd₂ bars bent up from bottom

ENTRANCO Engineers, Inc.

Sheet No. 1 of 1

Project No. 3-94002-10

PROJECT: OLD CROSS-CUT CANAL

SUBJECT:

MADE BY: WSK DATE: 10/94 CHECKED BY: VA DATE: 10/94

REVISED BY: DATE: CHECKED BY: DATE:

4000 PSI CONCRETE

ITEM DESCRIPTION	LENGTH (FT)	WIDTH (FT)	DEPTH (FT)	NO. OF ITEMS	TOTAL (CY) VOLUME
TOP SLAB	1.0	23.0	1.3333	1	30.67
BOT SLAB	1.0	23.67	1.3333	1	31.48
EXT WALL	1.0	1.0833	10.0	2	21.67
INT WALL	1.0	0.8333	10.0	1	8.33
TOP HAUNCH	1.0	0.50	0.50/2	4	0.50
					92.65 ft^3
					3.43CY

ENTRANCO Engineers, Inc.

Sheet No. 1 of 1

Project No. _____

PROJECT: X-CUT

SUBJECT: QUANTIES

MADE BY: WSIC DATE: 10/94 CHECKED BY: VA DATE: 10/94

REVISED BY: _____ DATE: _____ CHECKED BY: _____ DATE: _____

REINFORCING STEEL

ITEM DESCRIPTION	BAR SIZE	UNIT WEIGHT (LBS/FT)	UNIT LENGTH (FT)	NO. OF UNITS PER ITEM	NO. OF ITEMS	TOTAL WEIGHT (TONS)
TOP SLAB						
ff1	6	1.502	22.67	1	1	34.1
dd1	6	1.502	23.58	1	1	35.4
ee1	5	1.043	22.67	1	1	23.6
gg	4	0.668	1.025	32	1	21.9
BOT SLAB						
ff2	7	2.044	23.17	1	1	
dd2	6	1.502	23.92	1	1	35.9
ee2	5	1.043	22.17	1	1	23.1
gg	4	0.668	1.025	32	1	21.9
EXT WALL aa @6"	5	1.043	12.25	2	2	51.1
hh1	5	1.043	14.25	2	2	59.5
hh2	6	1.502	10.75	2	2	64.6
cc	4	0.668	1.025	14	2	19.2
Int WALL bb @	5	1.043	15.25	2	1	31.8
cc -	4	0.668	1.025	14	1	9.6
						431.7
					USE	435

spans and 4/5 for simple spans, a nonlinear distribution of strain shall be considered.

8.15.3.3 In reinforced concrete members, concrete resists no tension.

8.15.3.4 The modular ratio, $n = E_s/E_c$, may be taken as the nearest whole number (but not less than 6). Except in calculations for deflections, the value of n for lightweight concrete shall be assumed to be the same as for normal weight concrete of the same strength.

8.15.3.5 In doubly reinforced flexural members, an effective modular ratio of $2E_s/E_c$ shall be used to transform the compression reinforcement for stress computations. The compressive stress in such reinforcement shall not be greater than the allowable tensile stress.

8.15.4 Compression Members

The combined flexural and axial load capacity of compression members shall be taken as 35 percent of that computed in accordance with the provisions of Article 8.16.4. Slenderness effects shall be included according to the requirements of Article 8.16.5. The term P_u in Equation (8-41) shall be replaced by 2.5 times the design axial load. In using the provisions of Articles 8.16.4 and 8.16.5, ϕ shall be taken as 1.0.

8.15.5 Shear

8.15.5.1 Shear Stress

8.15.5.1.1 Design shear stress, v, shall be computed by:

$$v = \frac{V}{b_w d} \qquad (8\text{-}3)$$

where V is design shear force at section considered, b_w is the width of web, and d is the distance from the extreme compression fiber to the centroid of the longitudinal tension reinforcement. Whenever applicable, effects of torsion* shall be included.

8.15.5.1.2 For a circular section, b_w shall be the diameter and d need not be less than the distance from the extreme compression fiber to the centroid of the longitudinal reinforcement in the opposite half of the member.

8.15.5.1.3 For tapered webs, b_w shall be the average width or 1.2 times the minimum width, whichever is smaller.

8.15.5.1.4 When the reaction, in the direction of the applied shear, introduces compression into the end regions of a member, sections located less than a distance d from face of support may be designed for the same shear, V, as that computed at a distance d. An exception occurs when major concentrated loads are imposed between that point and the face of support. In that case sections closer than d to the support shall be designed for V at distance d plus the major concentrated loads.

8.15.5.2 Shear Stress Carried by Concrete

8.15.5.2.1 Shear in Beams and One-Way Slabs and Footings

For members subject to shear and flexure only, the allowable shear stress carried by the concrete, v_c, may be taken as $0.95\sqrt{f'_c}$. A more detailed calculation of the allowable shear stress can be made using:

$$v_c = 0.9\sqrt{f'_c} + 1{,}100\,\rho_w\left(\frac{Vd}{M}\right) \le 1.6\sqrt{f'_c} \qquad (8\text{-}4)$$

Note:

(a) M is the design moment occurring simultaneously with V at the section being considered.

(b) The quantity Vd/M shall not be taken greater than 1.0.

8.15.5.2.2 Shear in Compression Members

For members subject to axial compression, the allowable shear stress carried by the concrete, v_c, may be taken as $0.95\sqrt{f'_c}$. A more detailed calculation can be made using:

$$v_c = 0.9\left(1 + 0.0006\frac{N}{A_g}\right)\sqrt{f'_c} \qquad (8\text{-}5)$$

The quantity N/A_g shall be expressed in pounds per square inch.

8.15.5.2.3 Shear in Tension Members

For members subject to axial tension, shear reinforcement shall be designed to carry total shear, unless a more detailed calculation is made using

$$v_c = 0.9\left(1 + 0.004\frac{N}{A_g}\right)\sqrt{f'_c} \qquad (8\text{-}6)$$

* The design criteria for combined torsion and shear given in "Building Code Requirements for Reinforced Concrete"—American Concrete Institute 318 Bulletin may be used.

(c) All beam shear reinforcement shall extend into cast-in-place deck slabs. Extended shear reinforcement may be used in satisfying the minimum tie reinforcement.

8.15.5.6 Special Provisions for Slabs and Footings

8.15.5.6.1 Shear capacity of slabs and footings in the vicinity of concentrated loads or reactions shall be governed by the more severe of two conditions:

(a) Beam action for the slab or footing, with a critical section extending in a plane across the entire width and located at a distance d from the face of the concentrated load or reaction area. For this condition, the slab or footing shall be designed in accordance with Articles 8.15.5.1 through 8.15.5.3, except at footings supported on piles the shear on the critical section shall be determined in accordance with Article 4.4.11.3.

(b) Two-way action for the slab or footing, with a critical section perpendicular to the plane of the member and located so that its perimeter b_o is a minimum, but not closer than d/2 to the perimeter of the concentrated load or reaction area. For this condition, the slab or footing shall be designed in accordance with Articles 8.15.5.6.2 and 8.15.5.6.3.

8.15.5.6.2 Design shear stress, v, shall be computed by:

$$v = \frac{V}{b_o d} \qquad (8\text{-}12)$$

where V and b_o shall be taken at the critical section defined in 8.15.5.6.1(b).

8.15.5.6.3 Design shear stress, v, shall not exceed v_c given by Equation (8-13) unless shear reinforcement is provided in accordance with Article 8.15.5.6.4.

$$v_c = \left(0.8 + \frac{2}{\beta_c}\right)\sqrt{f'_c} \leq 1.8\sqrt{f'_c} \qquad (8\text{-}13)$$

β_c is the ratio of long side to short side of concentrated load or reaction area.

8.15.5.6.4 Shear reinforcement consisting of bars or wires may be used in slabs and footings in accordance with the following provisions:

(a) Shear stresses computed by Equation (8-12) shall be investigated at the critical section defined in 8.15.5.6.1(b) and at successive sections more distant from the support.

(b) Shear stress v_c at any section shall not exceed $0.9\sqrt{f'_c}$ and v shall not exceed $3\sqrt{f'_c}$.

(c) Where v exceeds $0.9\sqrt{f'_c}$, shear reinforcement shall be provided in accordance with Article 8.15.5.3.

8.15.5.7 Special Provisions for Slabs of Box Culverts

For slabs of box culverts under 2 feet or more fill, shear stress v_c may be computed by:

$$v_c = \sqrt{f'_c} + 2{,}200\rho\left(\frac{Vd}{M}\right) \qquad (8\text{-}14)$$

but v_c shall not exceed $1.8\sqrt{f'_c}$. For single cell box culverts only, v_c for slabs monolithic with walls need not be taken less than $1.4\sqrt{f'_c}$, and v_c for slabs simply supported need not be taken less than $1.2\sqrt{f'_c}$. The quantity Vd/M shall not be taken greater than 1.0 where M is the moment occurring simultaneously with V at the section considered. For slabs of box culverts under less than 2 feet of fill, applicable provisions of Articles 3.24 and 6.4 should be used.

8.15.5.8 Special Provisions for Brackets and Corbels*

8.15.5.8.1 Provisions of paragraph 8.15.5.8 shall apply to brackets and corbels with a shear span-to-depth ratio a_v/d not greater than unity, and subject to a horizontal tensile force N_c not larger than V. Distance d shall be measured at face of support.

8.15.5.8.2 Depth at outside edge of bearing area shall not be less than 0.5d.

8.15.5.8.3 Section at face of support shall be designed to resist simultaneously a shear V, a moment $[Va_v + N_c(h - d)]$, and a horizontal tensile force N_c. Distance h shall be measured at the face of support.

(a) Design of shear-friction reinforcement A_{vf} to resist shear V shall be in accordance with Article 8.15.5.4. For normal weight concrete, shear stress v shall not exceed $0.09f'_c$ nor 360 psi. For "all lightweight" or "sand-lightweight" concrete, shear stress v shall not exceed $(0.09 - 0.03a_v/d)f'_c$ nor $(360 - 126a_v/d)$ psi.

* These provisions do not apply to beam ledges. The PCA publication, "Notes on ACI 318-83," contains an example design of beam ledges—Part 16, example 16-3.

17.5.3.4 Splices of Reinforcement

Reinforcement shall be in conformity with Article 8.33.1.1. If lap splicing is used, laps shall be staggered with a minimum of one foot measured along the circumference of the arch. Ties shall be provided connecting the intrados and extrados reinforcement. Ties shall be at 12-inch maximum spacing, in both longitudinal and circumferential directions, except as modified by shear.

17.5.3.5 Footing Design

Design shall include consideration of differential horizontal and vertical movements and footing rotations. Footing design shall conform to Article 4.4.

17.6 REINFORCED CONCRETE BOX, CAST-IN-PLACE

17.6.1 Application

This specification is intended for use in the design of cast-in-place reinforced concrete box culverts.

17.6.2 Materials

17.6.2.1 Concrete

Concrete shall conform to Article 8.2 except that evaluation of f'_c may be based on test beams.

17.6.2.2 Reinforcement

Reinforcement shall meet the requirements of Article 8.3 except that for welded wire fabric a yield strength of 65,000 psi may be used. For wire fabric, the spacing of longitudinal wires shall be a maximum of 8 inches.

17.6.3 Concrete Cover for Reinforcement

The minimum concrete cover for reinforcement shall conform to Article 8.22. The top slab shall be considered a bridge slab for concrete cover considerations.

17.6.4 Design

17.6.4.1 General Requirements

Designs shall conform to applicable sections of these specifications except as provided otherwise in this section. For design loads and loading conditions see Section 3. For distribution of concentrated loads through earth for culverts with less than 2 feet of cover see Article 3.24.3, Case B, and for requirements for bottom distribution reinforcement in top slabs of such culverts see Article 3.24.10. For distribution of wheel loads to culverts with 2 feet or more of cover see Article 6.4. For reinforced concrete design requirements see Section 8.

17.6.4.2 Modification of Earth Loads for Soil Structure Interaction

The effects of soil structure interaction shall be taken into account and shall be based on the design earth cover, sidefill compaction, and bedding characteristics. These parameters may be determined by a soil-structure interaction analysis of the system. The loads given in Article 6.2 may be used, if they are multiplied by a soil-structure interaction factor, F_e, that accounts for the type and conditions of installation as defined in Figure 17.6A, so that the total earth load, W_E on the box section is:

$$W_E = F_e w B_c H \qquad (17\text{-}1)$$

F_e may be determined by the Marston-Spangler Theory of earth loads, as follows:

17.6.4.2.1 Embankment Installations

$$F_{e1} = 1 + 0.20\,\frac{H}{B_c} \qquad (17\text{-}2)$$

F_{e1} need not be greater than 1.15 for installations with compacted fill at the sides of the box section, and need not be greater than 1.4 for installations with uncompacted fill at the sides of the box section.

17.6.4.2.2 Trench Installations

$$F_{e2} = \frac{C_d B_d^2}{H B_c} \qquad (17\text{-}3)$$

Values of C_d can be obtained from Figure 17.4.B for normally encountered soils. The maximum value of F_{e2} need not exceed F_{e1}.

The soil-structure interaction factor, F_e, is not applicable if the Service Load Design Method is used.

17.6.4.3 Distribution of Concentrated Load Effects to Bottom Slab

The width of top slab strip used for distribution of concentrated wheel loads may be increased by twice the box height and used for the distribution of loads to the bottom slab.

4' of fill
No Plands

17.6.4.4 Distribution of Concentrated Loads in Skewed Culverts

Wheel loads on skewed culverts shall be distributed using the same provisions as given for culverts with main reinforcement parallel to traffic.

17.6.4.5 Span Length

For span length see Article 8.8, except when monolithic haunches included at 45 degrees are considered in the design, negative moment reinforcement in walls and slabs may be proportioned based on the bending moment at the intersection of haunch and the uniform depth member.

17.6.4.6 Strength Reduction Factors

Strength reduction factors for load factor design may be taken at 0.9 for combined flexure and thrust and as 0.85 for shear.

17.6.4.7 Crack Control

The maximum service load stress in the reinforcing steel for crack control shall be:

$$f_s = \frac{98}{\sqrt[3]{d_c A}} \text{ ksi} \qquad (17\text{-}19)$$

17.6.4.8 Minimum Reinforcement

Minimum reinforcement shall be provided in accordance with Article 8.17.1 at all cross sections subject to flexural tension, including the inside face of walls. Shrinkage and temperature reinforcement shall be provided near the inside surfaces of walls and slabs in accordance with Article 8.20.

17.7 REINFORCED CONCRETE BOX, PRECAST

17.7.1 Application

This specification is intended for use in design for precast reinforced concrete box sections. Boxes may be manufactured using conventional structural concrete and forms (formed) or with dry concrete and vibrating form pipe-making methods (machine made). Standard dimensions are shown in AASHTO Materials Specification M 259 and M 273.

17.7.2 Materials

17.7.2.1 Concrete

Concrete shall conform to Article 8.2 except that evaluation of f'_c may be based on cores.

17.7.2.2 Reinforcement

Reinforcement shall meet the requirements of Article 8.3 except that for welded wire fabric a yield strength of 65,000 psi may be used. For wire fabric, the spacing of longitudinal wires shall be a maximum of 8 inches.

17.7.3 Concrete Cover for Reinforcement

The minimum concrete cover for reinforcement in boxes reinforced with wire fabric shall be three times the wire diameter but not less than 1 inch. For boxes covered by less than 2 feet of fill, the minimum cover for reinforcement in the top of the slab shall be 2 inches.

17.7.4 Design

17.7.4.1 General Requirements

Design shall conform to applicable sections of these specifications except as provided otherwise in this section. For design loads and loading conditions see Section 3. For distribution of wheel loads to culvert slabs under less than 2 feet of cover see Article 3.24.3, Case B, and for requirements for bottom reinforcement in top slabs of such culverts see Article 3.24.10. For distribution of wheel loads to culvert slabs with 2 feet or more of cover, see Article 6.4.

For reinforced concrete design requirements see Section 8. For span length see Article 8.8, except as noted in Article 17.7.4.6.

17.7.4.2 Modification of Earth Loads for Soil-Structure Interaction

The effects of soil-structure interaction shall be taken into account and shall be based on the design earth cover, sidefill compaction, and bedding characteristics. These parameters may be determined by a soil-structure interaction analysis of the pipe-soil system. The loads given in Article 6.2 may be used, if they are multiplied by a soil-structure interaction factor, F_e, that accounts for the type and conditions of installation as defined in Figure 17.6A, so that the total earth load, W_E, on the box section is:

$$W_E = F_e w B_c H \qquad (17\text{-}1)$$

F_e may be determined by the Marston-Spangler Theory of earth loads as follows:

17.7.4.2.1 Embankment Installations

$$F_{e1} = 1 + 0.20 \frac{H}{B_c} \qquad (17\text{-}2)$$

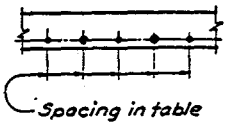
F_{e1} need not be greater than 1.15 for installations with compacted fill at the sides of the box section, and need not be greater than 1.4 for installations with uncompacted fill at the sides of the box section.

MADE W.S.K.	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAY DIVISION STRUCTURES SECTION VALUES OF "K" AND "J" FOR "N" = 8	PROJECT NO. 3.20 SHEET 3 OF 7 DATE 4-75
CHECKED G.R.H.		

$P = As/bd$ $\qquad K = \sqrt{2NP + (NP)^2} - NP \qquad$ $J = 1 - K/3$

P	K	J	P	K	J	P	K	J	P	K	J
.0001	.039	.987	.0051	.248	.917	.0101	.329	.890	.0151	.385	.872
.0002	.055	.982	.0052	.250	.917	.0102	.331	.890	.0152	.386	.871
.0003	.067	.978	.0053	.252	.916	.0103	.332	.889	.0153	.387	.871
.0004	.077	.974	.0054	.254	.915	.0104	.333	.889	.0154	.388	.871
.0005	.086	.971	.0055	.256	.915	.0105	.334	.889	.0155	.389	.870
.0006	.093	.969	.0056	.258	.914	.0106	.336	.888	.0156	.390	.870
.0007	.100	.967	.0057	.260	.913	.0107	.337	.888	.0157	.391	.870
.0008	.107	.964	.0058	.262	.913	.0108	.338	.887	.0158	.392	.869
.0009	.113	.962	.0059	.264	.912	.0109	.339	.887	.0159	.393	.869
.0010	.119	.960	.0060	.266	.911	.0110	.341	.886	.0160	.394	.869
.0011	.124	.959	.0061	.267	.911	.0111	.342	.886	.0161	.395	.868
.0012	.129	.957	.0062	.269	.910	.0112	.343	.886	.0162	.396	.868
.0013	.134	.955	.0063	.271	.910	.0113	.344	.885	.0163	.397	.868
.0014	.139	.954	.0064	.273	.909	.0114	.346	.885	.0164	.398	.867
.0015	.143	.952	.0065	.275	.908	.0115	.347	.884	.0165	.398	.867
.0016	.148	.951	.0066	.276	.908	.0116	.348	.884	.0166	.399	.867
.0017	.152	.949	.0067	.278	.907	.0117	.349	.884	.0167	.400	.867
.0018	.156	.948	.0068	.280	.907	.0118	.350	.883	.0168	.401	.866
.0019	.160	.947	.0069	.282	.906	.0119	.351	.883	.0169	.402	.866
.0020	.164	.945	.0070	.283	.906	.0120	.353	.882	.0170	.403	.866
.0021	.167	.944	.0071	.285	.905	.0121	.354	.882	.0171	.404	.865
.0022	.171	.943	.0072	.287	.904	.0122	.355	.882	.0172	.405	.865
.0023	.174	.942	.0073	.288	.904	.0123	.356	.881	.0173	.406	.865
.0024	.178	.941	.0074	.290	.903	.0124	.357	.881	.0174	.406	.865
.0025	.181	.940	.0075	.292	.903	.0125	.358	.881	.0175	.407	.864
.0026	.184	.939	.0076	.293	.902	.0126	.359	.880	.0176	.408	.864
.0027	.187	.938	.0077	.295	.902	.0127	.360	.880	.0177	.409	.864
.0028	.190	.937	.0078	.296	.901	.0128	.362	.879	.0178	.410	.863
.0029	.193	.936	.0079	.298	.901	.0129	.363	.879	.0179	.411	.863
.0030	.196	.935	.0080	.299	.900	.0130	.364	.879	.0180	.412	.863
.0031	.199	.934	.0081	.301	.900	.0131	.365	.878	.0181	.412	.863
.0032	.202	.933	.0082	.303	.899	.0132	.366	.878	.0182	.413	.862
.0033	.205	.932	.0083	.304	.899	.0133	.367	.878	.0183	.414	.862
.0034	.208	.931	.0084	.306	.898	.0134	.368	.877	.0184	.415	.862
.0035	.210	.930	.0085	.307	.898	.0135	.369	.877	.0185	.416	.861
.0036	.213	.929	.0086	.308	.897	.0136	.370	.877	.0186	.417	.861
.0037	.216	.928	.0087	.310	.897	.0137	.371	.876	.0187	.417	.861
.0038	.218	.927	.0088	.311	.896	.0138	.372	.876	.0188	.418	.861
.0039	.221	.926	.0089	.313	.896	.0139	.373	.876	.0189	.419	.860
.0040	.223	.926	.0090	.314	.895	.0140	.374	.875	.0190	.420	.860
.0041	.225	.925	.0091	.316	.895	.0141	.375	.875	.0191	.421	.860
.0042	.228	.924	.0092	.317	.894	.0142	.376	.875	.0192	.422	.859
.0043	.230	.923	.0093	.318	.894	.0143	.377	.874	.0193	.422	.859
.0044	.232	.923	.0094	.320	.893	.0144	.378	.874	.0194	.423	.859
.0045	.235	.922	.0095	.321	.893	.0145	.379	.874	.0195	.424	.859
.0046	.237	.921	.0096	.323	.892	.0146	.380	.873	.0196	.425	.858
.0047	.239	.920	.0097	.324	.892	.0147	.381	.873	.0197	.426	.858
.0048	.241	.920	.0098	.325	.892	.0148	.382	.873	.0198	.426	.858
.0049	.244	.919	.0099	.327	.891	.0149	.383	.872	.0199	.427	.858
.0050	.246	.918	.0100	.328	.891	.0150	.384	.872	.0200	.428	.857

AREAS OF BARS FOR SECTION OF SLAB ONE-FOOT WIDE



	Spacing* (in.)	Combinations of Bar Nos								
		#2+#2	#2+#3	#3+#3	#3+#4	#4+#4	#4+#5	#5+#5	#5+#6	#6+#6
1	2	0.30	0.48	0.66	0.93	1.20	1.53	1.86	2.25	2.64
2	2¼	0.27	0.42	0.59	0.82	1.07	1.36	1.65	2.00	2.35
3	2½	0.24	0.38	0.53	0.74	0.96	1.22	1.49	1.80	2.11
4	2¾	0.22	0.35	0.48	0.68	0.87	1.12	1.35	1.64	1.92
5	3	0.20	0.32	0.44	0.62	0.80	1.02	1.24	1.50	1.76
6	3¼	0.18	0.29	0.41	0.57	0.74	0.94	1.14	1.38	1.62
7	3½	0.17	0.28	0.38	0.53	0.69	0.87	1.06	1.28	1.51
8	3¾	0.16	0.26	0.35	0.50	0.64	0.82	0.99	1.20	1.41
9	4	0.15	0.24	0.33	0.47	0.60	0.77	0.93	1.13	1.32
10	4¼	0.14	0.23	0.31	0.44	0.56	0.72	0.88	1.06	1.24
11	4½	0.13	0.22	0.29	0.42	0.53	0.68	0.83	1.00	1.17
12	4¾	0.13	0.20	0.28	0.39	0.51	0.64	0.78	0.95	1.11
13	5	0.12	0.19	0.26	0.37	0.48	0.61	0.74	0.90	1.06
14	5¼	0.11	0.18	0.25	0.36	0.46	0.58	0.71	0.85	1.01
15	5½	0.11	0.17	0.24	0.34	0.44	0.56	0.68	0.82	0.96
16	5¾	0.10	0.16	0.23	0.32	0.42	0.53	0.65	0.78	0.92
17	6	0.10	0.16	0.22	0.31	0.40	0.51	0.62	0.75	0.88
18	6½	0.09	0.15	0.20	0.29	0.37	0.47	0.57	0.70	0.81
19	7	0.09	0.14	0.19	0.27	0.34	0.44	0.53	0.65	0.75
20	7½	0.08	0.13	0.18	0.25	0.32	0.41	0.50	0.60	0.70
21	8	0.08	0.13	0.17	0.24	0.30	0.38	0.47	0.56	0.66
22	8½	0.07	0.11	0.16	0.22	0.28	0.36	0.44	0.53	0.62
23	9	0.07	0.11	0.15	0.21	0.27	0.34	0.41	0.50	0.59
24	9½	0.06	0.10	0.14	0.20	0.25	0.32	0.39	0.48	0.56
25	10	0.06	0.10	0.13	0.19	0.24	0.31	0.37	0.45	0.53
26	10½	0.06	0.09	0.13	0.18	0.23	0.29	0.35	0.43	0.50
27	11	0.05	0.09	0.12	0.17	0.22	0.28	0.34	0.41	0.48
28	11½	0.05	0.08	0.11	0.16	0.21	0.27	0.32	0.39	0.46
29	12	0.05	0.08	0.11	0.16	0.20	0.26	0.31	0.38	0.44
30	13	....	....	0.10	0.14	0.18	0.24	0.29	0.35	0.41
31	14	....	....	0.09	0.13	0.17	0.22	0.27	0.33	0.38
32	15	....	....	0.09	0.13	0.16	0.21	0.25	0.30	0.35

*According to "Building Code Requirements for Reinforced Concrete (ACI 318-63)," the spacing between two adjacent bars must not exceed three times the slab thickness, *t*.

AREAS OF BARS FOR SECTION OF SLAB ONE-FOOT WIDE

$A_s/ft = A_{s_1}\frac{12}{S_1} + A_{s_2}\frac{12}{S_2}$

Combinations of Bar Nos										
#6+#7	#7+#7	#7+#8	#8+#8	#8+#9	#9+#9	#9+#10	#10+#10	#10+#11	#11+#11	
2.77	3.20									1
										2
2.50	2.88	3.34	3.79							3
2.27	2.62	3.03	3.45							4
2.08	2.40	2.78	3.16	3.58	4.00					5
1.92	2.22	2.57	2.92	3.31	3.69					6
1.78	2.06	2.38	2.71	3.06	3.43	3.89	4.36			7
1.66	1.92	2.22	2.53	2.86	3.20	3.63	4.06	4.53	4.99	8
1.56	1.80	2.09	2.37	2.69	3.00	3.41	3.81	4.25	4.68	9
1.47	1.69	1.97	2.23	2.53	2.82	3.20	3.59	3.99	4.40	10
1.39	1.60	1.85	2.11	2.38	2.67	3.02	3.39	3.77	4.16	11
1.32	1.52	1.76	2.00	2.26	2.53	2.86	3.21	3.57	3.94	12
1.25	1.44	1.67	1.90	2.15	2.40	2.72	3.05	3.39	3.74	13
1.19	1.37	1.59	1.81	2.04	2.29	2.59	2.90	3.23	3.57	14
1.13	1.31	1.51	1.72	1.95	2.18	2.48	2.77	3.09	3.40	15
1.09	1.25	1.45	1.65	1.86	2.09	2.37	2.65	2.96	3.26	16
1.04	1.20	1.39	1.58	1.79	2.00	2.27	2.54	2.83	3.12	17 @6"
0.96	1.11	1.28	1.46	1.65	1.85	2.09	2.35	2.61	2.88	18
0.89	1.03	1.19	1.35	1.54	1.71	1.95	2.18	2.43	2.67	19
0.83	0.96	1.11	1.26	1.43	1.60	1.82	2.03	2.27	2.50	20
0.78	0.90	1.04	1.19	1.34	1.50	1.70	1.91	2.12	2.34	21
0.73	0.85	0.98	1.12	1.27	1.41	1.61	1.79	2.00	2.20	22
0.69	0.80	0.93	1.05	1.20	1.33	1.52	1.69	1.89	2.08	23
0.66	0.76	0.88	1.00	1.13	1.26	1.43	1.60	1.79	1.97	24
0.63	0.72	0.84	0.95	1.08	1.20	1.36	1.52	1.70	1.87	25
0.60	0.69	0.80	0.90	1.02	1.14	1.30	1.45	1.62	1.78	26
0.57	0.65	0.76	0.86	0.98	1.09	1.24	1.39	1.55	1.70	27
0.55	0.63	0.73	0.82	0.93	1.04	1.19	1.33	1.48	1.63	28
0.52	0.60	0.70	0.79	0.90	1.00	1.14	1.27	1.42	1.56	29
0.48	0.55	0.64	0.73	0.83	0.92	1.05	1.17	1.31	1.44	30
0.45	0.51	0.60	0.68	0.77	0.86	0.98	1.09	1.22	1.34	31
0.42	0.48	0.56	0.63	0.72	0.80	0.91	1.02	1.14	1.25	32

FORMULAS, TABLES AND DIAGRAMS

A_s = cross-sectional area of tension steel reinforcement.
k = ratio of depth of neutral axis to depth d.
j = ratio of lever arm of resisting couple to depth d.
z = depth from compression face to resultant of the compressive stresses.
$jd = d - z$ = arm of resisting couple.
p = steel ratio $\frac{A_s}{bd}$

$$M = Tjd = A_s f_s jd = (f_s pj)bd^2 = Cjd = (\tfrac{1}{2} f_c kj)bd^2 = Rbd^2$$

$$R_s = f_s pj \qquad R_c = \tfrac{1}{2} f_c kj$$

$$k = \sqrt{2pn + (pn)^2} - pn \qquad z = \frac{kd}{3} \qquad j = 1 - \frac{k}{3}$$

$$k = \frac{1}{1 + \frac{f_s}{nf_c}} \qquad p = \frac{f_c}{2f_s}k$$

$$f_s = \frac{M}{A_s jd} \qquad f_c = \frac{2M}{kjbd^2} = \frac{2M}{k \cdot \text{Area} \cdot jd}$$

bd for rectangle
$\frac{\pi r^2}{2}$ for half circle

Balanced Reinforcement:—$p = \dfrac{1}{\frac{2f_s}{f_c}\left(\frac{f_s}{nf_c} + 1\right)}$

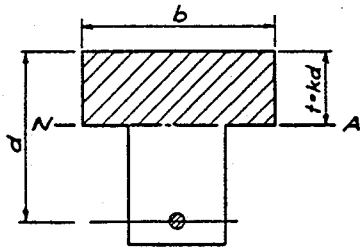
For tables and diagrams giving values of these constants for different stresses and g of concrete, see pages 3-14, 3-15, 3-17.

2. Tee Beams with Tension Reinforcement.*

ACI 900 limits b in symmetrical beams to $\frac{L}{4}$ and the projection either side of the st $8t$, or one-half the distance to the next beam. In one-sided beams, it limits the proje beyond the stem to $\frac{L}{12}$, $6t$, or one-half the distance to the next beam.

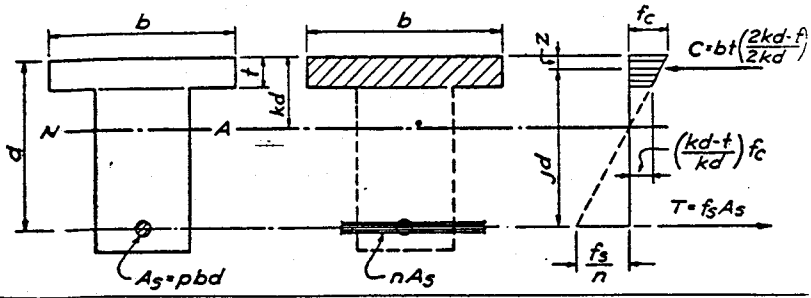
A. Flange thickness down to or below the neutral axis:—

This becomes a rectangular beam (see Item 1) of width b.



B. Shallow flange, neglecting stem:—

It is always conservative to neglect compression in the stem and, unless the f is extremely thin (say $t < 0.15d$), reasonably accurate.



* For application to specific numerical examples, see pages 7-7, 7-34, 7-60, 10-4.

FORMULAS, TABLES AND DIAGRAMS

Symbols have same meaning as for rectangular beams, Item 1 above; also

t = flange thickness.

$$z = \frac{t}{3}\frac{(3kd - 2t)}{(2kd - t)}$$

$$jd = d - z = d - \frac{t}{3}\frac{(3kd - 2t)}{(2kd - t)}$$

$$M_s = Tjd = A_s f_s jd = f_s jpbd^2 = \left(\frac{f_s}{n}\right)pnjbd^2 = C_s\left(\frac{f_s}{n}\right)bd^2 = R_s bd^2$$

where $C_s = pnj$; $\quad R_s = f_s pj$

$$M_c = Cjd = btj\left(\frac{2kd - t}{2k}\right)f_c = \frac{f_c j\frac{t}{d}}{2k}\left(2k - \frac{t}{d}\right)bd^2 = R_c bd^2 =$$

$$f_c\left(1 - \frac{t}{2kd}\right)\frac{t}{d}jbd^2 = C_c f_c bd^2$$

where $C_c = \left(1 - \frac{t}{2kd}\right)\frac{t}{d}j$; $\quad R_c = f_c j\frac{t}{d}\left(\frac{2k - \frac{t}{d}}{2k}\right)$

$$k = \frac{1}{\left(\frac{f_s}{nf_c} + 1\right)}$$

$$kd = \frac{2ndA_s + bt^2}{2nA_s + 2bt}; \qquad k = \frac{2pn + \left(\frac{t}{d}\right)^2}{2pn + 2\left(\frac{t}{d}\right)}$$

$$f_c = \frac{Mkd}{bt\left(kd - \frac{t}{2}\right)jd} = \frac{f_s k}{n(1 - k)} \qquad f_s = \frac{M}{A_s jd} = \frac{f_c n(1 - k)}{k}$$

$$j = \frac{6 - 6\left(\frac{t}{d}\right) + 2\left(\frac{t}{d}\right)^2 + \frac{\left(\frac{t}{d}\right)^3}{2pn}}{6 - 3\left(\frac{t}{d}\right)}$$

C. Shallow flange, including stem:—

No formulas are presented here because this refinement is seldom necessary, no diagrams or tables are readily available, and the method of transformed areas is the simplest attack on the problem.

D. Doubly Reinforced Tee Beams:—

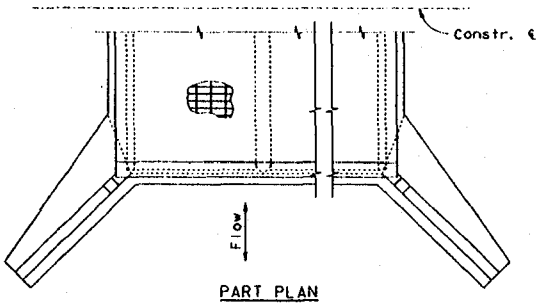
It is possible to reinforce a tee beam for compression, but, additional flange width being far more economical, compressive reinforcement would only be used when both the width and depth of beam are severely limited by space considerations. This relatively unusual case is best solved by the method of transformed areas.

For tables and diagrams giving values of these constants for different stresses and grades of concrete, see page 3-16.

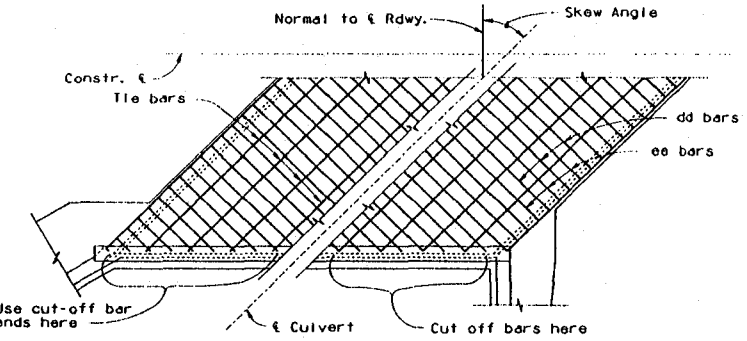
3. Rectangular Beams Reinforced for Both Tension and Compression.*

The doubly reinforced beam (a) (figure on page 3-8), can be thought of as a rectangular beam (b) with balanced tension reinforcement plus a supplementary internal couple (c) of the compression in the top steel and the stress in the additional tension steel, the excess area over that required for balanced reinforcement.

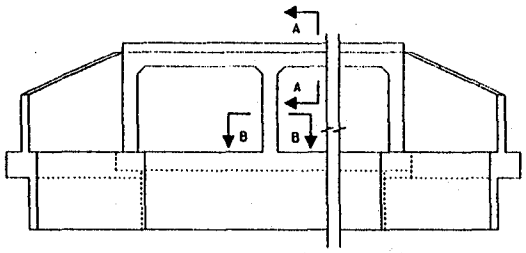
* For applications to examples, see "Negative Moment" on pages 7-36, 7-62 and "Negative Flexure" on pages 10-20 and 10-31.



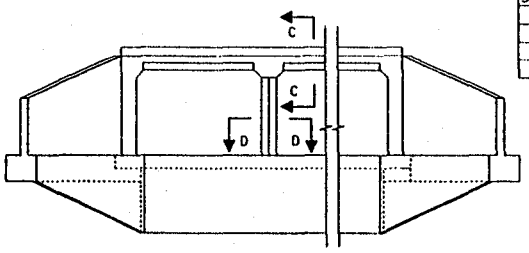
PART PLAN
Showing Inlet & Outlet Details



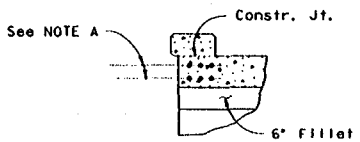
PART PLAN-SKEWED CULVERT
Showing Reinf. Steel Placement



TYPICAL ELEVATION-OUTLET END

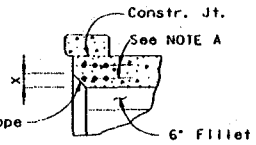


TYPICAL ELEVATION-INLET END

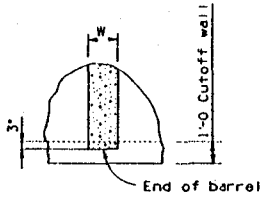


SECTION A-A

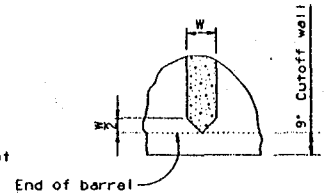
Span 'S'	Dim. 'X'
6'	3"
8'	4"
10'	5"
12'	6"



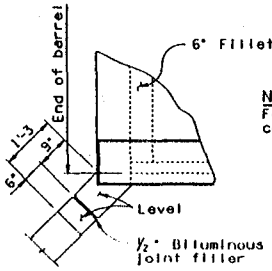
SECTION C-C



SECTION B-B

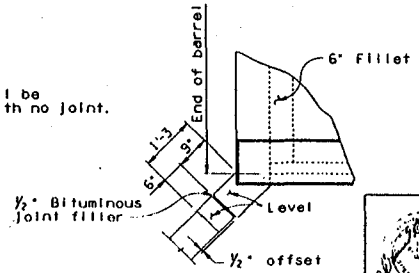


SECTION D-D

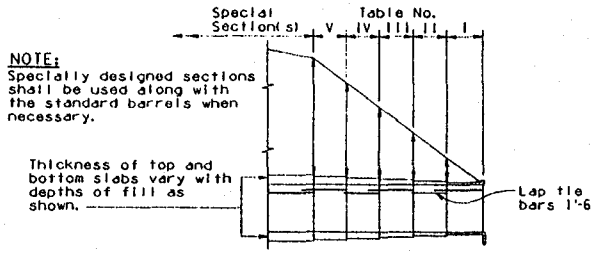


WINGWALL JOINT DETAIL
For all barrels under 8ft. (H<8')

NOTE
Footing shall be contiuous with no joint.



WINGWALL JOINT DETAIL
For all barrels 8ft. and over (H≥8')



NOTE:
Specially designed sections shall be used along with the standard barrels when necessary.

DIAGRAM SHOWING TABLES TO BE USED FOR VARIOUS FILL HEIGHTS

NOTE: Culvert barrels always begin and end with Table No. I.

GENERAL NOTES:

Construction Specification - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, latest Edition.

Design Specifications - AASHTO Standard Specifications for Highway Bridges, Edition of 1989 and 1990 Interim Specifications.

Loading Class - HS20-44 and/or Interstate Alternate Loading.

All concrete shall be Class "S" unless noted otherwise.

Reinforcing steel shall conform to ASTM Specification A615. Bar sizes #6 and smaller shall be designed as Grade 40 but may be furnished as Grade 40 or Grade 60. Bar sizes #7 and larger shall be designed and furnished as Grade 60.

All bend dimensions for reinforcing steel shall be out-to-out of bars. All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

Stresses:
Concrete ..... f'c = 3000 psi
Grade 40 reinforcing steel ..... fs = 20000 psi
Grade 60 reinforcing steel ..... fs = 24000 psi

Chamfer all exposed corners ¾" as per Standard B-19.10 unless noted otherwise.

Dimensions shall not be scaled from drawings.

QUANTITY NOTE:

Total Box Culvert Quantities include Barrel Quantities and Headwall Quantities. Add Apron Quantity when apron is used.
Standard headwall quantities include wings, curb and cut-off wall.
Barrel Quantities are obtained by mutiplying length of box by quantities per linear foot of box.

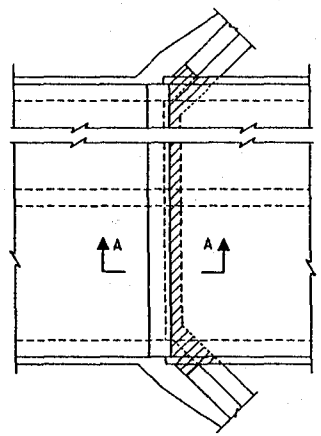
JOINT NOTE:

All structures shall have formed Constr. joints in top slab and walls (optional in floor slab) spaced not more than 38'-6" apart or as shown. Reinforcing steel shall project 1'-6" thru the joint. The joint shall be made with ¼" plywood bulkhead which shall be left in place. Joints shall be perpendicular to the centerline of the box.

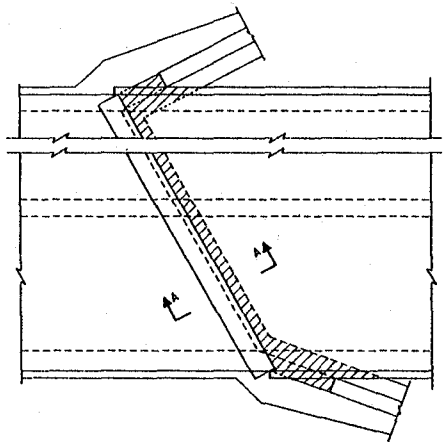
NOTE A:

For culverts skewed over 5° to 30° use 3#7 bars* top and bottom of slab. For culverts skewed over 30° to 45°, use 3#8 bars* top and bottom of slab. For culverts skewed over 45°, a special edge beam design is required.
*Reinforcing bar quantities have to be calculated.

DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION 4-92
APPROVED FOR DISTRIBUTION	MISCELLANEOUS DETAILS FOR STANDARD BOX CULVERTS	STANDARD NO. B-01.10

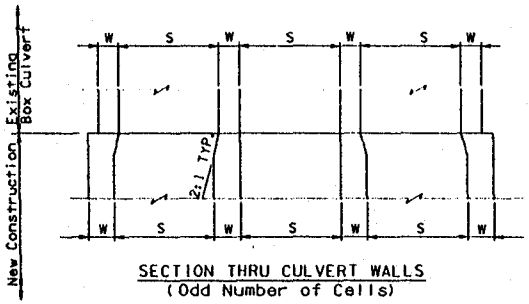


RIGHT ANGLE CULVERT

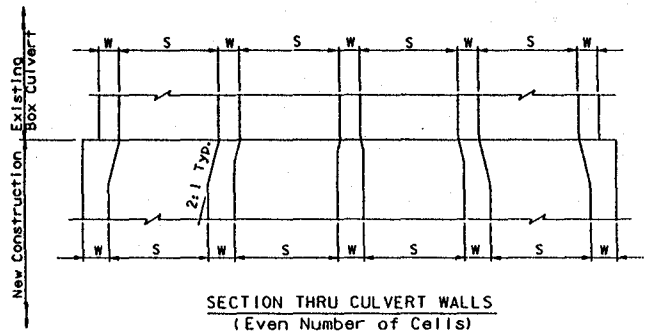


SKEWED CULVERT

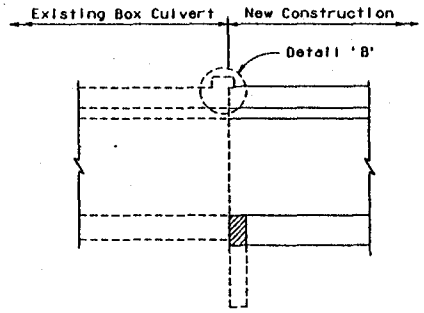
PLAN



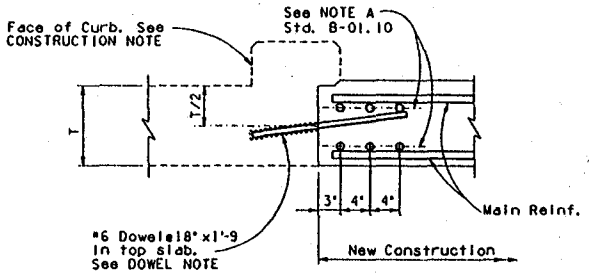
SECTION THRU CULVERT WALLS
(Odd Number of Cells)



SECTION THRU CULVERT WALLS
(Even Number of Cells)



SECTION A-A



DETAIL 'B'

NOTE:

For General Notes see Std. B-01.10.

CONSTRUCTION NOTE:

Remove existing headwall as required for new construction. If concrete headwall is removed to face of curb, no dowels are needed.
Use projecting reinforcing steel for bond in new concrete.
Curb to remain unless within 1'-0 of finish grade.
Wingwalls to be removed a Min. of 1'-6" to provide steel for bond.

DOWEL NOTE:

Drill 1" ϕ hole, 8" deep, for #6 dowel. Epoxy dowel in hole with an approved epoxy adhesive. Epoxy anchorage shall develop a tensile pullout strength of 13 kips. Details of the Anchorage System shall be submitted to the Engineer for approval prior to installation.

NOTE:

▨ Indicates payment limits for removal of concrete.

	DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION
	APPROVED FOR DISTRIBUTION	BOX CULVERT EXTENSION DETAILS	STANDARD NO. B-01.11

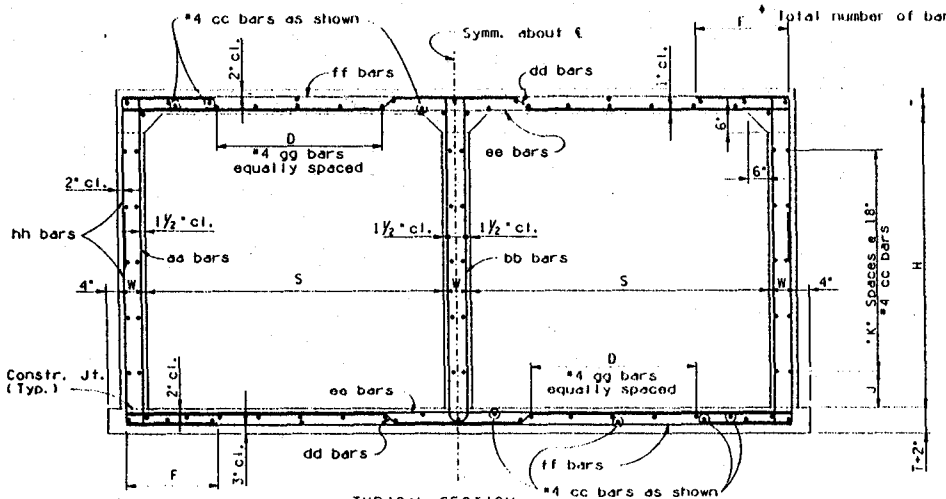
TABLE I
0'-10' FILL

Span "S"	Height "H"	Top Slab "T"	Walls "W"	aa Bar Size	aa Spacing	aa Length	bb Bar Size	bb Spacing	bb Length	cc ✦ Number	dd Bar Size	dd Spacing	dd Length	dd A	dd B	dd C	ee Bar Size	ee Spacing	ee Length	ff Bar Size	ff Spacing	ff Length	gg ✦ Number	gg D	hh Bar Size	hh Spacing	hh Length	hh F
6'	3'	9½"	8"	5	12"	4'-4	5	12"	8'-9	48	5	14"	13'-2	4'-7	2'-7	6½"	5	14"	13'-7	5	14"	13'-7	20	3'-0	4	7"	5'-1	2'-5
	4'	9½"	8"	5	12"	5'-4	5	12"	10'-9	54	5	14"	13'-2	4'-7	2'-7	6½"	5	14"	13'-7	5	14"	13'-7	20	3'-0	4	7"	5'-7	2'-5
	5'	9½"	8"	5	12"	6'-4	5	12"	12'-9	54	5	14"	13'-2	4'-7	2'-7	6½"	5	14"	13'-7	5	14"	13'-7	20	3'-0	4	7"	6'-1	2'-5
	6'	9½"	8"	5	12"	7'-4	5	12"	14'-9	60	5	14"	13'-2	4'-7	2'-7	6½"	5	14"	13'-7	5	14"	13'-7	20	3'-0	4	7"	6'-7	2'-5
	7'	9½"	8"	5	12"	8'-4	5	12"	16'-9	66	5	13"	13'-2	4'-7	2'-7	6½"	5	13"	13'-7	5	13"	13'-7	20	3'-0	4	6½"	7'-1	2'-5
8'	3'	9½"	9"	5	12"	4'-4	5	12"	8'-9	48	6	14"	17'-2	6'-1	3'-8	6½"	6	14"	17'-10	6	14"	17'-10	28	4'-0	6	7"	5'-6	2'-6
	4'	9½"	9"	5	12"	5'-4	5	12"	10'-9	54	6	14"	17'-2	6'-1	3'-8	6½"	6	14"	17'-10	6	14"	17'-10	28	4'-0	6	7"	6'-0	2'-6
	5'	9½"	9"	5	12"	6'-4	5	12"	12'-9	54	6	14"	17'-2	6'-1	3'-8	6½"	6	14"	17'-10	6	14"	17'-10	28	4'-0	6	7"	6'-6	2'-6
	6'	9½"	9"	5	12"	7'-4	5	12"	14'-9	60	6	14"	17'-2	6'-1	3'-8	6½"	6	14"	17'-10	6	14"	17'-10	28	4'-0	6	7"	7'-0	2'-6
	7'	9½"	9"	5	12"	8'-4	5	12"	16'-9	66	6	13"	17'-2	6'-1	3'-8	6½"	6	13"	17'-10	6	13"	17'-10	28	4'-0	5	6½"	7'-5	2'-6
	8'	9½"	9"	5	12"	9'-4	5	12"	18'-9	66	6	13"	17'-2	6'-1	3'-8	6½"	6	13"	17'-10	6	13"	17'-10	28	4'-0	6	6½"	8'-0	2'-6
10'	3'	10½"	11"	5	12"	4'-6	5	12"	9'-2	48	7	17"	21'-5	7'-7	4'-8	7½"	6	17"	22'-4	7	17"	22'-4	32	5'-0	6	8½"	6'-0	3'-0
	4'	10½"	11"	5	12"	5'-6	5	12"	11'-2	54	7	17"	21'-5	7'-7	4'-8	7½"	6	17"	22'-4	7	17"	22'-4	32	5'-0	6	8½"	6'-7	3'-0
	5'	10½"	11"	5	12"	6'-6	5	12"	13'-2	54	6	12"	21'-5	7'-7	4'-8	7½"	5	12"	22'-4	6	12"	22'-4	32	5'-0	5	6"	6'-8	2'-8
	6'	10½"	11"	5	12"	7'-6	5	12"	15'-2	60	6	12"	21'-5	7'-7	4'-8	7½"	5	12"	22'-4	6	12"	22'-4	32	5'-0	5	6"	7'-2	2'-8
	7'	10½"	11"	5	12"	8'-6	5	12"	17'-2	66	7	15"	21'-5	7'-7	4'-8	7½"	5	15"	22'-4	7	15"	22'-4	32	5'-0	6	7½"	7'-9	2'-8
	8'	10½"	11"	5	12"	9'-6	5	12"	19'-2	66	7	15"	21'-5	7'-7	4'-8	7½"	5	15"	22'-4	7	15"	22'-4	32	5'-0	6	7½"	8'-3	2'-8
	9'	10½"	11"	5	12"	10'-6	5	12"	21'-2	72	7	15"	21'-5	7'-7	4'-8	7½"	6	15"	22'-4	7	15"	22'-4	32	5'-0	6	7½"	8'-9	2'-8
	10'	10½"	11"	5	12"	11'-6	5	12"	23'-2	78	7	14"	21'-5	7'-7	4'-8	7½"	5	14"	22'-4	7	14"	22'-4	32	5'-0	6	7"	9'-3	2'-8
12'	8'	12½"	13"	5	12"	9'-10	5	12"	20'-0	66	7	13"	25'-8	9'-1	5'-6	9½"	5	13"	26'-10	7	13"	26'-10	40	6'-0	6	6½"	8'-6	2'-10
	9'	12½"	13"	5	12"	10'-10	5	12"	22'-0	72	8	16"	25'-8	9'-1	5'-6	9½"	5	16"	26'-10	8	16"	26'-10	40	6'-0	6	8"	9'-0	2'-10
	10'	12½"	13"	5	12"	11'-10	5	12"	24'-0	78	8	16"	25'-8	9'-1	5'-6	9½"	5	16"	26'-10	8	16"	26'-10	40	6'-0	6	8"	9'-6	2'-10
	11'	12½"	13"	5	12"	12'-10	5	12"	26'-0	78	7	12"	25'-8	9'-1	5'-6	9½"	4	12"	26'-10	7	12"	26'-10	40	6'-0	6	6"	10'-0	2'-10
	12'	12½"	13"	5	12"	13'-10	5	12"	28'-0	84	7	12"	25'-8	9'-1	5'-6	9½"	5	12"	26'-10	7	12"	26'-10	40	6'-0	6	6"	10'-6	2'-10

TABLE NO. II
10'-15' FILL

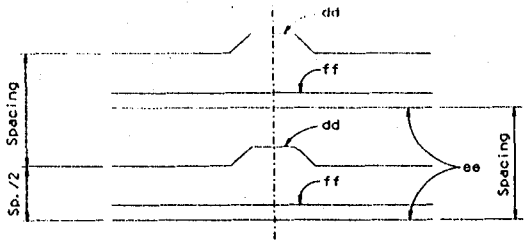
Span "S"	Height "H"	Top Slab "T"	Walls "W"	aa Bar Size	aa Spacing	aa Length	bb Bar Size	bb Spacing	bb Length	cc ✦ Number	dd Bar Size	dd Spacing	dd Length	dd A	dd B	dd C	ee Bar Size	ee Spacing	ee Length	ff Bar Size	ff Spacing	ff Length	gg ✦ Number	gg D	hh Bar Size	hh Spacing	hh Length	hh F
6'	3'	8"	8"	5	12"	4'-1	5	12"	8'-3	48	5	14"	13'-0	4'-7	2'-10	5"	5	14"	13'-7	5	14"	13'-7	16	3'-0	4	7"	5'-0	2'-5
	4'	8"	8"	5	12"	5'-1	5	12"	10'-3	54	5	14"	13'-0	4'-7	2'-10	5"	5	14"	13'-7	5	14"	13'-7	16	3'-0	4	7"	5'-6	2'-5
	5'	8"	8"	5	12"	6'-1	5	12"	12'-3	54	5	14"	13'-0	4'-7	2'-10	5"	5	14"	13'-7	5	14"	13'-7	16	3'-0	4	7"	6'-0	2'-5
	6'	8"	8"	5	12"	7'-1	5	12"	14'-3	60	5	14"	13'-0	4'-7	2'-10	5"	5	14"	13'-7	5	14"	13'-7	16	3'-0	4	7"	6'-6	2'-5
	7'	8"	8"	5	12"	8'-1	5	12"	16'-3	66	5	14"	13'-0	4'-7	2'-10	5"	5	14"	13'-7	5	14"	13'-7	16	3'-0	4	7"	7'-0	2'-5
8'	3'	10½"	9"	5	12"	4'-6	5	12"	9'-2	48	6	13"	17'-3	6'-1	3'-6	7½"	5	13"	17'-10	6	13"	17'-10	20	4'-0	4	6½"	5'-3	2'-6
	4'	10½"	9"	5	12"	5'-6	5	12"	11'-2	54	6	13"	17'-3	6'-1	3'-6	7½"	4	13"	17'-10	6	13"	17'-10	20	4'-0	4	6½"	5'-9	2'-6
	5'	10½"	9"	5	12"	6'-6	5	12"	13'-2	54	6	13"	17'-3	6'-1	3'-6	7½"	4	13"	17'-10	6	13"	17'-10	20	4'-0	4	6½"	6'-3	2'-6
	6'	10½"	9"	5	12"	7'-6	5	12"	15'-2	60	6	13"	17'-3	6'-1	3'-6	7½"	4	13"	17'-10	6	13"	17'-10	20	4'-0	4	6½"	6'-9	2'-6
	7'	10½"	9"	5	12"	8'-6	5	12"	17'-2	66	6	13"	17'-3	6'-1	3'-6	7½"	4	13"	17'-10	6	13"	17'-10	20	4'-0	4	6½"	7'-3	2'-6
	8'	10½"	9"	5	12"	9'-6	5	12"	19'-2	66	6	12"	17'-3	6'-1	3'-6	7½"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-9	2'-6
10'	3'	12½"	11"	5	12"	4'-10	5	12"	9'-10	48	7	14"	21'-6	7'-7	4'-4	9½"	4	14"	22'-4	7	14"	22'-4	24	5'-0	5	7"	5'-10	2'-8
	4'	12½"	11"	5	12"	5'-10	5	12"	11'-10	54	7	13"	21'-6	7'-7	4'-4	9½"	4	13"	22'-4	7	13"	22'-4	24	5'-0	4	6½"	6'-4	2'-8
	5'	12½"	11"	5	12"	6'-10	5	12"	13'-10	54	7	14"	21'-6	7'-7	4'-4	9½"	4	14"	22'-4	7	14"	22'-4	24	5'-0	5	7"	6'-10	2'-8
	6'	12½"	11"	5	12"	7'-10	5	12"	15'-10	60	7	13"	21'-6	7'-7	4'-4	9½"	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	7'-4	2'-8
	7'	12½"	11"	5	12"	8'-10	5	12"	17'-10	66	7	13"	21'-6	7'-7	4'-4	9½"	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	7'-10	2'-8
	8'	12½"	11"	5	12"	9'-10	5	12"	19'-10	66	7	13"	21'-6	7'-7	4'-4	9½"	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	8'-4	2'-8
	9'	12½"	11"	5	12"	10'-10	5	12"	21'-10	72	7	13"	21'-6	7'-7	4'-4	9½"	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	8'-10	2'-8
	10'	12½"	11"	5	12"	11'-10	5	12"	23'-10	78	7	13"	21'-6	7'-7	4'-4	9½"	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	9'-4	2'-8
12'	8'	15"	13"	5	12"	10'-3	5	12"	20'-9	66	8	15"	25'-10	9'-1	5'-1	12"	4	15"	26'-10	8	15"	26'-10	28	6'-0	6	7½"	8'-9	2'-11
	9'	15"	13"	5	12"	11'-3	5	12"	22'-9	72	8	15"	25'-10	9'-1	5'-1	12"	4	15"	26'-10	8	15"	26'-10	28	6'-0	6	7½"	9'-3	2'-11
	10'	15"	13"	5	12"	12'-3	5	12"	24'-9	78	8	15"	25'-10	9'-1	5'-1	12"	5	15"	26'-10	8	15"	26'-10	28	6'-0	6	7½"	9'-9	2'-11
	11'	15"	13"	5	12"	13'-3	5	12"	26'-9	78	8	14"	25'-10	9'-1	5'-1	12"	4	14"	26'-10	8	14"	26'-10	28	6'-0	5	7"	10'-9	3'-5
	12'	15"	13"	5	12"	14'-3	5	12"	28'-9	84	8	14"	25'-10	9'-1	5'-1	12"	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	11'-3	3'-5

✦ Total number of bars in the cross-section.



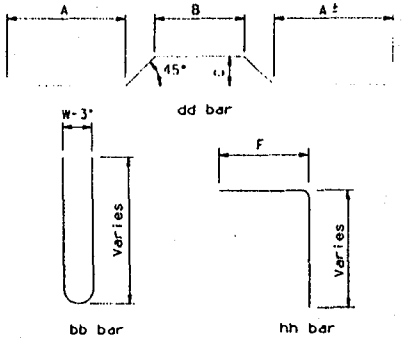
TYPICAL SECTION

NOTE:
Reinforcing shown is for placement location only.
Use the appropiate table to determine the reinforcing requirements.



REINFORCING BAR PLACING DIAGRAM

Height "H"	"J" Dim.	"K" Spaces
3'	9"	1
4'	3"	2
5'	12"	2
6'	9"	3
7'	3"	4
8'	12"	4
9'	9"	5
10'	3"	6
11'	12"	6
12'	9"	7



BENDS

NOTE:
See B-02.25 for Tables III thru V.
See B-01.10 for General Notes and Miscellaneous Details.
See B-02.70 for Quantities.

	DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION
	APPROVED FOR DISTRIBUTION	DOUBLE BARREL BOX CULVERT	STANDARD NO. B-02.20

TABLE NO. III
15'-20' FILL

Span "S"	Height "H"	Top Slab "T"	Walls "W"	aa Bar Size	aa Spacing	aa Length	bb Bar Size	bb Spacing	bb Length	cc Number ✦	dd Bar Size	dd Spacing	dd Length	dd A	dd B	dd C	ee Bar Size	ee Spacing	ee Length	ff Bar Size	ff Spacing	ff Length	gg Number ✦	gg D	hh Bar Size	hh Spacing	hh Length	hh F
6'	3'	9½"	8"	5	12"	4'-4	5	12"	8'-9	48	5	13"	13'-2	4'-7	2'-7	6½"	5	13"	13'-7	5	13"	13'-7	16	3'-0	4	6½"	5'-1	2'-5
	4'	9½"	8"	5	12"	5'-4	5	12"	10'-9	54	5	13"	13'-2	4'-7	2'-7	6½"	5	13"	13'-7	5	13"	13'-7	16	3'-0	4	6½"	5'-7	2'-5
	5'	9½"	8"	5	12"	6'-4	5	12"	12'-9	54	5	13"	13'-2	4'-7	2'-7	6½"	5	13"	13'-7	5	13"	13'-7	16	3'-0	4	6½"	6'-1	2'-5
	6'	9½"	8"	5	12"	7'-4	5	12"	14'-9	60	5	13"	13'-2	4'-7	2'-7	6½"	5	13"	13'-7	5	13"	13'-7	16	3'-0	4	6½"	6'-7	2'-5
	7'	9½"	8"	5	12"	8'-4	5	12"	16'-9	66	5	13"	13'-2	4'-7	2'-7	6½"	5	13"	13'-7	5	13"	13'-7	16	3'-0	4	6½"	7'-1	2'-5
8'	3'	12"	9"	5	12"	4'-9	5	12"	9'-8	48	6	12"	17'-4	6'-1	3'-3	9"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	5'-5	2'-6
	4'	12"	9"	5	12"	5'-9	5	12"	11'-8	54	6	12"	17'-4	6'-1	3'-3	9"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	5'-11	2'-6
	5'	12"	9"	5	12"	6'-9	5	12"	13'-8	54	6	12"	17'-4	6'-1	3'-3	9"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	6'-5	2'-6
	6'	12"	9"	5	12"	7'-9	5	12"	15'-8	60	6	12"	17'-4	6'-1	3'-3	9"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	6'-11	2'-6
	7'	12"	9"	5	12"	8'-9	5	12"	17'-8	66	6	12"	17'-4	6'-1	3'-3	9"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-5	2'-6
	8'	12"	9"	5	12"	9'-9	5	12"	19'-8	66	6	12"	17'-4	6'-1	3'-3	9"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-11	2'-6
10'	3'	15"	11"	5	12"	5'-3	5	12"	10'-8	48	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	6'-0	2'-8
	4'	15"	11"	5	12"	6'-3	5	12"	12'-8	54	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	6'-6	2'-8
	5'	15"	11"	5	12"	7'-3	5	12"	14'-8	54	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	7'-0	2'-8
	6'	15"	11"	5	12"	8'-3	5	12"	16'-8	60	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	7'-6	2'-8
	7'	15"	11"	5	12"	9'-3	5	12"	18'-8	66	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	8'-0	2'-8
	8'	15"	11"	5	12"	10'-3	5	12"	20'-8	66	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	8'-6	2'-8
	9'	15"	11"	5	12"	11'-3	5	12"	22'-8	72	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	9'-0	2'-8
	10'	15"	11"	5	12"	12'-3	5	12"	24'-8	78	7	13"	21'-9	7'-7	3'-11	1'-0	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	9'-6	2'-9
12'	8'	18"	13"	5	12"	10'-9	5	12"	21'-6	66	8	14"	26'-1	9'-1	4'-7	1'-3	4	14"	26'-10	8	14"	26'-10	28	6'-0	5	7"	9'-6	3'-5
	9'	18"	13"	5	12"	11'-9	5	12"	23'-6	72	8	14"	26'-1	9'-1	4'-7	1'-3	4	14"	26'-10	8	14"	26'-10	28	6'-0	5	7"	10'-0	3'-5
	10'	18"	13"	5	12"	12'-9	5	12"	25'-6	78	8	14"	26'-1	9'-1	4'-7	1'-3	4	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	10'-7	3'-5
	11'	18"	13"	5	12"	13'-9	5	12"	27'-6	78	8	14"	26'-1	9'-1	4'-7	1'-3	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	11'-1	3'-5
	12'	18"	13"	5	12"	14'-9	5	12"	29'-6	84	8	14"	26'-1	9'-1	4'-7	1'-3	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	11'-7	3'-5

TABLE NO. IV
20'-25' FILL

Span "S"	Height "H"	Top Slab "T"	Walls "W"	aa Bar Size	aa Spacing	aa Length	bb Bar Size	bb Spacing	bb Length	cc Number ✦	dd Bar Size	dd Spacing	dd Length	dd A	dd B	dd C	ee Bar Size	ee Spacing	ee Length	ff Bar Size	ff Spacing	ff Length	gg Number ✦	gg D	hh Bar Size	hh Spacing	hh Length	hh F
6'	3'	11"	8"	5	12"	4'-7	5	12"	9'-2	48	5	12"	13'-3	4'-7	2'-4	8"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	5'-3	2'-5
	4'	11"	8"	5	12"	5'-7	5	12"	11'-2	54	5	12"	13'-3	4'-7	2'-4	8"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	5'-9	2'-5
	5'	11"	8"	5	12"	6'-7	5	12"	13'-2	54	5	12"	13'-3	4'-7	2'-4	8"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	6'-3	2'-5
	6'	11"	8"	5	12"	7'-7	5	12"	15'-2	60	5	12"	13'-3	4'-7	2'-4	8"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	6'-9	2'-5
	7'	11"	8"	5	12"	8'-7	5	12"	17'-2	66	5	12"	13'-3	4'-7	2'-4	8"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	7'-3	2'-5
8'	3'	14"	9"	5	12"	5'-1	5	12"	10'-2	48	6	12"	17'-6	6'-1	2'-11	11"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	5'-7	2'-6
	4'	14"	9"	5	12"	6'-1	5	12"	12'-2	54	6	12"	17'-6	6'-1	2'-11	11"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	6'-1	2'-6
	5'	14"	9"	5	12"	7'-1	5	12"	14'-2	54	6	12"	17'-6	6'-1	2'-11	11"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	6'-7	2'-6
	6'	14"	9"	5	12"	8'-1	5	12"	16'-2	60	6	12"	17'-6	6'-1	2'-11	11"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-1	2'-6
	7'	14"	9"	5	12"	9'-1	5	12"	18'-2	66	6	12"	17'-6	6'-1	2'-11	11"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-7	2'-6
	8'	14"	9"	5	12"	10'-1	5	12"	20'-2	66	6	12"	17'-6	6'-1	2'-11	11"	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	8'-1	2'-6
10'	3'	17"	11"	5	12"	5'-7	5	12"	11'-2	48	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	6'-3	2'-9
	4'	17"	11"	5	12"	6'-7	5	12"	13'-2	54	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	6'-9	2'-9
	5'	17"	11"	5	12"	7'-7	5	12"	15'-2	54	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	7'-3	2'-9
	6'	17"	11"	5	12"	8'-7	5	12"	17'-2	60	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	7'-9	2'-9
	7'	17"	11"	5	12"	9'-7	5	12"	19'-2	66	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	8'-3	2'-9
	8'	17"	11"	5	12"	10'-7	5	12"	21'-2	66	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	8'-9	2'-9
	9'	17"	11"	5	12"	11'-7	5	12"	23'-2	72	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	9'-3	2'-9
	10'	17"	11"	5	12"	12'-7	5	12"	25'-2	78	7	13"	21'-10	7'-7	3'-7	1'-2	4	13"	22'-4	7	13"	22'-4	24	5'-0	5	6½"	9'-9	2'-9
12'	8'	20½"	13"	5	12"	11'-2	5	12"	22'-6	66	8	14"	26'-3	9'-1	4'-2	1'-5½	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	9'-3	2'-11
	9'	20½"	13"	5	12"	12'-2	5	12"	24'-6	72	8	14"	26'-3	9'-1	4'-2	1'-5½	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	9'-9	2'-11
	10'	20½"	13"	5	12"	13'-2	5	12"	26'-6	78	8	14"	26'-3	9'-1	4'-2	1'-5½	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	10'-3	2'-11
	11'	20½"	13"	5	12"	14'-2	5	12"	28'-6	78	8	14"	26'-3	9'-1	4'-2	1'-5½	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	11'-3	3'-5
	12'	20½"	13"	5	12"	15'-2	5	12"	30'-6	84	8	13"	26'-3	9'-1	4'-2	1'-5½	5	13"	26'-10	8	13"	26'-10	28	6'-0	5	6½"	11'-9	3'-5

✦ Total number of bars in the cross-section.

TABLE NO. V
25'-30' FILL

Span "S"	Height "H"	Top Slab "T"	Walls "W"	aa Bar Size	aa Spacing	aa Length	bb Bar Size	bb Spacing	bb Length	cc Number ✦	dd Bar Size	dd Spacing	dd Length	dd A	dd B	dd C	ee Bar Size	ee Spacing	ee Length	ff Bar Size	ff Spacing	ff Length	gg Number ✦	gg D	hh Bar Size	hh Spacing	hh Length	hh F
6'	3'	12½"	8"	5	12"	4'-10	5	12"	9'-10	48	6	16"	13'-4	4'-7	2'-1	9½"	6	16"	13'-7	6	16"	13'-7	16	3'-0	4	8"	5'-4	2'-5
	4'	12½"	8"	5	12"	5'-10	5	12"	11'-10	54	6	16"	13'-4	4'-7	2'-1	9½"	6	16"	13'-7	6	16"	13'-7	16	3'-0	4	8"	5'-10	2'-5
	5'	12½"	8"	5	12"	6'-10	5	12"	13'-10	54	6	16"	13'-4	4'-7	2'-1	9½"	6	16"	13'-7	6	16"	13'-7	16	3'-0	4	8"	6'-4	2'-5
	6'	12½"	8"	5	12"	7'-10	5	12"	15'-10	60	5	12"	13'-4	4'-7	2'-1	9½"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	6'-10	2'-5
	7'	12½"	8"	5	12"	8'-10	5	12"	17'-10	66	5	12"	13'-4	4'-7	2'-1	9½"	5	12"	13'-7	5	12"	13'-7	16	3'-0	4	6"	7'-4	2'-5
8'	3'	16"	9"	5	12"	5'-5	5	12"	11'-0	48	7	16"	17'-7	6'-1	2'-7	1'-1	4	16"	17'-10	7	16"	17'-10	20	4'-0	5	8"	6'-0	2'-7
	4'	16"	9"	5	12"	6'-5	5	12"	13'-0	54	7	16"	17'-7	6'-1	2'-7	1'-1	4	16"	17'-10	7	16"	17'-10	20	4'-0	5	8"	6'-6	2'-7
	5'	16"	9"	5	12"	7'-5	5	12"	15'-0	54	6	12"	17'-7	6'-1	2'-7	1'-1	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	6'-9	2'-6
	6'	16"	9"	5	12"	8'-5	5	12"	17'-0	60	6	12"	17'-7	6'-1	2'-7	1'-1	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-3	2'-6
	7'	16"	9"	5	12"	9'-5	5	12"	19'-0	66	6	12"	17'-7	6'-1	2'-7	1'-1	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	7'-9	2'-6
	8'	16"	9"	5	12"	10'-5	5	12"	21'-0	66	6	12"	17'-7	6'-1	2'-7	1'-1	4	12"	17'-10	6	12"	17'-10	20	4'-0	4	6"	8'-3	2'-6
10'	3'	19"	11"	5	12"	5'-11	5	12"	11'-9	48	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	6'-6	2'-9
	4'	19"	11"	5	12"	6'-11	5	12"	13'-9	54	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	7'-0	2'-9
	5'	19"	11"	5	12"	7'-11	5	12"	15'-9	54	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	7'-6	2'-9
	6'	19"	11"	5	12"	8'-11	5	12"	17'-9	60	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	8'-0	2'-9
	7'	19"	11"	5	12"	9'-11	5	12"	19'-9	66	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	8'-6	2'-9
	8'	19"	11"	5	12"	10'-11	5	12"	21'-9	66	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	9'-0	2'-9
	9'	19"	11"	5	12"	11'-11	5	12"	23'-9	72	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	9'-6	2'-9
	10'	19"	11"	5	11½"	12'-11	5	12"	25'-9	78	7	12"	22'-0	7'-7	3'-3	1'-4	4	12"	22'-4	7	12"	22'-4	24	5'-0	5	6"	10'-0	2'-9
12'	8'	23"	13"	5	12"	11'-7	5	12"	23'-0	66	8	14"	26'-5	9'-1	3'-9	1'-8	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	10'-0	3'-5
	9'	23"	13"	5	12"	12'-7	5	12"	25'-0	72	8	14"	26'-5	9'-1	3'-9	1'-8	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	10'-6	3'-5
	10'	23"	13"	5	12"	13'-7	5	12"	27'-0	78	8	14"	26'-5	9'-1	3'-9	1'-8	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	11'-0	3'-5
	11'	23"	13"	5	12"	14'-7	5	12"	29'-0	78	8	14"	26'-5	9'-1	3'-9	1'-8	5	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	11'-6	3'-5
	12'	23"	13"	5	9½"	15'-7	5	12"	31'-0	84	8	14"	26'-5	9'-1	3'-9	1'-8	6	14"	26'-10	8	14"	26'-10	28	6'-0	6	7"	12'-0	3'-5

DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION 7-88
APPROVED FOR DISTRIBUTION	DOUBLE BARREL BOX CULVERT	STANDARD NO. B-02.25

CHAPTER 3

STRENGTH AND SERVICEABILITY REQUIREMENTS

3-1. General

a. All reinforced-concrete hydraulic structures must satisfy both strength and serviceability requirements. In the strength design method, this is accomplished by multiplying the service loads by appropriate load factors and by a hydraulic factor, H_f. The hydraulic factor is applied to the overall load factor equations for obtaining the required nominal strength. The hydraulic factor is used to improve crack control in hydraulic structures by increasing reinforcement requirements, thereby reducing steel stresses at service load levels.

b. Two methods are available for determining the factored moments, shears, and thrusts for designing hydraulic structures by the strength design method. They are the single load factor method and a method based on the ACI 318 Building Code. Both methods are described herein.

c. In addition to strength and serviceability requirements, many hydraulic structures must also satisfy stability requirements under various loading and foundation conditions. The loads from stability analyses that are used to design structural components by the strength design method must be obtained as prescribed herein to assure correctness of application.

3-2. Stability Analysis

a. The stability analysis of structures, such as retaining walls, must be performed using unfactored loads. The unfactored loads and the resulting reactions are then used to determine the unfactored moments, shears, and thrusts at critical sections of the structure. The unfactored moments, shears, and thrusts are then multiplied by the appropriate load factors, and the hydraulic factor when appropriate, to determine the required strengths which, in turn, are used to establish the required section properties.

b. The single load factor method must be used when the loads on the structural component being analyzed include reactions from a soil-structure interaction stability analysis, such as footings for walls. For simplicity and ease of application, this method should generally be used for all elements of such structures. The load factor method based on the ACI 318 Building Code may be used for some elements of the structure, but must be used with caution to assure that the load combinations do not produce unconservative results.

3-3. Required Strength

Reinforced-concrete hydraulic structures and hydraulic structural members shall be designed to have a required strength, U_h, to resist dead and live loads in accordance with the following provisions. The hydraulic factor is to be applied in the determination of required nominal strength for all combinations of axial load and moment, as well as for diagonal tension (shear). However, the required design strength for reinforcement in diagonal tension (shear) should be calculated by applying a hydraulic factor of 1.3 to the excess shear. Excess shear is defined as the difference between the factored shear force at the section, V_u, and the shear strength provided by the concrete, ϕV_c. Thus $\phi V_s \geq 1.3$
$(V_u - \phi V_c)$, where ϕV_s is the design capacity of the shear reinforcement.

a. Single load factor method. In the single load factor method, both the dead and live loads are multiplied by the same load factor.

$$U = 1.7(D + L) \qquad (3\text{-}1)$$

where

D = internal forces and moments from dead loads of the concrete members only
L = internal forces and moments from live loads (loads other than the dead load of the concrete member)

For hydraulic structures, the basic load factor is then

multiplied by a hydraulic factor, H_f.

$$U_h = H_f(U) \qquad (3\text{-}2)$$

where $H_f = 1.3$ for hydraulic structures, except for members in direct tension. For members in direct tension, $H_f = 1.65$. Other values may be used subject to consultation with and approval by CECW-ED. Therefore, the required strength U_h to resist dead and live loads shall be at least equal to

$$U_h = 1.7H_f(D + L) \qquad (3\text{-}3)$$

An exception to the above occurs when resistance to the effects of wind or other forces that constitute short duration loads with low probability of occurrence are included in the design. For that case, the following loading combination should be used:

$$U_h = 0.75[1.7H_f(D + L)] \qquad (3\text{-}4)$$

b. Modified ACI 318 Building Code Method. The load factors prescribed in ACI 318 may be applied directly to hydraulic structures with two modifications. The load factor for lateral fluid pressure, F, should be taken as 1.7. The factored load combinations for total factored design load, U, as prescribed in ACI 318 shall be increased by the hydraulic factor $H_f = 1.3$, except for members in direct tension. For members in direct tension, $H_f = 1.65$.

The equations for required strength can be expressed as

$$U_h = 1.3U \qquad (3\text{-}5)$$

except for members in direct tension where

$$U_h = 1.65(U) \qquad (3\text{-}6)$$

For certain hydraulic structures such as U-frame locks and U-frame channels, the live load can have a relieving effect on the factored load combination used to determine the total factored load effects (shears, thrusts, and moments). In this case, the combination of factored dead and live loads with a live load factor of unity should be investigated and reported in the design documents.

c. Earthquake effects. If a resistance to specified earthquake loads or forces, E, are included, the following combinations shall apply.

(1) Unusual

(a) Nonsite-specific ground motion design earthquake (OBE)

$$U_h = 1.7(D + L) + 1.9E \qquad (3\text{-}7)$$

(b) Site-specific ground motion for design earthquake with time-history and response spectrum analysis (OBE)

$$U_h = 1.4(D + L) + 1.5E \qquad (3\text{-}8)$$

(2) Extreme

(a) Nonsite-specific ground motion (MCE)

$$U_h = 1.1(D + L) + 1.25E \qquad (3\text{-}9)$$

(b) Site-specific ground motion (MCE)

$$U_h = 1.0(D + L + E) \qquad (3\text{-}10)$$

d. Nonhydraulic structures. Reinforced concrete structures and structural members that are not classified as hydraulic shall be designed with the above guidance, except that the hydraulic factor shall not be used.

3-4. Design Strength of Reinforcement

a. Design should normally be based on 60,000 psi, the yield strength of ASTM Grade 60 reinforcement. Other grades may be used, subject to the provisions of paragraphs 2-2 and 3-4.b. The yield strength used in the design shall be indicated on the drawings.

b. Reinforcement with a yield strength in excess of 60,000 psi shall not be used unless a detailed investigation of ductility and serviceability requirements is conducted in consultation with and approved by CECW-ED.

3-5. Maximum Tension Reinforcement

a. For singly-reinforced flexural members, and for members subject to combined flexure and compressive axial load when the axial load strength ϕP_n is less than the smaller of $0.10f'_cA_g$ or ϕP_b, the ratio of tension reinforcement ρ provided shall conform to the following.

(1) Recommended limit = $0.25\ \rho_b$.

(2) Maximum permitted upper limit not requiring special study or investigation = $0.375\ \rho_b$. Values above $0.375\ \rho_b$ will require consideration of serviceability, constructibility, and economy.

(3) Maximum permitted upper limit when excessive deflections are not predicted when using the method specified in ACI 318 or other methods that predict deformations in substantial agreement with the results of comprehensive tests = 0.50 ρ_b.

(4) Reinforcement ratios above 0.5 ρ_b shall only be permitted if a detailed investigation of serviceability requirements, including computation of deflections, is conducted in consultation with and approved by CECW-ED. Under no circumstance shall the reinforcement ratio exceed 0.75 ρ_b.

b. Use of compression reinforcement shall be in accordance with provisions of ACI 318.

3-6. Control of Deflections and Cracking

a. Cracking and deflections due to service loads need not be investigated if the limits on the design strength and ratio of the reinforcement specified in paragraphs 3-4.a and 3-5.a(3) are not exceeded.

b. For design strengths and ratios of reinforcement exceeding the limits specified in paragraphs 3-4.a and 3-5.a(3), extensive investigations of deformations and cracking due to service loads should be made in consultation with CECW-ED. These investigations should include laboratory tests of materials and models, analytical studies, special construction procedures, possible measures for crack control, etc. Deflections and crack widths should be limited to levels which will not adversely affect the operation, maintenance, performance, or appearance of that particular structure.

3-7. Minimum Thickness of Walls

Walls with height greater than 10 feet shall be a minimum of 12 inches thick and shall contain reinforcement in both faces.

CHAPTER 4

FLEXURAL AND AXIAL LOADS

4-1. Design Assumptions and General Requirements

a. The assumed maximum usable strain ε_c at the extreme concrete compression fiber should be equal to 0.003 in accordance with ACI 318.

b. Balanced conditions for hydraulic structures exist at a cross section when the tension reinforcement ρ_b reaches the strain corresponding to its specified yield strength f_y just as the concrete in compression reaches its design strain ε_c.

c. Concrete stress of $0.85f'_c$ should be assumed uniformly distributed over an equivalent compression zone bounded by edges of the cross section and a straight line located parallel to the neutral axis at a distance $a = \beta_1 c$ from the fiber of maximum compressive strain.

d. Factor β_1 should be taken as specified in ACI 318.

e. The eccentricity ratio e'/d should be defined as

$$\frac{e'}{d} = \frac{M_u/P_u + d - h/2}{d} \qquad (4\text{-}1)^*$$

where e' = eccentricity of axial load measured from the centroid of the tension reinforcement

4-2. Flexural and Compressive Capacity – Tension Reinforcement Only

a. The design axial load strength ϕP_n at the centroid of compression members should not be taken greater than the following:

$$\phi P_{n(max)} = 0.8\phi[0.85f'_c(A_g - \rho bd) + f_y \rho bd] \qquad (4\text{-}2)$$

b. The strength of a cross section is controlled by compression if the load has an eccentricity ratio e'/d no greater than that given by Equation 4-3 and by tension if e'/d exceeds this value.

$$\frac{e'_b}{d} = \frac{2k_b - k_b^2}{2k_b - \dfrac{\rho f_y}{0.425f'_c}} \qquad (4\text{-}3)$$

where

$$k_b = \frac{\beta_1 E_s \varepsilon_c}{E_s \varepsilon_c + f_y} \qquad (4\text{-}4)$$

c. Sections controlled by tension should be designed so

$$\phi P_n = \phi(0.85f'_c k_u - \rho f_y)bd \qquad (4\text{-}5)$$

and

$$\phi M_n = \phi(0.85f'_c k_u - \rho f_y)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2 \qquad (4\text{-}6)$$

where k_u should be determined from the following equation:

$$k_u = \sqrt{\left(\frac{e'}{d} - 1\right)^2 + \left(\frac{\rho f_y}{0.425f'_c}\right)\frac{e'}{d}} - \left(\frac{e'}{d} - 1\right) \qquad (4\text{-}7)$$

d. Sections controlled by compression should be designed so

$$\phi P_n = \phi(0.85f'_c k_u - \rho f_s)bd \qquad (4\text{-}8)$$

and

$$\phi M_n = \phi(0.85f'_c k_u - \rho f_s)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2 \qquad (4\text{-}9)$$

* P_u is considered positive for compression and negative for tension.

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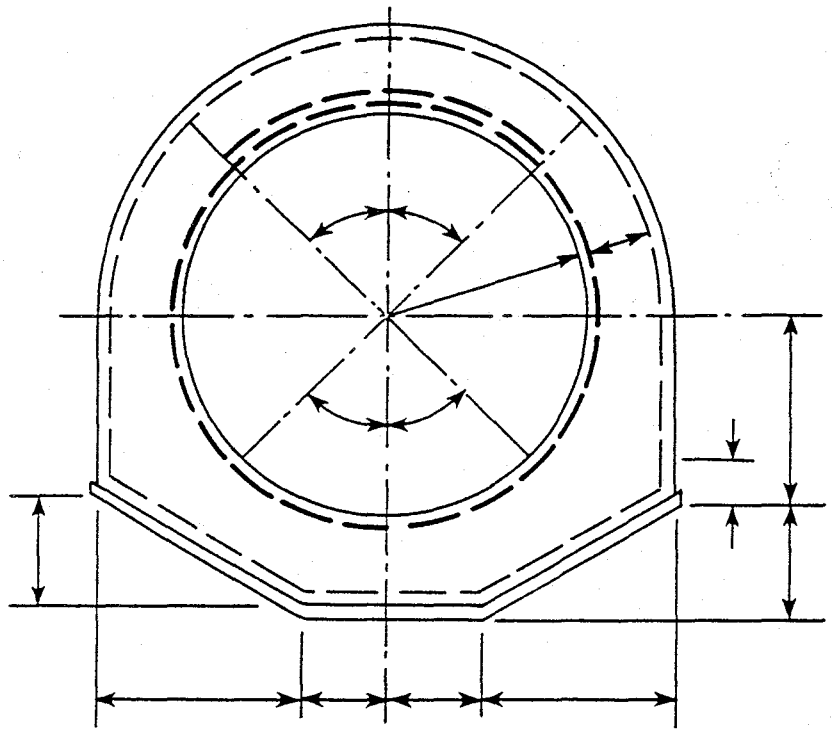

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ABSTRACT

Strength Design for Reinforced-Concrete Hydraulic Structures, a U.S. Army Corps of Engineers engineering manual, provides guidance for designing reinforced concrete hydraulic structures by the strength-design method. It presents such topics as: 1) Details of reinforcement; 2) strength and serviceability requirements, including load factors and limits on flexural reinforcement; 3) design equations for members subjected to flexural and/or axial loads; and 4) design for shear, including provisions for curved members and special straight members. Besides providing detailed information on these design procedures, this engineering manual presents the designer with examples of their applications. As additional assistance to the designer, it also includes the derivations of the combined flexural and axial load equations.

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REPLY TO
ATTENTION OF:

10 MAY 1993

Mr. James McCarty
President, American Society
of Civil Engineers
345 East 47th Street
New York, New York 10017

Dear Mr. McCarty:

I am pleased to furnish the American Society of Civil Engineers (ASCE) a copy of the U. S. Army Corps of Engineers engineering manual, EM 1110-2-2104, Strength Design for Reinforced-Concrete Hydraulic Structures. The Corps uses this manual as the basis for design of civil works structures which will be subjected to one or more of the following: submergence, wave action, spray, and severe climatic conditions. The procedures in this manual account for serviceability in terms of deflection, cracking, and durability.

I understand that ASCE plans to publish this manual for public distribution. I believe this will benefit the civil engineering community by improving transfer of technology between the Corps and other engineering professionals.

Sincerely,

Art Williams

Arthur E. Williams
Lieutenant General, U. S. Army
Commanding

Appendices

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CHAPTER 1

INTRODUCTION

1-1. Purpose

This manual provides guidance for designing reinforced-concrete hydraulic structures by the strength-design method.

1-2. Applicability

This manual applies to all HQUSACE/OCE elements, major subordinate commands, districts, laboratories, and field operating activities having civil works responsibilities.

1-3. References

a. EM 1110-1-2101, Working Stresses for Structural Design.

b. EM 1110-2-2902, Conduits, Culverts, and Pipes.

c. CW-03210, Civil Works Construction Guide Specification for Steel Bars, Welded Wire Fabric, and Accessories for Concrete Reinforcement.

d. American Concrete Institute, "Building Code Requirements and Commentary for Reinforced Concrete," ACI 318, Box 19150, Redford Station, Detroit, MI 48219.

e. American Concrete Institute, "Environmental Engineering Concrete Structures," ACI 350R, Box 19150, Redford Station, Detroit, MI 48219.

f. American Society for Testing and Materials, "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement," ASTM A 615-89, 1916 Race St., Philadelphia, PA 19103.

g. American Welding Society, "Structural Welding Code—Reinforcing Steel," AWS D1.4-790, 550 NW Le Jeune Rd., P.O. Box 351040, Miami, FL 33135.

h. Liu, Tony C. 1980 (Jul). "Strength Design of Reinforced Concrete Hydraulic Structures, Report 1: Preliminary Strength Design Criteria," Technical Report SL-80-4, US Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180.

i. Liu, Tony C., and Gleason, Scott. 1981 (Sep). "Strength Design of Reinforced Concrete Hydraulic Structures, Report 2: Design Aids for Use in the Design and Analysis of Reinforced Concrete Hydraulic Structural Members Subjected to Combined Flexural and Axial Loads," Technical Report SL-80-4, US Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180.

j. Liu, Tony C. 1981 (Sep). "Strength Design of Reinforced Concrete Hydraulic Structures, Report 3: T-Wall Design," Technical Report SL-80-4, US Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180.

1-4. Background

a. A reinforced-concrete hydraulic structure is one that will be subjected to one or more of the following: submergence, wave action, spray, chemically contaminated atmosphere, and severe climatic conditions. Typical hydraulic structures are stilling-basin slabs and walls, concrete-lined channels, portions of powerhouses, spillway piers, spray walls and training walls, floodwalls, intake and outlet structures below maximum high water and wave action, lock walls, guide and guard walls, and retaining walls subject to contact with water.

b. In general, existing reinforced-concrete hydraulic structures designed by the Corps, using the working stress method of EM 1110-1-2101, have held up extremely well. The Corps began using strength design methods in 1981 (Liu 1980, 1981 and Liu and Gleason 1981) to stay in step with industry, universities, and other engineering organizations. ETL 1110-2-265, "Strength Design Criteria for Reinforced Concrete Hydraulic Structures," dated 15 September 1981, was the first document providing guidance issued by the Corps concerning the use of strength design methods for hydraulic structures. The labor-intensive requirements of this ETL regarding the application of multiple load factors, as well as the fact that some load-factor combination conditions resulted in a less conservative design than if working stress methods were used, resulted in the development of ETL

1110-2-312, "Strength Design Criteria for Reinforced Concrete Hydraulic Structures," dated 10 March 1988.

c. The revised load factors in ETL 1110-2-312 were intended to ensure that the resulting design was as conservative as if working stress methods were used. Also, the single load factor concept was introduced. The guidance in this ETL differed from ACI 318 Building Code Requirements and Commentary for Reinforced Concrete primarily in the load factors, the concrete stress-strain relationship, and the yield strength of Grade 60 reinforcement. ETL 1110-2-312 guidance was intended to result in designs equivalent to those resulting when working stress methods were used.

d. Earlier Corps strength design methods deviated from ACI guidance because ACI 318 includes no provisions for the serviceability needs of hydraulic structures. Strength and stability are required, but serviceability in terms of deflections, cracking, and durability demand equal consideration. The importance of the Corps' hydraulic structures has caused the Corps to move cautiously, but deliberately, toward exclusive use of strength design methods.

e. This manual modifies and expands the guidance in ETL 1110-2-312 with an approach similar to that of ACI 350R-89. The concrete stress-strain relationship and the yield strength of Grade 60 reinforcement given in ACI 318 are adopted. Also, the load factors bear a closer resemblance to ACI 318 and are modified by a hydraulic factor, H_f, to account for the serviceability needs of hydraulic structures.

f. As in ETL 1110-2-312, this manual allows the use of a single load factor for both dead and live loads. In addition, the single load factor method is required when the loads on the structural component include reactions from a soil-structure stability analysis.

1-5. General Requirements

Reinforced-concrete hydraulic structures should be designed with the strength design method in accordance with the current ACI 318, except as hereinafter specified. The notations used are the same as those used in the ACI 318 Code and Commentary, except those defined herein.

1-6. Scope

a. This manual is written in sufficient detail to not only provide the designer with design procedures, but to also provide examples of their application. Also, derivations of the combined flexural and axial load equations are given to increase the designer's confidence and understanding.

b. General detailing requirements are presented in Chapter 2. Chapter 3 presents strength and serviceability requirements, including load factors and limits on flexural reinforcement. Design equations for members subjected to flexural and/or axial loads (including biaxial bending) are given in Chapter 4. Chapter 5 presents guidance for design for shear, including provisions for curved members and special straight members. The appendices include notation, equation derivations, and examples. The examples demonstrate: load-factor application, design of members subjected to combined flexural and axial loads, design for shear, development of an interaction diagram, and design of members subjected to biaxial bending.

1-7. Computer Programs

Copies of computer programs, with documentation, for the analysis and design of reinforced-concrete hydraulic structures are available and may be obtained from the Engineering Computer Programs Library, US Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199. For design to account for combined flexural and axial loads, any procedure that is consistent with ACI 318 guidance is acceptable, as long as the load factor and reinforcement percentage guidance given in this manual is followed.

1-8. Recision

Corps library computer program CSTR (X0066), based on ETL 1110-2-312, is replaced by computer program CASTR (X0067). Program CASTR is based on this new engineer manual.

CHAPTER 2

DETAILS OF REINFORCEMENT

2-1. General

This chapter presents guidance for furnishing and placing steel reinforcement in various concrete members of hydraulic structures.

2-2. Quality

The type and grade of reinforcing steel should be limited to ASTM A 615 (Billet Steel), Grade 60. Grade 40 reinforcement should be avoided since its availability is limited and designs based on Grade 40 reinforcement, utilizing the procedures contained herein, would be overly conservative. Reinforcement of other grades and types permitted by ACI 318 may be permitted for special applications subject to the approval of higher authority.

2-3. Anchorage, Bar Development, and Splices

The anchorage, bar development, and splice requirements should conform to ACI 318 and to the requirements presented below. Since the development length is dependent on a number of factors such as concrete strength and bar position, function, size, type, spacing, and cover, the designer must indicate the length of embedment required for bar development on the contract drawings. For similar reasons, the drawings should show the splice lengths and special requirements such as staggering of splices, etc. The construction specifications should be carefully edited to assure that they agree with reinforcement details shown on the drawings.

2-4. Hooks and Bends

Hooks and bends should be in accordance with ACI 318.

2-5. Bar Spacing

a. Minimum. The clear distance between parallel bars should not be less than 1-1/2 times the nominal diameter of the bars nor less than 1-1/2 times the maximum size of coarse aggregate. No. 14 and No. 18 bars should not be spaced closer than 6 and 8 inches, respectively, center to center. When parallel reinforcement is placed in two or more layers, the clear distance between layers should not be less than 6 inches. In horizontal layers, the bars in the upper layers should be placed directly over the bars in the lower layers. In vertical layers, a similar orientation should be used. In construction of massive reinforced concrete structures, bars in a layer should be spaced 12 inches center-to-center wherever possible to facilitate construction.

b. Maximum. The maximum center-to-center spacing of both primary and secondary reinforcement should not exceed 18 inches.

2-6. Concrete Protection for Reinforcement

The minimum cover for reinforcement should conform to the dimensions shown below for the

Concrete Section	Minimum Clear Cover of Reinforcement (inches)
Unformed surfaces in contact with foundation	4
Formed or screeded surfaces subject to cavitation or abrasion erosion, such as baffle blocks and stilling basin slabs	6
Formed and screeded surfaces such as stilling basin walls, chute spillway slabs, and channel lining slabs on grade:	
Equal to or greater than 24 inches in thickness	4
Greater than 12 inches and less than 24 inches in thickness	3
Equal to or less than 12 inches in thickness will be in accordance with ACI Code 318.	

NOTE. In no case shall the cover be less than:
1.5 times the nominal maximum size of aggregate, or
2.5 times the maximum diameter of reinforcement.

various concrete sections. The dimensions indicate the clear distance from the edge of the reinforcement to the surface of the concrete.

2-7. Splicing

a. General. Bars shall be spliced only as required and splices shall be indicated on contract drawings. Splices at points of maximum tensile stress should be avoided. Where such splices must be made they should be staggered. Splices may be made by lapping of bars or butt splicing.

b. Lapped Splices. Bars larger than No. 11 shall not be lap-spliced. Tension splices should be staggered longitudinally so that no more than half of the bars are lap-spliced at any section within the required lap length. If staggering of splices is impractical, applicable provisions of ACI 318 should be followed.

c. Butt Splices

(1) General. Bars larger than No. 11 shall be butt-spliced. Bars No. 11 or smaller should not be butt-spliced unless clearly justified by design details or economics. Due to the high costs associated with butt splicing of bars larger than No. 11, especially No. 18 bars, careful consideration should be given to alternative designs utilizing smaller bars. Butt splices should be made by either the thermit welding process or an approved mechanical butt-splicing method in accordance with the provisions contained in the following paragraphs. Normally, arc-welded splices should not be permitted due to the inherent uncertainties associated with welding reinforcement. However, if arc welding is necessary, it should be done in accordance with AWS D1.4, Structural Welding Code-Reinforcing Steel. Butt splices should develop in tension at least 125 percent of the specified yield strength, f_y, of the bar. Tension splices should be staggered longitudinally at least 5 feet for bars larger than No. 11 and a distance equal to the required lap length for No. 11 bars or smaller so that no more than half of the bars are spliced at any section. Tension splices of bars smaller than No. 14 should be staggered longitudinally a distance equal to the required lap length. Bars Nos. 14 and 18 shall be staggered longitudinally, a minimum of 5 feet so that no more than half of the bars are spliced at any one section.

(2) Thermit Welding. Thermit welding should be restricted to bars conforming to ASTM A 615 (billet steel) with a sulfur content not exceeding 0.05 percent based on ladle analysis. The thermit welding process should be in accordance with the provisions of Guide Specification CW-03210.

(3) Mechanical Butt Splicing. Mechanical butt splicing shall be made by an approved exothermic, threaded coupling, swaged sleeve, or other positive connecting type in accordance with the provisions of Guide Specification CW-03210. The designer should be aware of the potential for slippage in mechanical splices and insist that the testing provisions contained in this guide specification be included in the contract documents and utilized in the construction work.

2-8. Temperature and Shrinkage Reinforcement

a. In the design of structural members for temperature and shrinkage stresses, the area of reinforcement should be 0.0028 times the gross cross-sectional area, half in each face, with a maximum area equivalent to No. 9 bars at 12 inches in each face. Generally, temperature and shrinkage reinforcement for thin sections will be no less than No. 4 bars at 12 inches in each face.

b. Experience and/or analyses may indicate the need for an amount of reinforcement greater than indicated in paragraph 2-8a if the reinforcement is to be used for distribution of stresses as well as for temperature and shrinkage.

c. In general, additional reinforcement for temperature and shrinkage will not be needed in the direction and plane of the primary tensile reinforcement when restraint is accounted for in the analyses. However, the primary reinforcement should not be less than that required for shrinkage and temperature as determined above.

where

$$f_s = \frac{E_s \varepsilon_c (\beta_1 - k_u)}{k_u} \geq -f_y \qquad (4\text{-}10)$$

and k_u should be determined from the following equation by direct or iterative method:

$$k_u^3 + 2\left(\frac{e'}{d} - 1\right)k_u^2 + \left(\frac{E_s \varepsilon_c \rho e'}{0.425 f'_c d}\right)k_u - \frac{\beta_1 E_s \varepsilon_c \rho e'}{0.425 f'_c d} = 0 \qquad (4\text{-}11)$$

e. The balanced load and moment can be computed using either Equations 4-5 and 4-6 or Equations 4-8 and 4-9 with $k_u = k_b$ and $\frac{e'}{d} = \frac{e'_b}{d}$. The values of e'_b/d and k_b are given by Equations 4-3 and 4-4, respectively.

4-3. Flexural and Compressive Capacity – Tension and Compression Reinforcement

a. The design axial load strength ϕP_n of compression members should not be taken greater than the following:

$$\phi P_{n(max)} = 0.8\phi\{0.85 f'_c[A_g - (\rho + \rho')bd] + f_y(\rho + \rho')bd\} \qquad (4\text{-}12)$$

b. The strength of a cross section is controlled by compression if the load has an eccentricity ratio e'/d no greater than that given by Equation 4-13 and by tension if e'/d exceeds this value.

$$\frac{e'_b}{d} = \frac{2k_b - k_b^2 + \dfrac{\rho' f'_s\left(1 - \dfrac{d'}{d}\right)}{0.425 f'_c}}{2k_b - \dfrac{\rho f_y}{0.425 f'_c} + \dfrac{\rho' f'_s}{0.425 f'_c}} \qquad (4\text{-}13)$$

The value k_b is given in Equation 4-4 and f'_s is given in Equation 4-16 with $k_u = k_b$.

c. Sections controlled by tension should be designed so

$$\phi P_n = \phi(0.85 f'_c k_u + \rho' f'_s - \rho f_y)bd \qquad (4\text{-}14)$$

and

$$\phi M_n = \phi(0.85 f'_c k_u + \rho' f'_s - \rho f_y)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2 \qquad (4\text{-}15)$$

where

$$f'_s = \frac{\left(k_u - \beta_1 \dfrac{d'}{d}\right)}{(\beta_1 - k_u)} E_s \varepsilon_y \leq f_y \qquad (4\text{-}16)$$

and k_u should be determined from the following equation by direct or iterative methods:

$$k_u^3 + \left[2\left(\frac{e'}{d} - 1\right) - \beta_1\right]k_u^2 - \left\{\frac{f_y}{0.425 f'_c}\left[\rho'\left(\frac{e'}{d} + \frac{d'}{d} - 1\right) + \frac{\rho e'}{d}\right] + 2\beta_1\left(\frac{e'}{d} - 1\right)\right\}k_u + \frac{f_y \beta_1}{0.425 f'_c}\left[\frac{\rho' d'}{d}\left(\frac{e'}{d} + \frac{d'}{d} - 1\right) + \frac{\rho e'}{d}\right] = 0 \qquad (4\text{-}17)$$

d. Sections controlled by compression should be designed so

$$\phi P_n = \phi(0.85 f'_c k_u + \rho' f'_s - \rho f_s)bd \qquad (4\text{-}18)$$

and

$$\phi M_n = \phi(0.85 f'_c k_u + \rho' f'_s - \rho f_s)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2 \qquad (4\text{-}19)$$

where

$$f_s = \frac{E_s \varepsilon_c (\beta_1 - k_u)}{k_u} \geq -f_y \qquad (4\text{-}20)$$

and

$$f'_s = \frac{E_s \varepsilon_c\left[k_u - \beta_1\left(\dfrac{d'}{d}\right)\right]}{k_u} \leq f_y \qquad (4\text{-}21)$$

and k_u should be determined from the following equation by direct or iterative methods:

$$k_u^3 + 2\left(\frac{e'}{d} - 1\right)k_u^2 + \frac{E_s\varepsilon_c}{0.425f'_c}\left[(\rho + \rho')\left(\frac{e'}{d}\right) - \rho'\left(1 - \frac{d'}{d}\right)\right]k_u - \frac{\beta_1 E_s\varepsilon_c}{0.425f'_c}\left[\rho'\left(\frac{d'}{d}\right)\left(\frac{e'}{d} + \frac{d'}{d} - 1\right) + \rho\left(\frac{e'}{d}\right)\right] = 0 \quad (4\text{-}22)$$

Design for flexure utilizing compression reinforcement is discouraged. However, if compression reinforcement is used in members controlled by compression, lateral reinforcement shall be provided in accordance with the ACI Building Code.

e. The balanced load and moment should be computed using Equations 4-14, 4-15, 4-16, and 4-17 with $k_u = k_b$ and $\frac{e'}{d} = \frac{e'_b}{d}$. The values of e'_b/d and k_b are given by Equations 4-13 and 4-14, respectively.

4-4. Flexural and Tensile Capacity

a. The design axial strength ϕP_n of tensile members should not be taken greater than the following:

$$\phi P_{n(max)} = 0.8\phi(\rho + \rho')f_y bd \quad (4\text{-}23)$$

b. Tensile reinforcement should be provided in both faces of the member if the load has an eccentricity ratio e'/d in the following range:

$$\left(1 - \frac{h}{2d}\right) \geq \frac{e'}{d} \geq 0$$

The section should be designed so

$$\phi P_n = \phi(\rho f_y + \rho' f'_s)bd \quad (4\text{-}24)$$

and

$$\phi M_n = \phi(\rho f_y + \rho' f'_s)\left[\left(1 - \frac{h}{2d}\right) - \frac{e'}{d}\right]bd^2 \quad (4\text{-}25)$$

with

$$f'_s = f_y\frac{\left(k_u + \frac{d'}{d}\right)}{(k_u + 1)} \geq -f_y \quad (4\text{-}26)$$

and k_u should be determined from the following equation:

$$k_u = \frac{\rho'\frac{d'}{d}\left(1 - \frac{d'}{d} - \frac{e'}{d}\right) - \rho\frac{e'}{d}}{\rho\frac{e'}{d} - \rho'\left(1 - \frac{d'}{d} - \frac{e'}{d}\right)} \quad (4\text{-}27)$$

c. Sections subjected to a tensile load with an eccentricity ratio $e'/d < 0$ should be designed using Equations 4-5 and 4-6. The value of k_u is

$$k_u = -\left(\frac{e'}{d} - 1\right) - \sqrt{\left(\frac{e'}{d} - 1\right)^2 + \left(\frac{\rho f_y}{0.425f'_c}\right)\frac{e'}{d}} \quad (4\text{-}28)$$

d. Sections subject to a tensile load with an eccentricity ratio $e'/d < 0$ should be designed using Equations 4-14, 4-15, 4-16, and 4-17 if $A'_s > 0$ and $c > d'$.

4-5. Biaxial Bending and Axial Load

a. Provisions of paragraph 4-5 shall apply to reinforced concrete members subjected to biaxial bending.

b. For a given nominal axial load $P_n = P_u/\phi$, the following nondimensional equation shall be satisfied:

$$(M_{nx}/M_{ox})^K + (M_{ny}/M_{oy})^K \leq 1.0 \quad (4\text{-}29)$$

where

M_{nx}, M_{ny} = nominal biaxial bending moments with respect to the x and y axes, respectively

M_{ox}, M_{oy} = uniaxial nominal bending strength at P_n about the x and y axes, respectively

K = 1.5 for rectangular members
= 1.75 for square or circular members
= 1.0 for any member subjected to axial tension

c. M_{ox} and M_{oy} shall be determined in accordance with paragraphs 4-1 through 4-3.

CHAPTER 5

SHEAR

5-1. Shear Strength

The shear strength V_c provided by concrete shall be computed in accordance with ACI 318 except in the cases described in paragraphs 5-2 and 5-3.

5-2. Shear Strength for Special Straight Members

The provisions of this paragraph shall apply only to straight members of box culvert sections or similar structures that satisfy the requirements of 5-2.a and 5-2.b. The stiffening effects of wide supports and haunches shall be included in determining moments, shears, and member properties. The ultimate shear strength of the member is considered to be the load capacity that causes formation of the first inclined crack.

a. Members that are subjected to uniformly (or approximately uniformly) distributed loads that result in internal shear, flexure, and axial compression (but not axial tension).

b. Members having all of the following properties and construction details.

(1) Rectangular cross-sectional shapes.

(2) l_n/d between 1.25 and 9, where l_n is the clear span.

(3) f'_c not more than 6,000 psi.

(4) Rigid, continuous joints or corner connections.

(5) Straight, full-length reinforcement. Flexural reinforcement shall not be terminated even though it is no longer a theoretical requirement.

(6) Extension of the exterior face reinforcement around corners such that a vertical lap splice occurs in a region of compression stress.

(7) Extension of the interior face reinforcement into and through the supports.

c. The shear strength provided the concrete shall be computed as

$$V_c = \left[\left(11.5 - \frac{l_n}{d}\right)\sqrt{f'_c}\sqrt{1 + \frac{N_u/A_g}{5\sqrt{f'_c}}}\right]bd \quad (5\text{-}1)$$

at a distance of $0.15l_n$ from the face of the support.

d. The shear strength provided by the concrete shall not be taken greater than

$$V_c = 2\left[12 - \left(\frac{l_n}{d}\right)\right]\sqrt{f'_c}\,bd \quad (5\text{-}2)$$

and shall not exceed $10\sqrt{f'_c}\,bd$.

5-3. Shear Strength for Curved Members

At points of maximum shear, for uniformly loaded curved cast-in-place members with $R/d > 2.25$ where R is the radius curvature to the centerline of the member:

$$V_c = \left[4\sqrt{f'_c}\sqrt{1 + \frac{N_u/A_g}{4\sqrt{f'_c}}}\right]bd \quad (5\text{-}3)$$

The shear strength shall not exceed $10\sqrt{f'_c}\,bd$.

5-4. Empirical Approach

Shear strength based on the results of detailed laboratory or field tests conducted in consultation with and approved by CECW-ED shall be considered a valid extension of the provisions in paragraphs 5-2 and 5-3.

APPENDIX A

NOTATION

a_d	Depth of stress block at limiting value of balanced condition (Appendix D)
d_d	Minimum effective depth that a singly reinforced member may have and maintain steel ratio requirements (Appendix D)
e'	Eccentricity of axial load measured from the centroid of the tension reinforcement
e'_b	Eccentricity of nominal axial load strength, at balanced strain conditions, measured from the centroid of the tension reinforcement
H_f	Hydraulic structural factor equal to 1.3
k_b	Ratio of stress block depth (a) to the effective depth (d) at balanced strain conditions
k_u	Ratio of stress block depth (a) to the effective depth (d)
K	Exponent, equal to 1.0 for any member subject to axial tension, 1.5 for rectangular members and 1.75 for square or circular members, used in nondimensional biaxial bending expression
l_n	Clear span between supports
M_{DS}	Bending moment capacity at limiting value of balanced condition (Appendix D)
M_{nx}, M_{ny}	Nominal biaxial bending moments with respect to the x and y axes, respectively
M_{ox}, M_{oy}	Uniaxial nominal bending strength at P_n about the x and y axes, respectively
R	Radius of curvature to centerline of curved member

APPENDIX B

DERIVATION OF EQUATIONS FOR FLEXURAL AND AXIAL LOADS

B-1. General

Derivations of the design equations given in paragraphs 4-2 through 4-4 are presented below. The design equations provide a general procedure that may be used to design members for combined flexural and axial load.

B-2. Axial Compression and Flexure

a. Balanced Condition

From Figure B-1, the balanced condition, Equations 4-3 and 4-4 can be derived as follows:

From equilibrium,

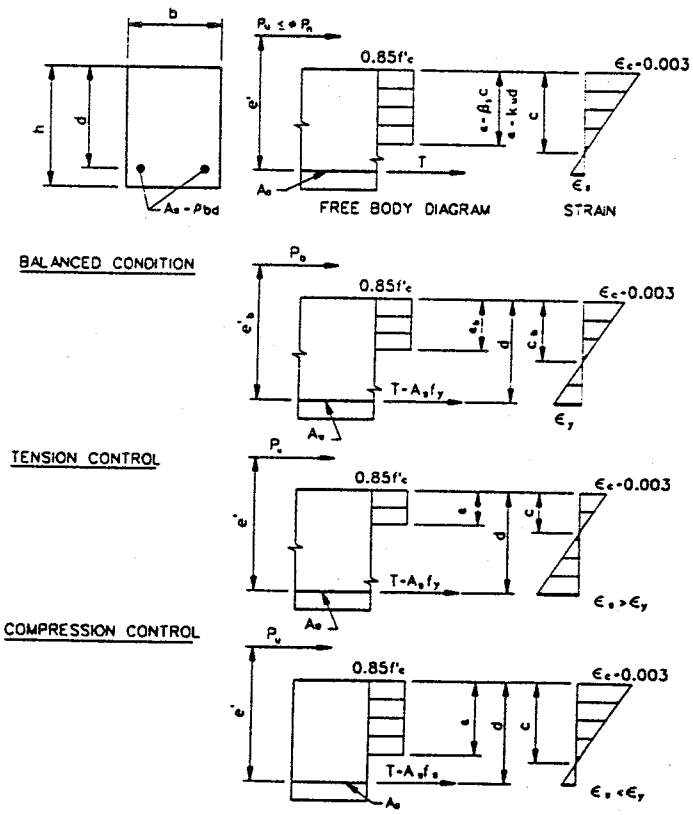


Figure B-1. Axial compression and flexure, single reinforcement

$$\frac{P_u}{\phi} = 0.85 f'_c b k_u d - A_s f_s \qquad \text{(B-1)}$$

let

$$j_u = d - \frac{a}{2} = d - \frac{k_u d}{2} \qquad \text{(B-2)}$$

from moment equilibrium,

$$\frac{P_u e'}{\phi} = (0.85 f'_c b k_u d)(j_u d) \qquad \text{(B-3)}$$

Rewrite Equation B-3 as:

$$\frac{P_u e'}{\phi} = (0.85 f'_c b k_u d)\left(d - \frac{k_u d}{2}\right)$$

$$= (0.85 f'_c b d^2)\left(k_u - \frac{k_u^2}{2}\right) \qquad \text{(B-4)}$$

$$= 0.425 f'_c (2k_u - k_u^2) b d^2$$

From the strain diagram at balanced condition (Figure B-1):

$$\frac{c_b}{d} = \frac{\varepsilon_c}{\varepsilon_c + \varepsilon_y}$$

$$\frac{\left(\frac{k_b d}{\beta_1}\right)}{d} = \frac{\varepsilon_c}{\varepsilon_c + \varepsilon_y} \qquad \text{(B-5)}$$

since $\varepsilon_y = \dfrac{f_y}{E_s}$

$$k_b = \frac{\beta_1 E_s \varepsilon_c}{E_s \varepsilon_c + f_y} \qquad \text{(B-6, Eq. 4-4)}$$

since $e'_b = \dfrac{P_b e'}{P_b}$ (B-7)

e'_b is obtained by substituting Equations B-4 and B-1 into Equation B-7 with $k_u = k_b$, $f_s = f_y$, and $P_u = P_b$.

$$e'_b = \frac{0.425f'_c(2k_b - k_b^2)bd^2}{0.85f'_c k_b bd - f_y \rho bd} \quad \text{(B-8)}$$

Therefore

$$\frac{e'_b}{d} = \frac{2k_b - k_b^2}{2k_b - \dfrac{f_y \rho}{0.425f'_c}} \quad \text{(B-9, Eq. 4-3)}$$

b. Sections Controlled by Tension (Figure B-1).

ϕP_n is obtained from Equation B-1 with $f_s = f_y$ as:

$$\phi P_n = \phi(0.85f'_c bk_u d - A_s f_y) \quad \text{(B-10, Eq. 4-5)}$$

$$\phi P_n = \phi(0.85)f'_c k_u - \rho f_y)bd$$

The design moment ϕM_n is expressed as:

$$\phi M_n = \phi P_n e$$

$$\phi M_n = \phi P_n\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]d \quad \text{(B-11)}$$

Therefore,

$$\phi M_n = \phi(0.85f'_c k_u - f_y \rho)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2$$

(B-12, Eq. 4-6)

Substituting Equation B-1 with $f_s = f_y$ into Equation B-4 gives

$$(0.85f'_c k_u bd - f_y \rho bd)e' = 0.425f'_c(2k_u - k_u^2)bd^2$$

(B-13)

which reduces to

$$k_u^2 + 2\left(\frac{e'}{d} - 1\right)k_u - \frac{f_y \rho e'}{0.425f'_c d} = 0 \quad \text{(B-14)}$$

Solving by the quadratic equation:

$$k_u = \sqrt{\left(\frac{e'}{d} - 1\right)^2 + \left(\frac{\rho f_y}{0.425f'_c}\right)\frac{e'}{d}} - \left(\frac{e'}{d} - 1\right)$$

(B-15, Eq. 4-7)

c. Sections Controlled by Compression (Figure B-1)

ϕP_n is obtained from Equation B-1

$$\phi P_n = \phi(0.85f'_c k_u - \rho f_s)bd \quad \text{(B-16, Eq. 4-8)}$$

and ϕM_n is obtained by multiplying Equation B-16 by e.

$$\phi M_n = \phi(0.85f'_c k_u - \rho f_s)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2$$

(B-17)

The steel stress, f_s, is expressed as $f_s = E_s \varepsilon_s$. From Figure B-1.

$$\frac{c}{d} = \frac{\varepsilon_c}{\varepsilon_c + \varepsilon_s}$$

or

$$\frac{\left(\dfrac{k_u d}{\beta_1}\right)}{d} = \frac{\varepsilon_c}{\varepsilon_c + \varepsilon_s}$$

Therefore,

$$f_s = \frac{E_s \varepsilon_c(\beta_1 - k_u)}{k_u} \quad \text{(B-18, Eq. 4-10)}$$

Substituting Equations B-1 and B-18 into B-4 gives

$$0.85f'_c k_u bde' - \left[\frac{E_s \varepsilon_c(\beta_1 - k_u)}{k_u}\right]\rho bde'$$

$$= 0.425f'_c(2k_u - k_u^2)bd^2 \quad \text{(B-19)}$$

which can be arranged as

$$k_u^3 + 2\left(\frac{e'}{d} - 1\right)k_u^2 + \left(\frac{E_s \varepsilon_c \rho e'}{0.425f'_c d}\right)k_u$$

$$- \frac{\beta_1 E_s \varepsilon_c \rho e'}{0.425f'_c d} = 0 \quad \text{(B-20, Eq. 4-11)}$$

B-3. Flexural and Compressive Capacity-Tension and Compression Reinforcement (Figure B-2)

a. Balanced Condition

Using Figure B-2, the balanced condition, Equation 4-13 can be derived as follows:

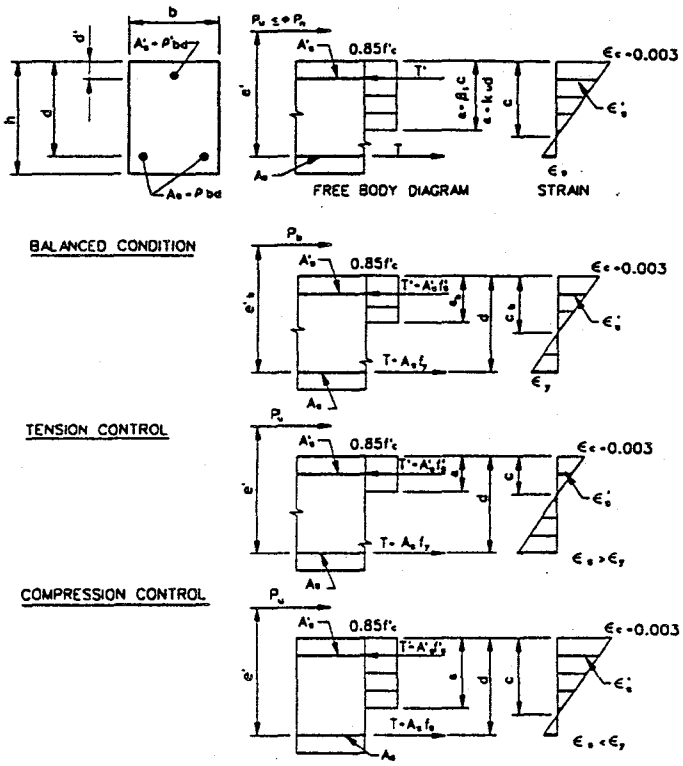


Figure B-2. Axial compression and flexure, double reinforcement

From equilibrium,

$$\frac{P_u}{\phi} = 0.85f'_c k_u bd + f'_s \rho' bd - f_s \rho bd \quad \text{(B-21)}$$

In a manner similar to the derivation of Equation B-4, moment equilibrium results in

$$\frac{P_u e'}{\phi} = 0.425f'_c(2k_u - k_u^2)bd^2 + f'_s \rho' bd(d - d') \quad \text{(B-22)}$$

As in Equation B-6,

$$k_b = \frac{\beta_1 E_s \varepsilon_c}{E_s \varepsilon_c + f_y} \quad \text{(B-23)}$$

considering that

$$e'_b = \frac{P_b e'}{P_b} \quad \text{(B-24)}$$

and using Equations B-21 and B-22:

$$e'_b = \frac{0.425f'_c(2k_b - k_b^2)bd^2 + f'_s \rho' bd(d - d')}{0.85f'_c k_b bd + f'_s \rho' bd - f_s \rho bd} \quad \text{(B-25)}$$

which can be rewritten as

$$e'_b = \frac{(2k_b - k_b^2)d + \dfrac{f'_s \rho'}{0.425f'_c}(d - d')}{2k_b + \dfrac{f_s \rho'}{0.425f'_c} - \dfrac{f_y \rho}{0.425f'_c}}$$

or

$$\frac{e'_b}{d} = \frac{2k_b - k_b^2 + \dfrac{f'_s \rho'\left(1 - \dfrac{d'}{d}\right)}{0.425f'_c}}{2k_b - \dfrac{f_y \rho}{0.425f'_c} + \dfrac{f'_s \rho'}{0.425f'_c}} \quad \text{(B-26, Eq. 4-13)}$$

b. Sections Controlled by Tension (Figure B-2)

ϕP_n is obtained as Equation B-21 with $f_s = f_y$.

$$\phi P_n = \phi(0.85f'_c k_u + \rho' f'_s - \rho f_y)bd \quad \text{(B-27, Eq. 4-14)}$$

Using Equations B-11 and B-27,

$$\phi M_n = \phi(0.85f'_c k_u + \rho' f'_s - \rho f_y)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2 \quad \text{(B-28, Eq. 4-15)}$$

From Figure B-2

$$\frac{\varepsilon'_s}{c - d'} = \frac{\varepsilon_y}{d - c};\ f'_s = E_s \varepsilon'_s;\ c = \frac{k_u d}{\beta_1}$$

Therefore,

$$\frac{f'_s}{E_s} = \left(\frac{k_u d}{\beta_1} - d'\right)\left(\frac{\varepsilon_y}{d - \dfrac{k_u d}{\beta_1}}\right)$$

or

$$f'_s = \frac{\left(k_u - \beta_1 \dfrac{d'}{d}\right)}{(\beta_1 - k_u)} E_s \varepsilon_y \quad \text{(B-29, Eq. 4-16)}$$

Substituting Equation B-21 with $f_s = f_y$ into Equation B-22 gives,

$$(0.85f'_c k_u bd + f'_s \rho' bd - f_y \rho bd)e' = 0.425f'_c(2k_u - k_u^2)bd^2 + f'_s \rho' bd(d - d') \quad \text{(B-30)}$$

Using Equation B-29, Equation B-30 can be written as:

$$k_u^3 + \left[2\left(\frac{e'}{d} - 1\right) - \beta_1\right]k_u^2 - \left\{\frac{f_y}{0.425f'_c}\left[\rho'\left(\frac{e'}{d} + \frac{d'}{d} - 1\right) + \frac{\rho e'}{d}\right] + 2\beta_1\left(\frac{e'}{d} - 1\right)\right\}k_u + \frac{f_y\beta_1}{0.425f'_c}\left[\rho'\frac{d'}{d}\left(\frac{e'}{d} + \frac{d'}{d} - 1\right) + \frac{\rho e'}{d}\right] = 0 \quad \text{(B-31, Eq. 4-17)}$$

c. Sections Controlled by Compression (Figure B-2)

ϕP_n is obtained from equilibrium

$$\phi P_n = \phi(0.85f'_c k_u + \rho' f'_s - \rho f_s)bd \quad \text{(B-32, Eq. 4-18)}$$

Using Equations B-11 and B-32,

$$\phi M_n = \phi(0.85f'_c k_u + \rho' f'_s - \rho f_s)\left[\frac{e'}{d} - \left(1 - \frac{h}{2d}\right)\right]bd^2 \quad \text{(B-33, Eq. 4-19)}$$

From Figure B-2

$$\frac{\varepsilon_s}{d - c} = \frac{\varepsilon_c}{c};\ f_s = E_s\varepsilon_s;\ c = \frac{k_u d}{\beta_1}$$

which can be written as

$$f_s = \frac{E_s\varepsilon_c(\beta_1 - k_u)}{k_u} \quad \text{(B-34, Eq. 4-20)}$$

Also,

$$\frac{\varepsilon'_s}{c - d'} = \frac{\varepsilon_c}{c}$$

which can be rewritten as

$$f'_s = \frac{E_s\varepsilon_c\left[k_u - \beta_1\left(\frac{d'}{d}\right)\right]}{k_u} \quad \text{(B-35, Eq. 4-21)}$$

From Equations B-21 and B-22

$$(0.85f'_c k_u bd = f'_s \rho' bd - f_s \rho bd)e' = 0.425f'_c(2k_u - k_u^2)bd^2 + f'_s \rho' bd(d - d') \quad \text{(B-36)}$$

Substituting Equations B-34 and B-35 with $k_b = k_u$ into Equation B-36 gives

$$k_u^3 + 2\left(\frac{e'}{d} - 1\right)k_u^2 + \frac{E_s\varepsilon_c}{0.425f'_c}\left[(\rho + \rho')\left(\frac{e'}{d}\right) - \rho'\left(1 - \frac{d'}{d}\right)\right]k_u - \frac{\beta_1 E_s\varepsilon_c}{0.425f'_c}\left[\rho'\left(\frac{d'}{d}\right)\left(\frac{e'}{d} + \frac{d'}{d} - 1\right) + \rho\left(\frac{e'}{d}\right)\right] = 0 \quad \text{(B-37, Eq. 4-22)}$$

B-4. Flexural and Tensile Capacity

a. Pure Tension (Figure B-3)

From equilibrium (double reinforcement)

$$\phi P_n = \phi(A_s + A'_s)f_y \quad \text{(B-38)}$$

For design, the axial load strength of tension members is limited to 80 percent of the design axial load strength at zero eccentricity. Therefore,

$$\phi P_{n(max)} = 0.8\phi(\rho + \rho')f_y bd \quad \text{(B-39, Eq. 4-23)}$$

b. For the case where $1 - (h/2d) \geq (e'/d) \geq 0$, the applied tensile resultant P_u/ϕ lies between the two layers of steel. From equilibrium

$$\phi P_n = \phi(A_s f_y + A'_s f'_s)$$

or

$$\phi P_n = \phi(\rho f_y + \rho' f'_s)bd \quad \text{(B-40, Eq. 4-24)}$$

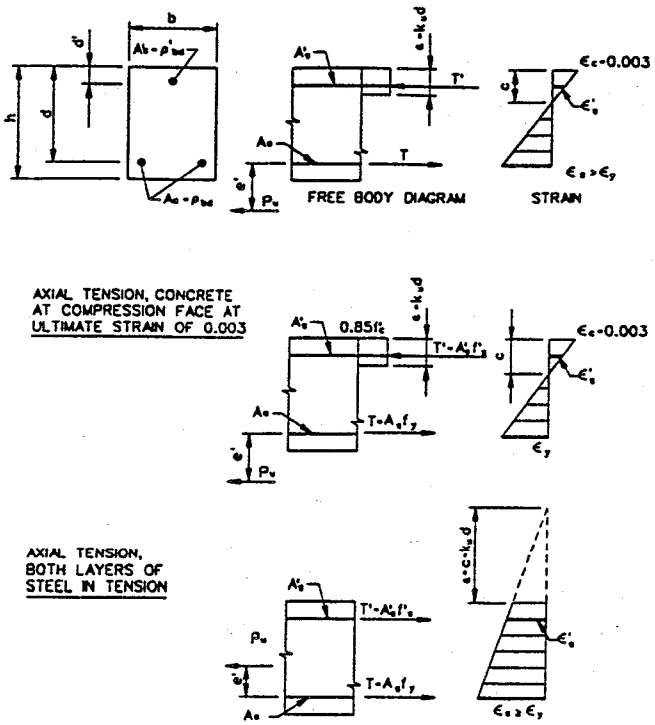


Figure B-3. Axial tension and flexure, double reinforcement

and

$$\phi M_n = \phi P_n\left[\left(1 - \frac{h}{2d}\right) - \frac{e'}{d}\right]d$$

or

$$\phi M_n = \phi(\rho f_y + \rho' f_s')\left[\left(1 - \frac{h}{2d}\right) - \frac{e'}{d}\right]bd^2$$

(B-41, Eq. 4-25)

From Figure B-3,

$$\frac{\varepsilon_s'}{a + d'} = \frac{\varepsilon_y}{a + d}$$

which can be rewritten as

$$f_s' = f_y \frac{\left(k_u + \dfrac{d'}{d}\right)}{(k_u + 1)} \quad \text{(B-42, Eq. 4-26)}$$

From Figure B-3 equilibrium requires:

$$A_s f_s e' = A_s' f_s'(d - d' - e') \qquad \text{(B-43)}$$

Substituting Equation B-42 and $f_s = f_y$ into Equation B-43 results in

$$k_u = \frac{\rho'\left(\dfrac{d'}{d}\right)\left(1 - \dfrac{d'}{d} - \dfrac{e'}{d}\right) - \rho\left(\dfrac{e'}{d}\right)}{\rho\left(\dfrac{e'}{d}\right) - \rho'\left(1 - \dfrac{d'}{d} - \dfrac{e'}{d}\right)}$$

(B-44, Eq. 4-27)

c. The case where $(e'/d) < 0$ is similar to the combined flexural and compression case. Therefore, k_u is derived in a manner similar to the derivation of Equation B-15 and is given as

$$k_u = -\left(\frac{e'}{d} - 1\right) - \sqrt{\left(\frac{e'}{d} - 1\right)^2 + \left(\frac{\rho f_y}{0.425 f_c'}\right)\frac{e'}{d}}$$

(B-45, Eq. 4-28)

APPENDIX C

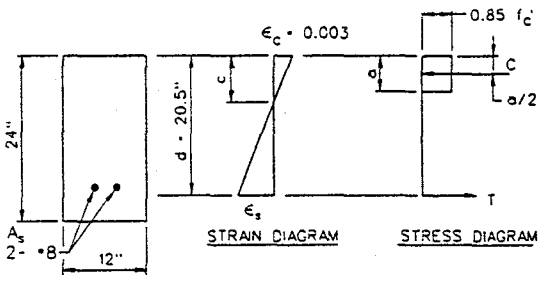
INVESTIGATION EXAMPLES

C-1. General

For the designer's convenience and reference, the following examples are provided to illustrate how to determine the flexural capacity of existing concrete sections in accordance with this Engineer Manual and ACI 318.

C-2. Analysis of a Singly Reinforced Beam

Given: $f'_c = 3$ ksi $\quad \beta_1 = 0.85$
$f_y = 60$ ksi $\quad E_s = 29{,}000$ ksi
$A_s = 1.58$ in.^{2}



Solution:

1. Check steel ratio

$$\rho_{act} = \frac{A_s}{bd}$$

$$= \frac{1.58}{12(20.5)}$$

$$= 0.006423$$

$$\rho_b = 0.85\beta_1 \frac{f'_c}{f_y}\left(\frac{87{,}000}{87{,}000 + f_y}\right)$$

$$= 0.85(0.85)\left(\frac{3}{60}\right)\left(\frac{87{,}000}{87{,}000 + 60{,}000}\right)$$

$$= 0.02138$$

in accordance with paragraph 3-5 check:

$$0.25\rho_b = 0.00534$$

$$0.375\rho_b = 0.00802$$

$$\rho_{act} = 0.00642$$

$$0.25\rho_b < \rho_{act} < 0.375\rho_b$$

ρ_{act} is greater than the recommended limit, but less than the maximum permitted upper limit not requiring special study or investigation. Therefore, no special consideration for serviceability, constructibility, and economy is required. This reinforced section is satisfactory.

2. Assume the steel yields and compute the internal forces:

$$T = A_s f_s = 1.58(60) = 94.8 \text{ kips}$$

$$C = 0.85 f'_c ba$$

$$C = 0.85(3)(12)a = 30.6a$$

3. From equilibrium set $T = C$ and solve for a:

$$94.8 = 30.6a \rightarrow a = 3.10 \text{ in.}$$

Then, $a = \beta c \rightarrow c = \dfrac{3.10}{0.85} = 3.65$ in.

4. Check ε_s to demonstrate steel yields prior to crushing of the concrete:

$$\frac{\varepsilon_s}{20.5 - c} = \frac{0.003}{c}$$

$$\varepsilon_s = 16.85\left(\frac{0.003}{3.65}\right) = 0.0138$$

$$\varepsilon_y = \frac{f_y}{E_s} = \frac{60}{29{,}000} = 0.00207$$

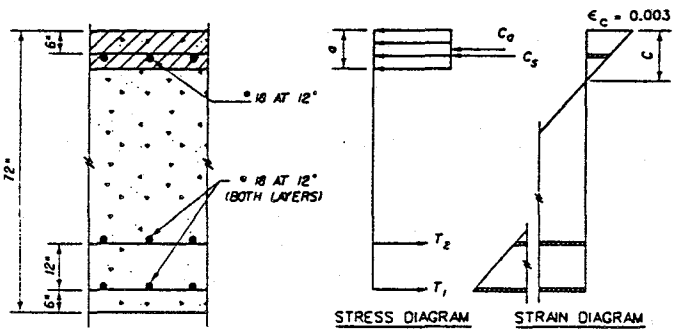
$\varepsilon_s < \varepsilon_y$ Ok, steel yields

5. Compute the flexural capacity:

$$\phi M_n = \phi(A_s f_y)(d - a/2)$$
$$= 0.90(94.8)\left(20.5 - \frac{3.10}{2}\right)$$
$$= 1616.8 \text{ in.-k}$$
$$= 134.7 \text{ ft-k}$$

C-3. Analysis of an Existing Beam — Reinforcement in Both Faces

Given: $f'_c = 3{,}000$ psi $\quad \varepsilon_c = 0.003$
$f_y = 60{,}000$ psi $\quad \beta_1 = 0.85$
$A_s = 8.00$ in.^{2} $\quad E_s = 29{,}000{,}000$ psi
$A'_s = 4.00$ in.^{2}



Solution:

1. First analyze considering steel in tension face only

$$\rho = \frac{A_s}{bd} = \frac{8}{(60)(12)} = 0.011$$

$$\rho_{bal} = 0.85\frac{\beta_1 f'_c}{f_y} = \frac{87{,}00}{87{,}000 + f_y} = 0.0214$$

$$\rho = \frac{0.011}{0.0214}\rho_{bal} = 0.51\rho_b$$

Note: ρ exceeds maximum permitted upper limit not requiring special study or investigation = 0.375 ρ_b. See Chapter 3.

$$T = A_s f_y$$
$$T = 8(60) = 480 \text{ kips}$$

then $C_c = 0.85 f'_c ba = 30.6a$

$$T = C_c$$
$$\therefore \quad a = 15.7 \text{ in. and } c = 18.45 \text{ in.}$$

By similar triangles, demonstrate that steel yields

$$\frac{\varepsilon_c}{18.45} = \frac{\varepsilon_{s(2)}}{54 - c} \Rightarrow \varepsilon_{s(2)} = 0.0057 > \varepsilon_y = 0.0021$$

ok; both layers of steel yield.

$$\text{Moment capacity} = 480 \text{ kips } (d - a/2)$$
$$= 480 \text{ kips } (52.15 \text{ in.})$$
$$M = 25{,}032 \text{ in.-k}$$

2. Next analyze considering steel in compression face

$$\rho' = \frac{4}{12(60)} = 0.0056$$

$$\rho - \rho' = 0.0054$$
$$= 0.85\frac{\beta_1 f'_c}{f_y}\cdot\frac{d'}{d}\left(\frac{87{,}000}{87{,}000 - f_y}\right) = 0.016$$

$$\rho - \rho' \leq 0.0116$$

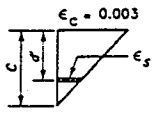
$\therefore$ compression steel does not yield, must do general analysis using σ:ε compatability
Locate neutral axis

$$T = 480 \text{ kips}$$
$$C_c = 0.85 f_c ba = 30.6a$$
$$C_s = A'_s(f'_s - 0.85 f'_c) = 4(f'_s - 2.55)$$

By similar triangles

$$\frac{\varepsilon'_s}{c - 6} = \frac{0.003}{c}$$

Substitute $c = \dfrac{a}{0.85} = 1.176a$



Then $\varepsilon'_s = 0.003 - \dfrac{0.0153}{a}$

Since $f'_s = E\varepsilon'_s \Rightarrow f'_s = \left(87 - \dfrac{443.7}{a}\right)$ksi

Then

$$C_s = 4\left(87 - 2.55 - \frac{443.7}{a}\right)\text{kips}$$

$$T = C_c + C_s = 480 \text{ kips}$$

Substitute for C_c and C_s and solve for a

$$30.6a + 337.8 - \frac{1774.8}{a} = 480$$

$$a^2 - 4.65a - 58 = 0$$

Then $a = 10.3$ in. and $c = 12.1$ in.

Check $\varepsilon_s' > \varepsilon_y$

By similar triangles $\dfrac{0.003}{12.1} = \dfrac{\varepsilon_s'}{d - 12.1}$

$$\varepsilon_s' = 0.0119 > 0.0021$$

$$C_c = 30.6a \approx 315 \text{ kips}$$

$$C_s = 4(41.37) \approx 165 \text{ kips}$$

$$C_c + C_s = 480 \text{ kips} = T$$

$$\text{Resultant of } C_c \text{ and } C_s = \frac{315\left(\frac{10.3}{2}\right) + (165)(6)}{480}$$

$$= 5.4 \text{ in.}$$

Internal Moment Arm $= 60 - 5.4 = 54.6$ in.

$$M = 480(54.6) = 26{,}208 \text{ in.-k}$$

	Comparison	
	Tension Steel Only	Compression Steel
a	15.7 in.	10.3 in.
c	18.45 in.	12.1 in.
Arm	52.15 in.	54.6 in.
M	25,032 in.-k	26,208 in.-k ⇒ 4.7 percent increase

APPENDIX D

DESIGN EXAMPLES

D-1. Design Procedure

For convenience, a summary of the steps used in the design of the examples in this appendix is provided below. This procedure may be used to design flexural members subjected to pure flexure or flexure combined with axial load. The axial load may be tension or compression.

Step 1 — Compute the required nominal strength M_n, P_n where M_u and P_u are determined in accordance with paragraph 4-1.

Mu

$$M_n = \frac{M_n}{\phi} \qquad P_n = \frac{P_u}{\phi}$$

Note: Step 2 below provides a convenient and quick check to ensure that members are sized properly to meet steel ratio limits. The expressions in Step 2a are adequate for flexure and small axial load. For members with significant axial loads, the somewhat more lengthy procedures of Step 2b should be used.

Step 2a — Compute d_d from Table D-1. The term d_d is the minimum effective depth a member may have and meet the limiting requirements on steel ratio. If $d \geq d_d$, the member is of adequate depth to meet steel ratio requirements and A_s is determined using Step 3.

Step 2b — When significant axial load is present, the expressions for d_d become cumbersome and it becomes easier to check the member size by determining M_{DS}. M_{DS} is the maximum bending moment a member may carry and remain within the specified steel ratio limits.

$$M_{DS} = 0.85 f'_c a_d b(d - a_d/2) - (d - h/2)P_n \quad \text{(D-1)}$$

where

$$a_d = K_d d \quad \text{(D-2)}$$

and K_d is found from Table D-1.

Step 3 — Singly Reinforced. When $d \geq d_d$ (or $M_n \leq M_{DS}$) the following equations are used to compute A_s.

Table D-1
Minimum Effective Depth

f'_c (psi)	f_y (psi)	$\frac{\rho^*}{\rho_b}$	K_d	d_d (in.)
3000	60	0.25	0.125765	$\sqrt{\frac{3.3274 M_n^{**}}{b}}$
4000	60	0.25	0.125765	$\sqrt{\frac{2.4956 M_n^{*}}{b}}$
5000	60	0.25	0.118367	$\sqrt{\frac{2.1129 M_n^{*}}{b}}$

* See Section 3-5. Maximum Tension Reinforcement
** μ_n units are inch-kips

$$K_u = 1 - \sqrt{1 - \frac{M_n + P_n(d - h/2)}{0.425 f'_c b d^2}} \quad \text{(D-3)}$$

$$A_s = \frac{0.85 f'_c K_u b d - P_n}{f_y} \quad \text{(D-4)}$$

where

$$K_d = \frac{\left(\frac{\rho}{\rho_b}\right)\beta_1 \varepsilon_c}{\varepsilon_c + \frac{f_y}{E_s}}$$

$$d_d = \sqrt{\frac{M_n}{0.85 f'_c k_d b\left(1 - \frac{k_d}{2}\right)}}$$

D-2. Singly Reinforced Example

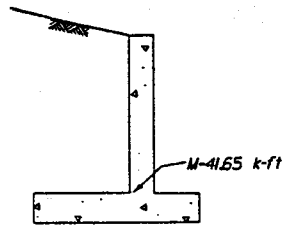
The following example demonstrates the use of the design procedure outlined in paragraph D-1 for a Singly Reinforced Beam with the

recommended steel ratio of 0.25 ρ_b. The required area of steel is computed to carry the moment at the base of a retaining wall stem.

Given:

$M = 41.65$ k-ft

(where M = moment from *unfactored* dead and live loads)



$f'_c = 3.0$ ksi
$f_y = 60$ ksi
$d = 20$ in.

First compute the required strength, M_u.

$$M_u = 1.7\ H_f(D + L)$$

$$M_u = (1.7)(1.3)(41.65) = 92.047 \text{ k-ft}$$

Step 1. $M_n = M_u/\phi$

$= 92.047/0.90 = 102.274$ k-ft

Step 2. $d_d = \sqrt{\dfrac{3.3274M_n}{b}} = 18.45$ in. (Table D-1)

$d > d_d$ therefore member size is adequate

Step 3.

$$K_u = 1 - \sqrt{1 - \frac{M_n + P_n(d - h/2)}{0.425f'_c bd^2}}$$

$$K_u = 1 - \sqrt{1 - \frac{(102.274)(12)}{(0.425)(3.0)(12)(20)^2}}$$

$$= 0.10587 \qquad \text{(D-3)}$$

$$A_s = \frac{0.85f'_c K_u bd}{f_y}$$

$$= \frac{(0.85)(3.0)(0.10587)(12)(20)}{60}$$

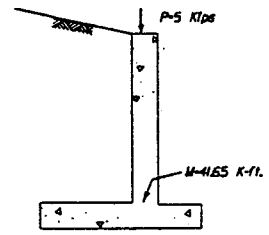
$$A_s = 1.08 \text{ sq in.} \qquad \text{(D-4)}$$

D-3. Combined Flexure Plus Axial Load Example

The following example demonstrates the use of the design procedure outlined in paragraph D-1 for a beam subjected to flexure plus small axial compressive load. The amount of tensile steel required to carry the moment and axial load at the base of a retaining wall stem is found.

Given: $M = 41.65$ k-ft
$P = 5$ kips (weight of stem)

where M and P are the moment and axial load from an *unfactored* analysis.



$f'_c = 3.0$ ksi

$f_y = 60$ ksi

$d = 20$ in.

$h = 24$ in.

First compute the required strength, M_u, P_u

$$M_u = 1.7\ H_f(D + L)$$

$$M_u = (1.7)(1.3)(41.65) = 92.047 \text{ k-ft}$$

$$P_u = 1.7H_f(D + L)$$

$$P_u = (1.7)(1.3)(5.0) = 11.05 \text{ kips}$$

Since axial load is present a value must be found for ϕ.

For small axial load

$$\phi \simeq 0.9 - [(0.20P_u)/(0.10f'_c A_g)]$$

$$\phi \simeq 0.88$$

Step 1.

$$M_n = M_u/\phi = 92.047/0.88 = 104.60 \text{ k-ft}$$

$$P_n = P_u/\phi = 11.05/0.88 = 12.56 \text{ kips}$$

Step 2.

$$a_d = K_d d \qquad \text{(D-2)}$$

$$a_d = (0.12577)(20) = 2.515$$

$$M_{DS} = 0.85f'_c a_d b(d - a_d/2.0) - (d - h/2.0)P_n \qquad \text{(D-1)}$$

$$M_{DS} = (0.85)(3.0)(2.515)(12)(20 - 1.258) - (20 - 12)(12.56)$$

$$M_{DS} = 1341.9 \text{ k-in. or } 111.82 \text{ k-ft}$$

$M_{DS} > M_n$ therefore member size is adequate

Step 3.

$$K_u = 1 - \sqrt{1 - \frac{M_n + P_n(d - h/2)}{0.425 f'_c b d^2}}$$

$$K_u = 1 - \sqrt{1 - \frac{(12)104.6 + 12.56(20 - 12)}{(0.425)(3.0)(12)(20)^2}}$$

$$K_u = 0.11768$$

$$A_s = \frac{0.85 f'_c K_u b d - P_n}{f_y}$$

$$A_s = \frac{(0.85)(3.0)(0.11768)(12)(20) - 12.56}{60}$$

$$A_s = 0.99 \text{ sq in.} \qquad \text{(D-4)}$$

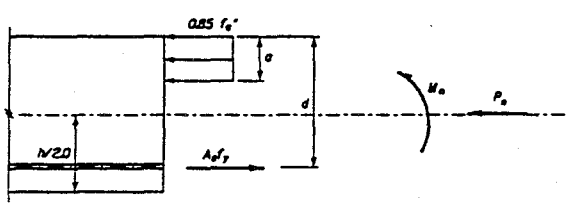
D-4. Derivation of Design Equations

The following paragraphs provide derivations of the design equations presented in paragraph D-1.

(1) Derivation of Design Equations for Singly Reinforced Members. The figure below shows the condition of stress on a singly reinforced member subject to a moment M_n and load P_n. Equations for design may be developed by satisfying conditions of equilibrium on the section.

By requiring the ΣM about the tensile steel to equal zero

$$M_n = 0.85 f'_c ab(d - a/2) - P_n(d - h/2) \qquad \text{(D-5)}$$



By requiring the ΣH to equal zero

$$A_s f_y = 0.85 f'_c ab - P_n \qquad \text{(D-6)}$$

Expanding Equation D-5 yields

$$M_n = 0.85 f'_c abd - 0.425 f'_c a^2 b - P_n(d - h/2)$$

Let $a = K_u d$; then

$$M_n = 0.85 f'_c K_u b d^2 - 0.425 f'_c K_u^2 d^2 b - P_n(d - h/2)$$

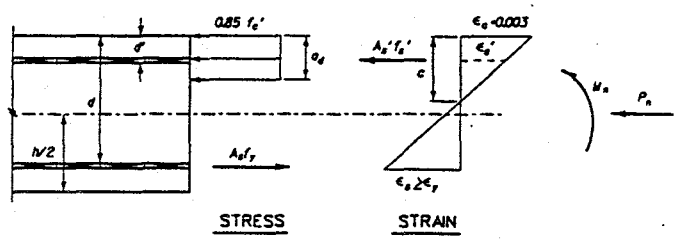
The above equation may be solved for K_u using the solution for a quadratic equation

$$K_u = 1 - \sqrt{1 - \frac{M_n + P_n(d - h/2)}{0.425 f'_c b d^2}} \qquad \text{(D-3)}$$

Substituting $K_u d$ for a in Equation D-6 then yields

$$A_s = \frac{0.85 f'_c K_u b d - P_n}{f_y}$$

(2) Derivation of Design Equations for Doubly Reinforced Members. The figure below shows the conditions of stress and strain on a doubly reinforced member subjected to a moment M_n and load P_n. Equations for design are developed in a manner identical to that shown previously for singly reinforced beams.



Requiring ΣH to equal zero yields

$$A_s = \frac{0.85 f'_c K_d b d - P_n + A'_s f'_s}{f_y} \qquad \text{(D-7)}$$

By setting $a_d = \beta_1 c$ and using the similar triangles from the strain diagram above, ε'_s and f'_s may be found:

$$f'_s = \frac{(a_d - \beta_1 d')\varepsilon_c E_s}{a_d}$$

An expression for the moment carried by the concrete (M_{DS}) may be found by summing moments about the tensile steel of the concrete contribution.

$$M_{DS} = 0.85 f'_c a_d b(d - a_d/2) - (d - h/2)P_n \qquad \text{(D-1)}$$

Finally, an expression for A'_s may be found by requiring the compression steel to carry any moment above that which the concrete can carry ($M_n - M_{DS}$).

$$A'_s = \frac{M_n - M_{DS}}{f'_s(d - d')} \qquad \text{(D-8)}$$

(3) Derivation of Expression of d_d. The expression for d_d is found by substituting $a_d = k_d d_d$ in the equation shown above for M_{DS} and solving the resulting quadratic expression for d_d.

$$d_d = \sqrt{\frac{M_{DS}}{[0.85 f'_c K_d b(1 - K_d/2)]}} \qquad \text{(D-9)}$$

D-5. Shear Strength Example for Special Straight Members

Paragraph 5.2 describes the conditions for which a special shear strength criterion shall apply for straight members. The following example demonstrates the application of Equation 5-1. Figure D-1 shows a rectangular conduit with factored loads, 1.7 H_f (dead load + live load). The following parameters are given or computed for the roof slab of the conduit:

$f'_c = 4{,}000$ psi

$l_n = 10.0$ ft $= 120$ in.

$d = 2.0$ ft $= 24$ in.

$b = 1.0$ ft (unit width) $= 12$ in.

$N_u = 6.33(5) = 31.7$ kips

$A_g = 2.33$ sq ft $= 336$ sq in.

$$V_c = \left[\left(11.5 - \frac{120 \text{ in.}}{24 \text{ in.}}\right)\sqrt{4{,}000} \times \sqrt{1 + \left(\frac{\frac{31{,}700 \text{ lb}}{336 \text{ sq in.}}}{5\sqrt{4{,}000}}\right)}\right](12 \text{ in.})(24 \text{ in.})$$

(D-10, Eq. 5-1)

$V_c = 134{,}906$ lb $= 134.9$ kips

Check limit $V_c = 10\sqrt{f'_c}bd = 10\sqrt{4{,}000}$ (12 in.)(24 in.) $= 182{,}147$ lb

Compare shear strength with applied shear.

$\phi V_c = 0.85(134.9 \text{ kips}) = 114.7$ kips

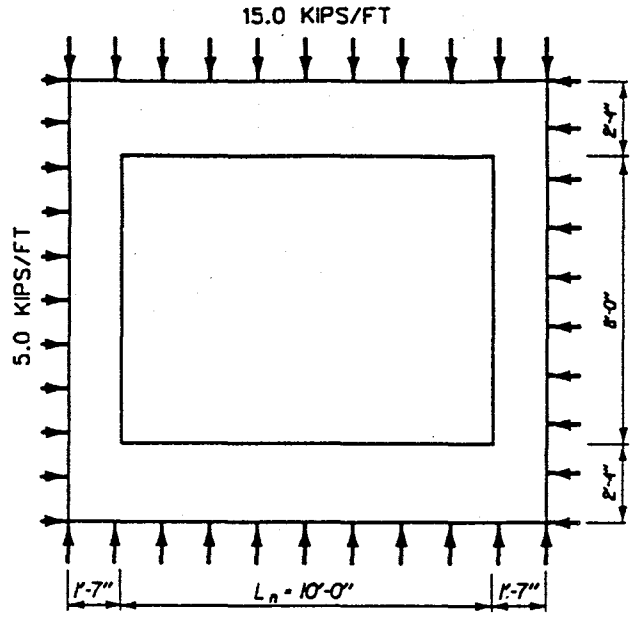


Figure D-1. Rectangular conduit

V_u at $0.15(l_n)$ from face of the support is

$$V_u = w\left(\frac{l_n}{2} - 0.15 l_n\right)$$

$$= 15.0 \text{ kips/ft}\left[\left(\frac{10 \text{ ft}}{2}\right) - (0.15)(10 \text{ ft})\right]$$

$= 52.5$ kips $< \phi V_c$; shear strength adequate

D-6. Shear Strength Example for Curved Members

Paragraph 5-3 describes the conditions for which Equation 5-3 shall apply. The following example applies Equation 5-3 to the circular conduit presented in Figure D-2. Factored loads are shown, and the following values are given or computed:

$f'_c = 4{,}000$ psi

$b = 12$ in.

$d = 43.5$ in.

$A_g = 576$ sq in.

$N_u = 162.5$ kips

$V_u = 81.3$ kips at a section 45 degrees from the crown

$$V_c = 4\sqrt{4{,}000}\left[\sqrt{1 + \left(\frac{\frac{162{,}500 \text{ lb}}{576 \text{ sq in.}}}{4\sqrt{4{,}000}}\right)}\right](12 \text{ in.})(24 \text{ in.})$$

$$V_c = 192{,}058 \text{ lb} = 192.1 \text{ kips}$$

Check limit $V_c = 10\sqrt{f'_c}bd = 10\sqrt{4{,}000}$ (12 in.) (43.5 in.) = 330,142 lb

Compare shear strength with applied shear

$$\phi V_c = 0.85(192.1 \text{ kips}) = 163.3 \text{ kips}$$

$V_u < \phi V_c$; shear strength adequate

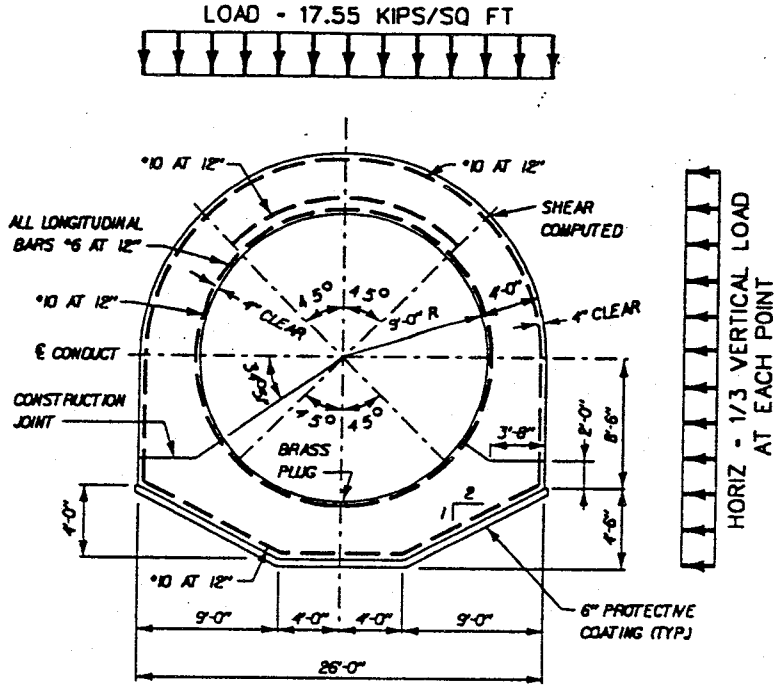


Figure D-2. Circular conduit

APPENDIX E

INTERACTION DIAGRAM

E-1. Introduction

A complete discussion on the construction of interaction diagrams is beyond the scope of this manual; however, in order to demonstrate how the equations presented in Chapter 4 may be used to construct a diagram a few basic points will be computed. Note that the effects of ϕ, the strength reduction factor, have not been considered. Using the example cross section shown below compute the points defined by 1, 2, 3 notations shown in Figure E-1.

Given: $f'_c = 3.0$ ksi

$f_y = 60$ ksi

$A_s = 2.0$ sq in.

$d = 22$ in.

$h = 24$ in.

$b = 12$ in.

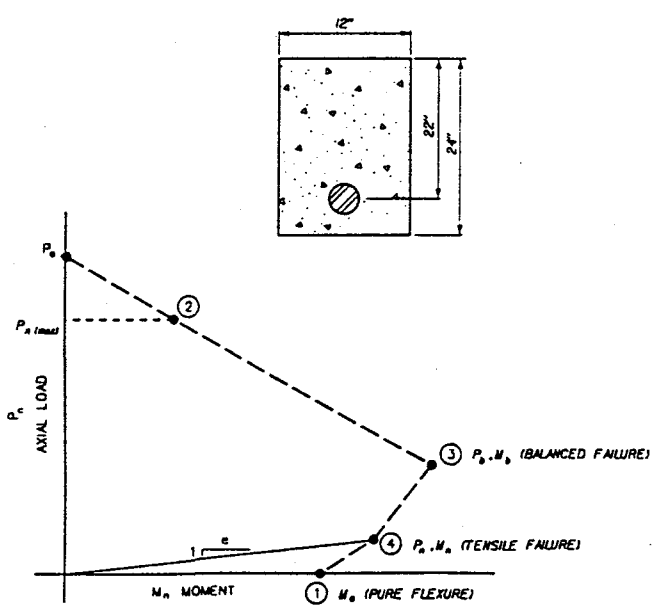
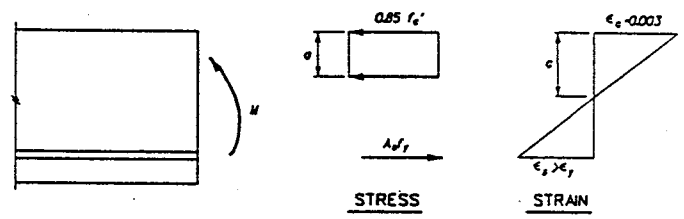


Figure E-1. Interaction diagram

E-2. Determination of Point 1, Pure Flexure



$$\phi M_n = \phi 0.85 f'_c ab(d - a/2)$$

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{(2.0)(60.0)}{(0.85)(3.0)(12)} = 3.922 \text{ in.}$$

$$M_n = (0.85)(3.0)(3.922)(12)(22 - 1.961)$$

$$M_n = 2404.7 \text{ k-in.}$$

$$M_n = 200.4 \text{ k-ft} \qquad \text{(D-5)}$$

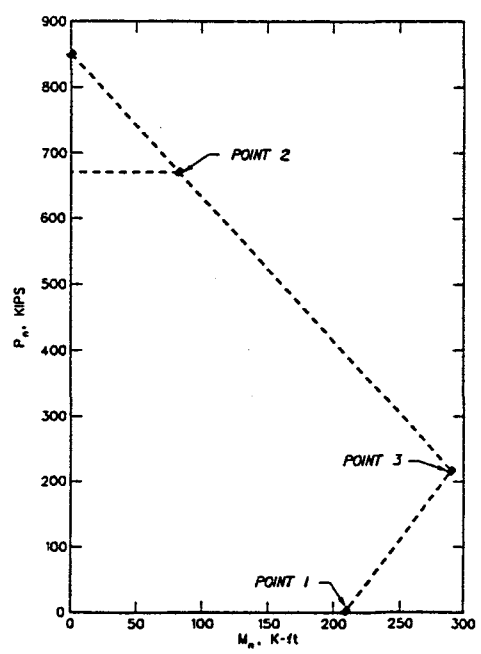


Figure E-2. Interaction diagram solution

APPENDIX F

AXIAL LOAD WITH BIAXIAL BENDING — EXAMPLE

F-1. In accordance with paragraph 4-5, design an 18- by 18-inch reinforced concrete column for the following conditions:

$f'_c = 3{,}000$ psi

$f_y = 60{,}000$ psi

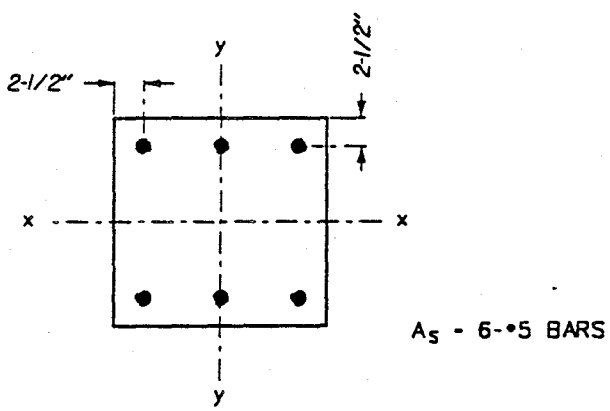
$P_u = 100$ kips, $P_n = P_u/0.7 = 142.9$ kips

$M_{ux} = 94$ ft-kips, $M_{nx} = M_{ux}/0.7 = 134.3$ ft-kips

$M_{uy} = 30$ ft-kips, $M_{ny} = M_{uy}/0.7 = 42.8$ ft-kips

Let concrete cover plus one-half a bar diameter equal 2.5 in.

F-2. Using uniaxial design procedures (Appendix E), select reinforcement for P_n and bending about the x-axis since $M_{nx} > M_{ny}$. The resulting cross-section is given below.



F-3. Figures F-1 and F-2 present the nominal strength interaction diagrams about x- and y-axes. It is seen from Figure F-2 that the member is adequate for uniaxial bending about the y-axis with $P_n = 142.9$ kips and $M_{ny} = 42.8$ ft-kips. From Figures F-1 and F-2 at $P_n = 142.9$ kips:

$$M_{ox} = 146.1 \text{ ft-kips}$$

$$M_{oy} = 145.9 \text{ ft-kips}$$

For a square column, it is necessary to satisfy:

$$(M_{nx}/M_{ox})^{1.75} + (M_{ny}/M_{oy})^{1.75} \leq 1.0$$

$$(134.3/146.1)^{1.75} + (42.8/145.9)^{1.75}$$

$$= 0.98 < 1.0$$

If a value greater than 1.0 is obtained, increase reinforcement and/or increase member dimensions.

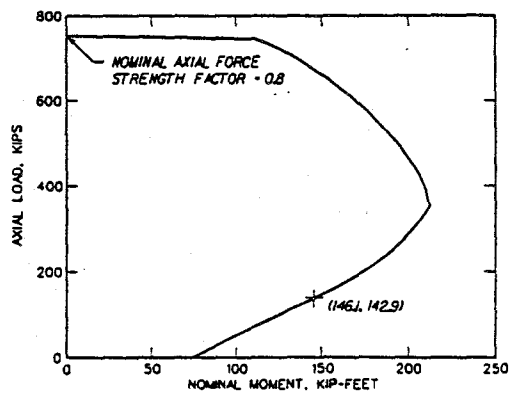


Figure F-1. Nominal strength about the x-axis

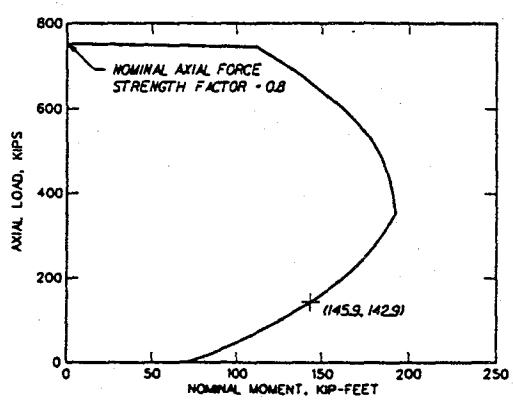
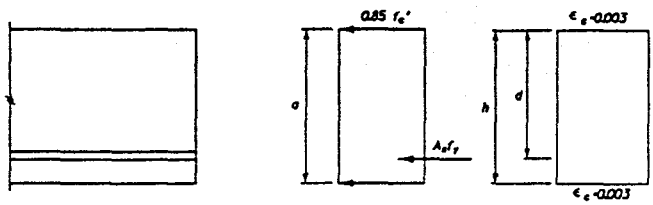


Figure F-2. Nominal strength about the y-axis

E-3. Determination of Point 2, Maximum Axial Capacity



$$\phi P_{n(max)} = \phi 0.80 P_o$$

$$\phi P_{n(max)} = \phi 0.80[0.85 f'_c(A_g - \rho bd) + f_y \rho bd]$$

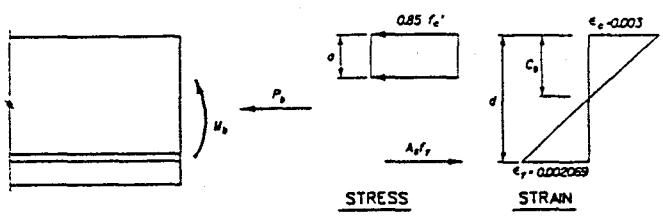
$$P_{n(max)} = 0.80[(0.85)(3.0)(288 - 2.0) + (60.0)(2.0)]$$

$$P_{n(max)} = 0.80(849.3) = 679.44 \text{ kips} \qquad (4\text{-}2)$$

E-4. Determination of Point 3, Balanced Point

(1) Find $k_b = \dfrac{\beta_1 E_s \varepsilon_c}{E_s \varepsilon_c + f_y}$

$$k_b = \frac{(0.85)(29{,}000)(0.003)}{(29{,}000)(0.003) + 60} = 0.5031 \qquad (4\text{-}4)$$



(2) Find $\dfrac{e'_b}{d} = \dfrac{2k_u - k_u^2}{2k_u - \dfrac{\rho f_y}{0.425 f'_c}}$

$$\frac{e'_b}{d} = \frac{(2)(0.5031) - (0.5031)^2}{(2)(0.5031) - \dfrac{(0.00758)(60)}{(0.425)(3.0)}}$$

$$= 1.15951 \qquad (4\text{-}3)$$

(3) Find $\phi P_b = \phi[0.85 f'_c k_b - \rho f_y]bd$

$$P_b = [(0.85)(3.0)(0.5031) - (0.00758)(60.0)](12)(22.0)$$

$$P_b = 218.62 \text{ kips}$$

(4) Find $\phi M_b = \phi[0.85 f'_c k_b - \rho f_y] \cdot \left[\dfrac{e'}{d} - \left(1 - \dfrac{h}{2d}\right)\right] bd^2$

$$M_b = [(0.85)(3.0)(0.5031) - (0.00758)(60)] \cdot [1.15951 - (1 - 24.0/44.0)] \cdot (12)(22.0)^2$$

$$M_b = 3390.65 \text{ k-in.}$$

$$M_b = 282.55 \text{ k-ft} \qquad (4\text{-}6)$$

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*          S T A A D - III                       *
*          REVISION 12.1 (VERSION 12 LEVEL 1)    *
*          PROPRIETARY PROGRAM OF                *
*          RESEARCH ENGINEERS,INC.               *
*          DATE=  ,  JUL 22, 1994                *
*          TIME=    13:36:57                     *
*                                                *
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```
STAAD PLANE X-CUT CANAL 2-10X10 CBC
UNIT KIP FEET
JOINT COORDINATES
1 0. 11.3333 ; 2 10.9583 11.3333 ; 3 21.9167 11.3333
4 0. 0. 0. 14 21.9167 0. 0.
MEMBER INCIDENCE
1 1 2 ; 2 2 3 ; 3 1 4 ; 4 2 9 ; 5 3 14 ; 6 4 5 15 1
MEMBER PROPERTIES
1 2 PRISMATIC AX 1.3333 IZ 0.1975
3 5 PRISMATIC AX 1.0833 IZ 0.1059
4 PRISMATIC AX 0.8333 IZ 0.0482
6 TO 15 PRISMATIC AX 1.3333 IZ 0.1975
CONSTANTS
E 520000. ALL
DENSITY 0.15 ALL
SUPPORTS
5 TO 13 FIXED BUT FX MZ KFY 1894.0
4 14 FIXED BUT MZ KFY 1703.0 KFX 100
*============================================================
LOAD 1 DEAD LOAD
SELFWEIGHT Y -1.0
*============================================================
LOAD 2 DRY 15'FILL WT.
MEMBER LOAD
1 2 UNI Y -1.65
*============================================================
LOAD 3 DRY 15'LAT.SOIL
MEMBER LOAD
3 TRAP GX 0.94 1.62
5 TRAP GX -0.94 -1.62
*============================================================
LOAD 13 DRY LAT.SOIL TO TOP OF BOX ONLY
MEMBER LOAD
3 TRAP GX 0.04 0.72
5 TRAP GX -0.04 -0.72
*============================================================
LOAD 4 WET 15'FILL WT.
MEMBER LOAD
1 2 UNI Y -2.10
*============================================================
LOAD 5 WET 15'LAT.SOIL
MEMBER LOAD
3 TRAP GX 1.41 2.43
5 TRAP GX -1.41 -2.43
*============================================================
LOAD 15 WET LAT.SOIL TO TOP OF BOX ONLY
MEMBER LOAD
3 TRAP GX 0.06 1.08
```

```
5 TRAP GX -0.06 -1.08
*============================================================
LOAD 10 SYMM LL ON 15'FILL
MEMBER LOAD
1 2 UNI Y -0.15
*============================================================
LOAD 11 UNSYMM LL ON 15'FILL
MEMBER LOAD
1 UNI Y -0.15
*============================================================
LOAD 18 BOUYANT F - HGL 12' MAX ABOVE SOFFIT OF BOX @ BOX BOT
MEMBER LOAD
6 TO 15 UNI Y 1.456
*============================================================
LOAD 19 WATER INSIDE   HGL @ CROWN - FLOWING FULL CONDITION
MEMBER LOAD
6 TO 15 UNI Y -0.624
3 TRAP GX  0.000 -0.624
5 TRAP GX 0.000 0.624
*============================================================
LOAD 20 WATER INSIDE   HGL 12' MAX ABOVE SOFFIT OF BOX
MEMBER LOAD
1 2 UNI Y 0.749
6 TO 15 UNI Y -1.374
3 TRAP GX -0.749 -1.373
5 TRAP GX 0.749 1.373
*================================================================
*BEGIN LOAD COMBINATIONS FOR ANALYSIS
*================================================================
*
*LOAD COMB 100 THRU 118 FOR 1/2 LATERAL SOIL PRESSURE INVESTAGATION
*OF TOP AND BOTTOM SLABS - MEMBERS 1,2,AND 6 THRU 24
*
*================================================================
LOAD COMB 100 SELF DL
              1 1.0
*================================================================
*START DRY SOIL ANALYSIS WITH 1/2 LATERAL PRESSURES
*================================================================
LOAD COMB 101 SELF DL + HALF DRY LAT SOIL TO TOP OF BOX
              1 1.0     13 0.5
LOAD COMB 102 SELF DL + DRY 4'FILL + HALF LAT.SOIL
              1 1.0     2 1.0        3 0.5
LOAD COMB 103 SELF DL + DRY 4'FILL + HALF LAT.SOIL + SYMM.LL
              1 1.0     2 1.0        3 0.5           10 1.0
LOAD COMB 104 SELF DL + DRY 4'FILL + HALF LAT.SOIL + UNSYM.LL
              1 1.0     2 1.0        3 0.5           11 1.0
LOAD COMB 105 SELF DL + DRY 4'FILL + HALF LAT.SOIL + SYMM.LL +WATER
              1 1.0     2 1.0        3 0.5           10 1.0    19 1.0
LOAD COMB 106 SELF DL + DRY 4'FILL + HALF LAT.SOIL +UNSYM.LL +WATER
              1 1.0     2 1.0        3 0.5           11 1.0    19 1.0
LOAD COMB 107 SELF DL + DRY 4'FILL + HALF LAT.SOIL + SYMM.LL +WATER
              1 1.0     2 1.0        3 0.5           10 1.0    20 1.0
LOAD COMB 108 SELF DL + DRY 4'FILL + HALF LAT.SOIL +UNSYM.LL +WATER
              1 1.0     2 1.0        3 0.5           11 1.0    20 1.0
*================================================================
*START SATURATED SOIL ANALYSIS WITH 1/2 LATERAL PRESSURES
*================================================================
LOAD COMB 111 SELF DL + HALF WET LAT SOIL TO TOP OF BOX
              1 1.0     15 0.5
```

```
109.    LOAD COMB 112 SELF DL + WET 15'FILL + HALF LAT.SOIL
110.                1 1.0     4 1.0        5 0.5
111.    LOAD COMB 113 SELF DL + WET 15'FILL + HALF LAT.SOIL + SYMM.LL
112.                1 1.0     4 1.0        5 0.5     10 1.0
113.    LOAD COMB 114 SELF DL + WET 15'FILL + HALF LAT.SOIL + UNSYM.LL
114.                1 1.0     4 1.0        5 0.5      11 1.0
115.    LOAD COMB 115 SELF DL +WET 15'FILL +HALF LAT.SOIL +SYMM.LL +H2O_FUL
116.                1 1.0     4 1.0       5 0.5    10 1.0  19 1.0  18  0.49
117.    LOAD COMB 116 SELF DL +WET 15'FILL +HALF LAT.SOIL +UNSYM.LL+H2O_FUL
118.                1 1.0     4 1.0       5 0.5  11 1.0    19 1.0  18  0.49
119.    LOAD COMB 117 SELF DL +WET 15'FILL +HALF LAT.SOIL +SYMM.LL+ H2O_PRE
120.                1 1.0     4 1.0        5 0.5  10 1.0    20 1.0  18 1.00
121.    LOAD COMB 118 SELF DL +WET 15'FILL +HALF LAT.SOIL +UNSYM.LL+H2O_PRE
122.                1 1.0     4 1.0        5 0.5  11 1.0    20 1.0  18 1.0
123.    *================================================================
124.    *BEGIN FULL LATERAL SOIL ANALYSIS FOR ALL -M AREAS & +M  WALL AREAS.
125.    *================================================================
126.    *
127.    *START DRY SOIL ANALYSIS
128.    *================================================================
129.    LOAD COMB 121 SELF DL + FULL DRY LAT SOIL TO TOP OF BOX
130.                1 1.0     13 1.0
131.    LOAD COMB 122 SELF DL + DRY 4'FILL + FULL LAT.SOIL
132.                1 1.0     2 1.0        3 1.0
133.    LOAD COMB 123 SELF DL + DRY 4'FILL + FULL LAT.SOIL + SYMM.LL
134.                1 1.0     2 1.0        3 1.0           10 1.0
135.    LOAD COMB 124 SELF DL + DRY 4'FILL + FULL LAT.SOIL + UNSYM.LL
136.                1 1.0     2 1.0        3 1.0           11 1.0
137.    LOAD COMB 125 SELF DL +DRY 4'FILL +FULL LAT.SOIL +SYMM.LL +H2O_FUL
138.                1 1.0     2 1.0        3 1.0           10 1.0    19 1.0
139.    LOAD COMB 126 SELF DL +DRY 4'FILL +FULL LAT.SOIL +UNSYM.LL +H2O_FUL
140.                1 1.0     2 1.0        3 1.0           11 1.0    19 1.0
141.    LOAD COMB 127 SELF DL +DRY 4'FILL +FULL LAT.SOIL +SYMM.LL +H2O_PRE
142.                1 1.0     2 1.0        3 1.0           10 1.0    20 1.0
143.    LOAD COMB 128 SELF DL +DRY 4'FILL +FULL LAT.SOIL +UNSYM.LL +H2O_PRE
144.                1 1.0     2 1.0        3 1.0           11 1.0    20 1.0
145.    *================================================================
146.    *START SATURATED SOIL ANALYSIS
147.    *================================================================
148.    LOAD COMB 131 SELF DL + FULL WET LAT SOIL TO TOP OF BOX
149.                1 1.0     15 1.0
150.    LOAD COMB 132 SELF DL + WET 15'FILL + FULL LAT.SOIL
151.                1 1.0     4 1.0        5 1.0
152.    LOAD COMB 133 SELF DL + WET 15'FILL + FULL LAT.SOIL + SYMM.LL
153.                1 1.0     4 1.0        5 1.0   10 1.0
154.    LOAD COMB 134 SELF DL + WET 15'FILL + FULL LAT.SOIL + UNSYM.LL
155.                1 1.0     4 1.0        5 0.5  11 1.0
156.    LOAD COMB 135 SELF DL +WET 4'FILL +FULL LAT.SOIL + SYMM.LL +H2O_FUL
157.                1 1.0     4 1.0        5 1.0  10 1.0    19 1.0  18 0.49
158.    LOAD COMB 136 SELF DL +WET 15'FILL +FULL LAT.SOIL +UNSYM.LL+H2O_FUL
159.                1 1.0     4 1.0        5 1.0  11 1.0    19 1.0  18 0.49
160.    LOAD COMB 137 SELF DL +WET 15'FILL +FULL LAT.SOIL + SYMM.LL+H2O_PRE
161.                1 1.0     4 1.0        5 1.0  10 1.0    20 1.0  18 1.0
162.    LOAD COMB 138 SELF DL +WET 15'FILL +FULL LAT.SOIL +UNSYM.LL+H2O_PRE
163.                1 1.0     4 1.0        5 1.0  11 1.0    20 1.0  18 1.0
164.    *================================================================
165.    PERFORM ANALYSIS
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS = 14/ 15/ 11
ORGINAL/FINAL BAND-WIDTH = 11/ 2
TOTAL PRIMARY LOAD CASES = 12, TOTAL DEGREES OF FREEDOM = 42
SIZE OF STIFFNESS MATRIX = 378 DOUBLE PREC. WORDS
TOTAL REQUIRED DISK SPACE = 0.04 MEGA-BYTES

++ PROCESSING ELEMENT STIFFNESS MATRIX. 13:36:59
++ PROCESSING GLOBAL STIFFNESS MATRIX. 13:36:59
++ PROCESSING TRIANGULAR FACTORIZATION. 13:36:59
++ CALCULATING JOINT DISPLACEMENTS. 13:37: 0
++ CALCULATING ELEMENT FORCES. 13:37: 0

166. PRINT ANALYSIS RESULTS LIST

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	-0.00002	-0.01111	0.00000	0.00000	0.00000	-0.00004
	2	0.00007	-0.02688	0.00000	0.00000	0.00000	-0.00040
	3	0.00124	0.00306	0.00000	0.00000	0.00000	0.00028
	13	0.00027	0.00128	0.00000	0.00000	0.00000	0.00007
	4	0.00008	-0.03422	0.00000	0.00000	0.00000	-0.00051
	5	0.00185	0.00459	0.00000	0.00000	0.00000	0.00042
	15	0.00041	0.00192	0.00000	0.00000	0.00000	0.00011
	10	0.00001	-0.00244	0.00000	0.00000	0.00000	-0.00004
	11	-0.00115	-0.00296	0.00000	0.00000	0.00000	-0.00003
	18	-0.00003	0.01636	0.00000	0.00000	0.00000	0.00002
	19	-0.00020	-0.00811	0.00000	0.00000	0.00000	-0.00007
	20	-0.00101	-0.00582	0.00000	0.00000	0.00000	-0.00007
	100	-0.00002	-0.01111	0.00000	0.00000	0.00000	-0.00004
	101	0.00012	-0.01047	0.00000	0.00000	0.00000	0.00000
	102	0.00066	-0.03646	0.00000	0.00000	0.00000	-0.00029
	103	0.00067	-0.03891	0.00000	0.00000	0.00000	-0.00033
	104	-0.00049	-0.03942	0.00000	0.00000	0.00000	-0.00033
	105	0.00047	-0.04702	0.00000	0.00000	0.00000	-0.00040
	106	-0.00069	-0.04754	0.00000	0.00000	0.00000	-0.00039
	107	-0.00034	-0.04473	0.00000	0.00000	0.00000	-0.00040
	108	-0.00150	-0.04524	0.00000	0.00000	0.00000	-0.00039
	111	0.00018	-0.01015	0.00000	0.00000	0.00000	0.00002
	112	0.00099	-0.04303	0.00000	0.00000	0.00000	-0.00033
	113	0.00099	-0.04547	0.00000	0.00000	0.00000	-0.00037
	114	-0.00017	-0.04599	0.00000	0.00000	0.00000	-0.00037
	115	0.00078	-0.04557	0.00000	0.00000	0.00000	-0.00043
	116	-0.00038	-0.04608	0.00000	0.00000	0.00000	-0.00042
	117	-0.00005	-0.03493	0.00000	0.00000	0.00000	-0.00042
	118	-0.00121	-0.03545	0.00000	0.00000	0.00000	-0.00041
	121	0.00025	-0.00983	0.00000	0.00000	0.00000	0.00004
	122	0.00128	-0.03493	0.00000	0.00000	0.00000	-0.00016
	123	0.00129	-0.03738	0.00000	0.00000	0.00000	-0.00019
	124	0.00012	-0.03789	0.00000	0.00000	0.00000	-0.00019
	125	0.00109	-0.04549	0.00000	0.00000	0.00000	-0.00026
	126	-0.00007	-0.04601	0.00000	0.00000	0.00000	-0.00025
	127	0.00028	-0.04320	0.00000	0.00000	0.00000	-0.00026
	128	-0.00088	-0.04371	0.00000	0.00000	0.00000	-0.00025
	131	0.00039	-0.00919	0.00000	0.00000	0.00000	0.00007
	132	0.00191	-0.04073	0.00000	0.00000	0.00000	-0.00012
	133	0.00192	-0.04318	0.00000	0.00000	0.00000	-0.00016
	134	-0.00017	-0.04599	0.00000	0.00000	0.00000	-0.00037
	135	0.00171	-0.04327	0.00000	0.00000	0.00000	-0.00022
	136	0.00055	-0.04379	0.00000	0.00000	0.00000	-0.00021
	137	0.00088	-0.03264	0.00000	0.00000	0.00000	-0.00021
	138	-0.00028	-0.03315	0.00000	0.00000	0.00000	-0.00021
2	1	0.00000	-0.00948	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.03510	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00283	0.00000	0.00000	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	13	0.00000	0.00069	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.04467	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00424	0.00000	0.00000	0.00000	0.00000
	15	0.00000	0.00104	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.00319	0.00000	0.00000	0.00000	0.00000
	11	-0.00116	-0.00160	0.00000	0.00000	0.00000	0.00004
	18	0.00000	0.01994	0.00000	0.00000	0.00000	0.00000
	19	0.00000	-0.00910	0.00000	0.00000	0.00000	0.00000
	20	0.00000	-0.00521	0.00000	0.00000	0.00000	0.00000
	100	0.00000	-0.00948	0.00000	0.00000	0.00000	0.00000
	101	0.00000	-0.00914	0.00000	0.00000	0.00000	0.00000
	102	0.00000	-0.04317	0.00000	0.00000	0.00000	0.00000
	103	0.00000	-0.04636	0.00000	0.00000	0.00000	0.00000
	104	-0.00116	-0.04477	0.00000	0.00000	0.00000	0.00004
	105	0.00000	-0.05546	0.00000	0.00000	0.00000	0.00000
	106	-0.00116	-0.05386	0.00000	0.00000	0.00000	0.00004
	107	0.00000	-0.05157	0.00000	0.00000	0.00000	0.00000
	108	-0.00116	-0.04998	0.00000	0.00000	0.00000	0.00004
	111	0.00000	-0.00897	0.00000	0.00000	0.00000	0.00000
	112	0.00000	-0.05204	0.00000	0.00000	0.00000	0.00000
	113	0.00000	-0.05523	0.00000	0.00000	0.00000	0.00000
	114	-0.00116	-0.05363	0.00000	0.00000	0.00000	0.00004
	115	0.00000	-0.05455	0.00000	0.00000	0.00000	0.00000
	116	-0.00116	-0.05296	0.00000	0.00000	0.00000	0.00004
	117	0.00000	-0.04050	0.00000	0.00000	0.00000	0.00000
	118	-0.00116	-0.03890	0.00000	0.00000	0.00000	0.00004
	121	0.00000	-0.00879	0.00000	0.00000	0.00000	0.00000
	122	0.00000	-0.04176	0.00000	0.00000	0.00000	0.00000
	123	0.00000	-0.04495	0.00000	0.00000	0.00000	0.00000
	124	-0.00116	-0.04335	0.00000	0.00000	0.00000	0.00004
	125	0.00000	-0.05404	0.00000	0.00000	0.00000	0.00000
	126	-0.00116	-0.05245	0.00000	0.00000	0.00000	0.00004
	127	0.00000	-0.05016	0.00000	0.00000	0.00000	0.00000
	128	-0.00116	-0.04857	0.00000	0.00000	0.00000	0.00004
	131	0.00000	-0.00845	0.00000	0.00000	0.00000	0.00000
	132	0.00000	-0.04992	0.00000	0.00000	0.00000	0.00000
	133	0.00000	-0.05311	0.00000	0.00000	0.00000	0.00000
	134	-0.00116	-0.05363	0.00000	0.00000	0.00000	0.00004
	135	0.00000	-0.05243	0.00000	0.00000	0.00000	0.00000
	136	-0.00116	-0.05083	0.00000	0.00000	0.00000	0.00004
	137	0.00000	-0.03838	0.00000	0.00000	0.00000	0.00000
	138	-0.00116	-0.03678	0.00000	0.00000	0.00000	0.00004
3	1	0.00002	-0.01111	0.00000	0.00000	0.00000	0.00004
	2	-0.00007	-0.02688	0.00000	0.00000	0.00000	0.00040
	3	-0.00124	0.00306	0.00000	0.00000	0.00000	-0.00028
	13	-0.00027	0.00128	0.00000	0.00000	0.00000	-0.00007
	4	-0.00008	-0.03422	0.00000	0.00000	0.00000	0.00051
	5	-0.00185	0.00459	0.00000	0.00000	0.00000	-0.00042

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	15	-0.00041	0.00192	0.00000	0.00000	0.00000	-0.00011
	10	-0.00001	-0.00244	0.00000	0.00000	0.00000	0.00004
	11	-0.00116	0.00052	0.00000	0.00000	0.00000	0.00000
	18	0.00003	0.01636	0.00000	0.00000	0.00000	-0.00002
	19	0.00020	-0.00811	0.00000	0.00000	0.00000	0.00007
	20	0.00101	-0.00582	0.00000	0.00000	0.00000	0.00007
	100	0.00002	-0.01111	0.00000	0.00000	0.00000	0.00004
	101	-0.00012	-0.01047	0.00000	0.00000	0.00000	0.00000
	102	-0.00066	-0.03646	0.00000	0.00000	0.00000	0.00029
	103	-0.00067	-0.03891	0.00000	0.00000	0.00000	0.00033
	104	-0.00182	-0.03594	0.00000	0.00000	0.00000	0.00030
	105	-0.00047	-0.04702	0.00000	0.00000	0.00000	0.00040
	106	-0.00163	-0.04406	0.00000	0.00000	0.00000	0.00036
	107	0.00034	-0.04473	0.00000	0.00000	0.00000	0.00040
	108	-0.00081	-0.04177	0.00000	0.00000	0.00000	0.00036
	111	-0.00018	-0.01015	0.00000	0.00000	0.00000	-0.00002
	112	-0.00099	-0.04303	0.00000	0.00000	0.00000	0.00033
	113	-0.00099	-0.04547	0.00000	0.00000	0.00000	0.00037
	114	-0.00215	-0.04251	0.00000	0.00000	0.00000	0.00034
	115	-0.00078	-0.04557	0.00000	0.00000	0.00000	0.00043
	116	-0.00194	-0.04261	0.00000	0.00000	0.00000	0.00039
	117	0.00005	-0.03493	0.00000	0.00000	0.00000	0.00042
	118	-0.00111	-0.03197	0.00000	0.00000	0.00000	0.00038
	121	-0.00025	-0.00983	0.00000	0.00000	0.00000	-0.00004
	122	-0.00128	-0.03493	0.00000	0.00000	0.00000	0.00016
	123	-0.00128	-0.03738	0.00000	0.00000	0.00000	0.00019
	124	-0.00244	-0.03441	0.00000	0.00000	0.00000	0.00016
	125	-0.00109	-0.04549	0.00000	0.00000	0.00000	0.00026
	126	-0.00224	-0.04253	0.00000	0.00000	0.00000	0.00023
	127	-0.00028	-0.04320	0.00000	0.00000	0.00000	0.00026
	128	-0.00143	-0.04024	0.00000	0.00000	0.00000	0.00023
	131	-0.00039	-0.00919	0.00000	0.00000	0.00000	-0.00007
	132	-0.00191	-0.04073	0.00000	0.00000	0.00000	0.00012
	133	-0.00192	-0.04318	0.00000	0.00000	0.00000	0.00016
	134	-0.00215	-0.04251	0.00000	0.00000	0.00000	0.00034
	135	-0.00171	-0.04327	0.00000	0.00000	0.00000	0.00022
	136	-0.00286	-0.04031	0.00000	0.00000	0.00000	0.00019
	137	-0.00088	-0.03264	0.00000	0.00000	0.00000	0.00021
	138	-0.00203	-0.02967	0.00000	0.00000	0.00000	0.00018
4	1	0.00002	-0.01070	0.00000	0.00000	0.00000	0.00008
	2	-0.00007	-0.02504	0.00000	0.00000	0.00000	0.00026
	3	0.00151	0.00341	0.00000	0.00000	0.00000	-0.00030
	13	0.00054	0.00138	0.00000	0.00000	0.00000	-0.00010
	4	-0.00008	-0.03187	0.00000	0.00000	0.00000	0.00033
	5	0.00227	0.00511	0.00000	0.00000	0.00000	-0.00045
	15	0.00082	0.00207	0.00000	0.00000	0.00000	-0.00016
	10	-0.00001	-0.00228	0.00000	0.00000	0.00000	0.00002
	11	0.00000	-0.00277	0.00000	0.00000	0.00000	0.00004

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	18	0.00003	0.01632	0.00000	0.00000	0.00000	0.00005
	19	-0.00047	-0.00818	0.00000	0.00000	0.00000	0.00006
	20	-0.00127	-0.00691	0.00000	0.00000	0.00000	0.00008
	100	0.00002	-0.01070	0.00000	0.00000	0.00000	0.00008
	101	0.00029	-0.01001	0.00000	0.00000	0.00000	0.00003
	102	0.00071	-0.03403	0.00000	0.00000	0.00000	0.00019
	103	0.00071	-0.03631	0.00000	0.00000	0.00000	0.00022
	104	0.00071	-0.03680	0.00000	0.00000	0.00000	0.00023
	105	0.00023	-0.04448	0.00000	0.00000	0.00000	0.00028
	106	0.00024	-0.04498	0.00000	0.00000	0.00000	0.00029
	107	-0.00056	-0.04321	0.00000	0.00000	0.00000	0.00030
	108	-0.00056	-0.04371	0.00000	0.00000	0.00000	0.00031
	111	0.00043	-0.00966	0.00000	0.00000	0.00000	0.00000
	112	0.00107	-0.04001	0.00000	0.00000	0.00000	0.00019
	113	0.00107	-0.04228	0.00000	0.00000	0.00000	0.00021
	114	0.00107	-0.04278	0.00000	0.00000	0.00000	0.00023
	115	0.00061	-0.04246	0.00000	0.00000	0.00000	0.00030
	116	0.00061	-0.04296	0.00000	0.00000	0.00000	0.00032
	117	-0.00017	-0.03287	0.00000	0.00000	0.00000	0.00035
	118	-0.00016	-0.03337	0.00000	0.00000	0.00000	0.00036
	121	0.00056	-0.00932	0.00000	0.00000	0.00000	-0.00002
	122	0.00147	-0.03233	0.00000	0.00000	0.00000	0.00004
	123	0.00146	-0.03460	0.00000	0.00000	0.00000	0.00007
	124	0.00147	-0.03510	0.00000	0.00000	0.00000	0.00008
	125	0.00099	-0.04278	0.00000	0.00000	0.00000	0.00013
	126	0.00099	-0.04328	0.00000	0.00000	0.00000	0.00014
	127	0.00019	-0.04151	0.00000	0.00000	0.00000	0.00015
	128	0.00020	-0.04201	0.00000	0.00000	0.00000	0.00016
	131	0.00084	-0.00863	0.00000	0.00000	0.00000	-0.00008
	132	0.00221	-0.03745	0.00000	0.00000	0.00000	-0.00004
	133	0.00220	-0.03973	0.00000	0.00000	0.00000	-0.00001
	134	0.00107	-0.04278	0.00000	0.00000	0.00000	0.00023
	135	0.00175	-0.03991	0.00000	0.00000	0.00000	0.00008
	136	0.00175	-0.04041	0.00000	0.00000	0.00000	0.00009
	137	0.00097	-0.03031	0.00000	0.00000	0.00000	0.00012
	138	0.00097	-0.03081	0.00000	0.00000	0.00000	0.00014
5	1	0.00002	-0.00850	0.00000	0.00000	0.00000	0.00008
	2	-0.00005	-0.01865	0.00000	0.00000	0.00000	0.00019
	3	0.00121	-0.00159	0.00000	0.00000	0.00000	-0.00010
	13	0.00043	-0.00040	0.00000	0.00000	0.00000	-0.00004
	4	-0.00007	-0.02374	0.00000	0.00000	0.00000	0.00024
	5	0.00182	-0.00239	0.00000	0.00000	0.00000	-0.00014
	15	0.00065	-0.00060	0.00000	0.00000	0.00000	-0.00005
	10	0.00000	-0.00170	0.00000	0.00000	0.00000	0.00002
	11	0.00000	-0.00183	0.00000	0.00000	0.00000	0.00003
	18	0.00003	0.01776	0.00000	0.00000	0.00000	0.00005
	19	-0.00038	-0.00729	0.00000	0.00000	0.00000	0.00001
	20	-0.00102	-0.00698	0.00000	0.00000	0.00000	-0.00006

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	100	0.00002	-0.00850	0.00000	0.00000	0.00000	0.00008
	101	0.00023	-0.00870	0.00000	0.00000	0.00000	0.00006
	102	0.00057	-0.02795	0.00000	0.00000	0.00000	0.00022
	103	0.00057	-0.02965	0.00000	0.00000	0.00000	0.00024
	104	0.00057	-0.02978	0.00000	0.00000	0.00000	0.00025
	105	0.00019	-0.03694	0.00000	0.00000	0.00000	0.00025
	106	0.00019	-0.03707	0.00000	0.00000	0.00000	0.00026
	107	-0.00045	-0.03662	0.00000	0.00000	0.00000	0.00018
	108	-0.00045	-0.03676	0.00000	0.00000	0.00000	0.00020
	111	0.00034	-0.00880	0.00000	0.00000	0.00000	0.00005
	112	0.00086	-0.03344	0.00000	0.00000	0.00000	0.00025
	113	0.00085	-0.03513	0.00000	0.00000	0.00000	0.00027
	114	0.00086	-0.03526	0.00000	0.00000	0.00000	0.00028
	115	0.00049	-0.03372	0.00000	0.00000	0.00000	0.00030
	116	0.00049	-0.03385	0.00000	0.00000	0.00000	0.00032
	117	-0.00013	-0.02435	0.00000	0.00000	0.00000	0.00026
	118	-0.00013	-0.02449	0.00000	0.00000	0.00000	0.00028
	121	0.00045	-0.00890	0.00000	0.00000	0.00000	0.00004
	122	0.00118	-0.02875	0.00000	0.00000	0.00000	0.00017
	123	0.00117	-0.03044	0.00000	0.00000	0.00000	0.00019
	124	0.00117	-0.03058	0.00000	0.00000	0.00000	0.00020
	125	0.00079	-0.03774	0.00000	0.00000	0.00000	0.00020
	126	0.00080	-0.03787	0.00000	0.00000	0.00000	0.00021
	127	0.00016	-0.03742	0.00000	0.00000	0.00000	0.00013
	128	0.00016	-0.03755	0.00000	0.00000	0.00000	0.00015
	131	0.00067	-0.00910	0.00000	0.00000	0.00000	0.00002
	132	0.00177	-0.03463	0.00000	0.00000	0.00000	0.00018
	133	0.00176	-0.03633	0.00000	0.00000	0.00000	0.00019
	134	0.00086	-0.03526	0.00000	0.00000	0.00000	0.00028
	135	0.00140	-0.03492	0.00000	0.00000	0.00000	0.00023
	136	0.00140	-0.03505	0.00000	0.00000	0.00000	0.00024
	137	0.00077	-0.02555	0.00000	0.00000	0.00000	0.00019
	138	0.00078	-0.02568	0.00000	0.00000	0.00000	0.00021
6	1	0.00001	-0.00704	0.00000	0.00000	0.00000	0.00003
	2	-0.00004	-0.01599	0.00000	0.00000	0.00000	0.00000
	3	0.00091	-0.00238	0.00000	0.00000	0.00000	0.00002
	13	0.00033	-0.00078	0.00000	0.00000	0.00000	0.00000
	4	-0.00005	-0.02035	0.00000	0.00000	0.00000	0.00000
	5	0.00136	-0.00357	0.00000	0.00000	0.00000	0.00003
	15	0.00049	-0.00117	0.00000	0.00000	0.00000	0.00001
	10	0.00000	-0.00145	0.00000	0.00000	0.00000	0.00000
	11	0.00000	-0.00119	0.00000	0.00000	0.00000	0.00002
	18	0.00002	0.01895	0.00000	0.00000	0.00000	0.00004
	19	-0.00028	-0.00747	0.00000	0.00000	0.00000	-0.00002
	20	-0.00076	-0.00864	0.00000	0.00000	0.00000	-0.00005
	100	0.00001	-0.00704	0.00000	0.00000	0.00000	0.00003
	101	0.00018	-0.00743	0.00000	0.00000	0.00000	0.00003
	102	0.00043	-0.02422	0.00000	0.00000	0.00000	0.00004

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	103	0.00042	-0.02568	0.00000	0.00000	0.00000	0.00004
	104	0.00043	-0.02542	0.00000	0.00000	0.00000	0.00006
	105	0.00014	-0.03315	0.00000	0.00000	0.00000	0.00003
	106	0.00014	-0.03289	0.00000	0.00000	0.00000	0.00004
	107	-0.00034	-0.03432	0.00000	0.00000	0.00000	-0.00001
	108	-0.00033	-0.03406	0.00000	0.00000	0.00000	0.00001
	111	0.00026	-0.00763	0.00000	0.00000	0.00000	0.00003
	112	0.00064	-0.02918	0.00000	0.00000	0.00000	0.00005
	113	0.00064	-0.03063	0.00000	0.00000	0.00000	0.00005
	114	0.00064	-0.03037	0.00000	0.00000	0.00000	0.00007
	115	0.00037	-0.02882	0.00000	0.00000	0.00000	0.00005
	116	0.00037	-0.02856	0.00000	0.00000	0.00000	0.00007
	117	-0.00010	-0.02033	0.00000	0.00000	0.00000	0.00003
	118	-0.00010	-0.02006	0.00000	0.00000	0.00000	0.00005
	121	0.00034	-0.00782	0.00000	0.00000	0.00000	0.00004
	122	0.00088	-0.02541	0.00000	0.00000	0.00000	0.00006
	123	0.00088	-0.02687	0.00000	0.00000	0.00000	0.00006
	124	0.00088	-0.02661	0.00000	0.00000	0.00000	0.00007
	125	0.00059	-0.03434	0.00000	0.00000	0.00000	0.00004
	126	0.00060	-0.03408	0.00000	0.00000	0.00000	0.00005
	127	0.00012	-0.03551	0.00000	0.00000	0.00000	0.00000
	128	0.00012	-0.03525	0.00000	0.00000	0.00000	0.00002
	131	0.00050	-0.00821	0.00000	0.00000	0.00000	0.00004
	132	0.00133	-0.03096	0.00000	0.00000	0.00000	0.00007
	133	0.00132	-0.03242	0.00000	0.00000	0.00000	0.00007
	134	0.00064	-0.03037	0.00000	0.00000	0.00000	0.00007
	135	0.00105	-0.03061	0.00000	0.00000	0.00000	0.00007
	136	0.00105	-0.03035	0.00000	0.00000	0.00000	0.00008
	137	0.00058	-0.02211	0.00000	0.00000	0.00000	0.00005
	138	0.00058	-0.02185	0.00000	0.00000	0.00000	0.00007
7	1	0.00001	-0.00688	0.00000	0.00000	0.00000	-0.00002
	2	-0.00003	-0.01856	0.00000	0.00000	0.00000	-0.00019
	3	0.00061	-0.00099	0.00000	0.00000	0.00000	0.00007
	13	0.00022	-0.00042	0.00000	0.00000	0.00000	0.00002
	4	-0.00003	-0.02362	0.00000	0.00000	0.00000	-0.00024
	5	0.00091	-0.00148	0.00000	0.00000	0.00000	0.00011
	15	0.00033	-0.00063	0.00000	0.00000	0.00000	0.00003
	10	0.00000	-0.00169	0.00000	0.00000	0.00000	-0.00002
	11	0.00000	-0.00100	0.00000	0.00000	0.00000	0.00000
	18	0.00001	0.01968	0.00000	0.00000	0.00000	0.00002
	19	-0.00019	-0.00808	0.00000	0.00000	0.00000	-0.00002
	20	-0.00051	-0.00932	0.00000	0.00000	0.00000	0.00001
	100	0.00001	-0.00688	0.00000	0.00000	0.00000	-0.00002
	101	0.00012	-0.00708	0.00000	0.00000	0.00000	-0.00001
	102	0.00029	-0.02593	0.00000	0.00000	0.00000	-0.00017
	103	0.00028	-0.02761	0.00000	0.00000	0.00000	-0.00018
	104	0.00029	-0.02693	0.00000	0.00000	0.00000	-0.00017
	105	0.00009	-0.03569	0.00000	0.00000	0.00000	-0.00021

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	106	0.00010	-0.03501	0.00000	0.00000	0.00000	-0.00019
	107	-0.00022	-0.03693	0.00000	0.00000	0.00000	-0.00018
	108	-0.00022	-0.03625	0.00000	0.00000	0.00000	-0.00016
	111	0.00017	-0.00719	0.00000	0.00000	0.00000	0.00000
	112	0.00043	-0.03123	0.00000	0.00000	0.00000	-0.00020
	113	0.00043	-0.03292	0.00000	0.00000	0.00000	-0.00022
	114	0.00043	-0.03224	0.00000	0.00000	0.00000	-0.00020
	115	0.00024	-0.03135	0.00000	0.00000	0.00000	-0.00023
	116	0.00025	-0.03067	0.00000	0.00000	0.00000	-0.00021
	117	-0.00007	-0.02255	0.00000	0.00000	0.00000	-0.00019
	118	-0.00006	-0.02187	0.00000	0.00000	0.00000	-0.00017
	121	0.00023	-0.00729	0.00000	0.00000	0.00000	0.00000
	122	0.00059	-0.02642	0.00000	0.00000	0.00000	-0.00013
	123	0.00059	-0.02811	0.00000	0.00000	0.00000	-0.00015
	124	0.00059	-0.02742	0.00000	0.00000	0.00000	-0.00013
	125	0.00040	-0.03618	0.00000	0.00000	0.00000	-0.00017
	126	0.00040	-0.03550	0.00000	0.00000	0.00000	-0.00016
	127	0.00008	-0.03742	0.00000	0.00000	0.00000	-0.00014
	128	0.00008	-0.03674	0.00000	0.00000	0.00000	-0.00012
	131	0.00033	-0.00750	0.00000	0.00000	0.00000	0.00001
	132	0.00088	-0.03198	0.00000	0.00000	0.00000	-0.00014
	133	0.00088	-0.03366	0.00000	0.00000	0.00000	-0.00016
	134	0.00043	-0.03224	0.00000	0.00000	0.00000	-0.00020
	135	0.00070	-0.03209	0.00000	0.00000	0.00000	-0.00018
	136	0.00070	-0.03141	0.00000	0.00000	0.00000	-0.00016
	137	0.00039	-0.02330	0.00000	0.00000	0.00000	-0.00014
	138	0.00039	-0.02261	0.00000	0.00000	0.00000	-0.00012
8	1	0.00000	-0.00770	0.00000	0.00000	0.00000	-0.00004
	2	-0.00001	-0.02457	0.00000	0.00000	0.00000	-0.00024
	3	0.00030	0.00094	0.00000	0.00000	0.00000	0.00006
	13	0.00011	0.00014	0.00000	0.00000	0.00000	0.00002
	4	-0.00002	-0.03127	0.00000	0.00000	0.00000	-0.00030
	5	0.00045	0.00140	0.00000	0.00000	0.00000	0.00010
	15	0.00016	0.00021	0.00000	0.00000	0.00000	0.00003
	10	0.00000	-0.00223	0.00000	0.00000	0.00000	-0.00002
	11	0.00000	-0.00115	0.00000	0.00000	0.00000	-0.00001
	18	0.00001	0.02000	0.00000	0.00000	0.00000	0.00001
	19	-0.00009	-0.00867	0.00000	0.00000	0.00000	-0.00002
	20	-0.00025	-0.00848	0.00000	0.00000	0.00000	0.00005
	100	0.00000	-0.00770	0.00000	0.00000	0.00000	-0.00004
	101	0.00006	-0.00763	0.00000	0.00000	0.00000	-0.00003
	102	0.00014	-0.03180	0.00000	0.00000	0.00000	-0.00024
	103	0.00014	-0.03404	0.00000	0.00000	0.00000	-0.00027
	104	0.00014	-0.03295	0.00000	0.00000	0.00000	-0.00025
	105	0.00005	-0.04270	0.00000	0.00000	0.00000	-0.00028
	106	0.00005	-0.04162	0.00000	0.00000	0.00000	-0.00027
	107	-0.00011	-0.04251	0.00000	0.00000	0.00000	-0.00022
	108	-0.00011	-0.04143	0.00000	0.00000	0.00000	-0.00020

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	111	0.00009	-0.00759	0.00000	0.00000	0.00000	-0.00002
	112	0.00021	-0.03827	0.00000	0.00000	0.00000	-0.00029
	113	0.00021	-0.04050	0.00000	0.00000	0.00000	-0.00032
	114	0.00022	-0.03942	0.00000	0.00000	0.00000	-0.00030
	115	0.00012	-0.03937	0.00000	0.00000	0.00000	-0.00033
	116	0.00013	-0.03828	0.00000	0.00000	0.00000	-0.00032
	117	-0.00003	-0.02898	0.00000	0.00000	0.00000	-0.00026
	118	-0.00003	-0.02789	0.00000	0.00000	0.00000	-0.00025
	121	0.00011	-0.00756	0.00000	0.00000	0.00000	-0.00002
	122	0.00029	-0.03133	0.00000	0.00000	0.00000	-0.00021
	123	0.00029	-0.03357	0.00000	0.00000	0.00000	-0.00023
	124	0.00030	-0.03248	0.00000	0.00000	0.00000	-0.00022
	125	0.00020	-0.04224	0.00000	0.00000	0.00000	-0.00025
	126	0.00020	-0.04115	0.00000	0.00000	0.00000	-0.00024
	127	0.00004	-0.04205	0.00000	0.00000	0.00000	-0.00019
	128	0.00004	-0.04096	0.00000	0.00000	0.00000	-0.00017
	131	0.00017	-0.00749	0.00000	0.00000	0.00000	-0.00001
	132	0.00044	-0.03757	0.00000	0.00000	0.00000	-0.00025
	133	0.00044	-0.03980	0.00000	0.00000	0.00000	-0.00027
	134	0.00022	-0.03942	0.00000	0.00000	0.00000	-0.00030
	135	0.00035	-0.03867	0.00000	0.00000	0.00000	-0.00028
	136	0.00035	-0.03758	0.00000	0.00000	0.00000	-0.00027
	137	0.00019	-0.02828	0.00000	0.00000	0.00000	-0.00021
	138	0.00020	-0.02719	0.00000	0.00000	0.00000	-0.00020
9	1	0.00000	-0.00838	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.02855	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00192	0.00000	0.00000	0.00000	0.00000
	13	0.00000	0.00043	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.03634	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00288	0.00000	0.00000	0.00000	0.00000
	15	0.00000	0.00064	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.00260	0.00000	0.00000	0.00000	0.00000
	11	0.00000	-0.00130	0.00000	0.00000	0.00000	0.00000
	18	0.00000	0.02006	0.00000	0.00000	0.00000	0.00000
	19	0.00000	-0.00893	0.00000	0.00000	0.00000	0.00000
	20	0.00000	-0.00754	0.00000	0.00000	0.00000	0.00000
	100	0.00000	-0.00838	0.00000	0.00000	0.00000	0.00000
	101	0.00000	-0.00816	0.00000	0.00000	0.00000	0.00000
	102	0.00000	-0.03597	0.00000	0.00000	0.00000	0.00000
	103	0.00000	-0.03856	0.00000	0.00000	0.00000	0.00000
	104	0.00000	-0.03726	0.00000	0.00000	0.00000	0.00000
	105	0.00000	-0.04749	0.00000	0.00000	0.00000	0.00000
	106	0.00000	-0.04619	0.00000	0.00000	0.00000	0.00000
	107	0.00000	-0.04611	0.00000	0.00000	0.00000	0.00000
	108	0.00000	-0.04481	0.00000	0.00000	0.00000	0.00000
	111	0.00000	-0.00806	0.00000	0.00000	0.00000	0.00000
	112	0.00000	-0.04327	0.00000	0.00000	0.00000	0.00000
	113	0.00000	-0.04587	0.00000	0.00000	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	114	0.00000	-0.04457	0.00000	0.00000	0.00000	0.00000
	115	0.00000	-0.04497	0.00000	0.00000	0.00000	0.00000
	116	0.00000	-0.04367	0.00000	0.00000	0.00000	0.00000
	117	0.00000	-0.03335	0.00000	0.00000	0.00000	0.00000
	118	0.00000	-0.03206	0.00000	0.00000	0.00000	0.00000
	121	0.00000	-0.00795	0.00000	0.00000	0.00000	0.00000
	122	0.00000	-0.03501	0.00000	0.00000	0.00000	0.00000
	123	0.00000	-0.03760	0.00000	0.00000	0.00000	0.00000
	124	0.00000	-0.03630	0.00000	0.00000	0.00000	0.00000
	125	0.00000	-0.04653	0.00000	0.00000	0.00000	0.00000
	126	0.00000	-0.04523	0.00000	0.00000	0.00000	0.00000
	127	0.00000	-0.04515	0.00000	0.00000	0.00000	0.00000
	128	0.00000	-0.04385	0.00000	0.00000	0.00000	0.00000
	131	0.00000	-0.00773	0.00000	0.00000	0.00000	0.00000
	132	0.00000	-0.04183	0.00000	0.00000	0.00000	0.00000
	133	0.00000	-0.04443	0.00000	0.00000	0.00000	0.00000
	134	0.00000	-0.04457	0.00000	0.00000	0.00000	0.00000
	135	0.00000	-0.04353	0.00000	0.00000	0.00000	0.00000
	136	0.00000	-0.04223	0.00000	0.00000	0.00000	0.00000
	137	0.00000	-0.03191	0.00000	0.00000	0.00000	0.00000
	138	0.00000	-0.03061	0.00000	0.00000	0.00000	0.00000
10	1	0.00000	-0.00770	0.00000	0.00000	0.00000	0.00004
	2	0.00001	-0.02457	0.00000	0.00000	0.00000	0.00024
	3	-0.00030	0.00094	0.00000	0.00000	0.00000	-0.00006
	13	-0.00011	0.00014	0.00000	0.00000	0.00000	-0.00002
	4	0.00002	-0.03127	0.00000	0.00000	0.00000	0.00030
	5	-0.00045	0.00140	0.00000	0.00000	0.00000	-0.00010
	15	-0.00016	0.00021	0.00000	0.00000	0.00000	-0.00003
	10	0.00000	-0.00223	0.00000	0.00000	0.00000	0.00002
	11	0.00000	-0.00109	0.00000	0.00000	0.00000	0.00001
	18	-0.00001	0.02000	0.00000	0.00000	0.00000	-0.00001
	19	0.00009	-0.00867	0.00000	0.00000	0.00000	0.00002
	20	0.00025	-0.00848	0.00000	0.00000	0.00000	-0.00005
	100	0.00000	-0.00770	0.00000	0.00000	0.00000	0.00004
	101	-0.00006	-0.00763	0.00000	0.00000	0.00000	0.00003
	102	-0.00014	-0.03180	0.00000	0.00000	0.00000	0.00024
	103	-0.00014	-0.03404	0.00000	0.00000	0.00000	0.00027
	104	-0.00014	-0.03289	0.00000	0.00000	0.00000	0.00026
	105	-0.00005	-0.04270	0.00000	0.00000	0.00000	0.00028
	106	-0.00004	-0.04156	0.00000	0.00000	0.00000	0.00028
	107	0.00011	-0.04251	0.00000	0.00000	0.00000	0.00022
	108	0.00011	-0.04137	0.00000	0.00000	0.00000	0.00021
	111	-0.00009	-0.00759	0.00000	0.00000	0.00000	0.00002
	112	-0.00021	-0.03827	0.00000	0.00000	0.00000	0.00029
	113	-0.00021	-0.04050	0.00000	0.00000	0.00000	0.00032
	114	-0.00021	-0.03936	0.00000	0.00000	0.00000	0.00031
	115	-0.00012	-0.03937	0.00000	0.00000	0.00000	0.00033
	116	-0.00012	-0.03823	0.00000	0.00000	0.00000	0.00032

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	117	0.00003	-0.02898	0.00000	0.00000	0.00000	0.00026
	118	0.00004	-0.02784	0.00000	0.00000	0.00000	0.00025
	121	-0.00011	-0.00756	0.00000	0.00000	0.00000	0.00002
	122	-0.00029	-0.03133	0.00000	0.00000	0.00000	0.00021
	123	-0.00029	-0.03357	0.00000	0.00000	0.00000	0.00023
	124	-0.00029	-0.03242	0.00000	0.00000	0.00000	0.00023
	125	-0.00020	-0.04224	0.00000	0.00000	0.00000	0.00025
	126	-0.00020	-0.04109	0.00000	0.00000	0.00000	0.00024
	127	-0.00004	-0.04205	0.00000	0.00000	0.00000	0.00019
	128	-0.00004	-0.04090	0.00000	0.00000	0.00000	0.00018
	131	-0.00017	-0.00749	0.00000	0.00000	0.00000	0.00001
	132	-0.00044	-0.03757	0.00000	0.00000	0.00000	0.00025
	133	-0.00044	-0.03980	0.00000	0.00000	0.00000	0.00027
	134	-0.00021	-0.03936	0.00000	0.00000	0.00000	0.00031
	135	-0.00035	-0.03867	0.00000	0.00000	0.00000	0.00028
	136	-0.00035	-0.03752	0.00000	0.00000	0.00000	0.00027
	137	-0.00019	-0.02828	0.00000	0.00000	0.00000	0.00021
	138	-0.00019	-0.02713	0.00000	0.00000	0.00000	0.00020
11	1	-0.00001	-0.00688	0.00000	0.00000	0.00000	0.00002
	2	0.00003	-0.01856	0.00000	0.00000	0.00000	0.00019
	3	-0.00061	-0.00099	0.00000	0.00000	0.00000	-0.00007
	13	-0.00022	-0.00042	0.00000	0.00000	0.00000	-0.00002
	4	0.00003	-0.02362	0.00000	0.00000	0.00000	0.00024
	5	-0.00091	-0.00148	0.00000	0.00000	0.00000	-0.00011
	15	-0.00033	-0.00063	0.00000	0.00000	0.00000	-0.00003
	10	0.00000	-0.00169	0.00000	0.00000	0.00000	0.00002
	11	0.00000	-0.00068	0.00000	0.00000	0.00000	0.00002
	18	-0.00001	0.01968	0.00000	0.00000	0.00000	-0.00002
	19	0.00019	-0.00808	0.00000	0.00000	0.00000	0.00002
	20	0.00051	-0.00932	0.00000	0.00000	0.00000	-0.00001
	100	-0.00001	-0.00688	0.00000	0.00000	0.00000	0.00002
	101	-0.00012	-0.00708	0.00000	0.00000	0.00000	0.00001
	102	-0.00029	-0.02593	0.00000	0.00000	0.00000	0.00017
	103	-0.00028	-0.02761	0.00000	0.00000	0.00000	0.00018
	104	-0.00028	-0.02661	0.00000	0.00000	0.00000	0.00018
	105	-0.00009	-0.03569	0.00000	0.00000	0.00000	0.00021
	106	-0.00009	-0.03468	0.00000	0.00000	0.00000	0.00021
	107	0.00022	-0.03693	0.00000	0.00000	0.00000	0.00018
	108	0.00023	-0.03593	0.00000	0.00000	0.00000	0.00018
	111	-0.00017	-0.00719	0.00000	0.00000	0.00000	0.00000
	112	-0.00043	-0.03123	0.00000	0.00000	0.00000	0.00020
	113	-0.00043	-0.03292	0.00000	0.00000	0.00000	0.00022
	114	-0.00043	-0.03192	0.00000	0.00000	0.00000	0.00021
	115	-0.00024	-0.03135	0.00000	0.00000	0.00000	0.00023
	116	-0.00024	-0.03035	0.00000	0.00000	0.00000	0.00023
	117	0.00007	-0.02255	0.00000	0.00000	0.00000	0.00019
	118	0.00007	-0.02155	0.00000	0.00000	0.00000	0.00019
	121	-0.00023	-0.00729	0.00000	0.00000	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	122	-0.00059	-0.02642	0.00000	0.00000	0.00000	0.00013
	123	-0.00059	-0.02811	0.00000	0.00000	0.00000	0.00015
	124	-0.00058	-0.02710	0.00000	0.00000	0.00000	0.00015
	125	-0.00040	-0.03618	0.00000	0.00000	0.00000	0.00017
	126	-0.00040	-0.03518	0.00000	0.00000	0.00000	0.00017
	127	-0.00008	-0.03742	0.00000	0.00000	0.00000	0.00014
	128	-0.00008	-0.03642	0.00000	0.00000	0.00000	0.00014
	131	-0.00033	-0.00750	0.00000	0.00000	0.00000	-0.00001
	132	-0.00088	-0.03197	0.00000	0.00000	0.00000	0.00014
	133	-0.00088	-0.03366	0.00000	0.00000	0.00000	0.00016
	134	-0.00043	-0.03192	0.00000	0.00000	0.00000	0.00021
	135	-0.00070	-0.03209	0.00000	0.00000	0.00000	0.00018
	136	-0.00070	-0.03109	0.00000	0.00000	0.00000	0.00018
	137	-0.00039	-0.02330	0.00000	0.00000	0.00000	0.00014
	138	-0.00039	-0.02229	0.00000	0.00000	0.00000	0.00014
12	1	-0.00001	-0.00704	0.00000	0.00000	0.00000	-0.00003
	2	0.00004	-0.01599	0.00000	0.00000	0.00000	0.00000
	3	-0.00091	-0.00238	0.00000	0.00000	0.00000	-0.00002
	13	-0.00033	-0.00078	0.00000	0.00000	0.00000	0.00000
	4	0.00005	-0.02035	0.00000	0.00000	0.00000	0.00000
	5	-0.00136	-0.00357	0.00000	0.00000	0.00000	-0.00003
	15	-0.00049	-0.00117	0.00000	0.00000	0.00000	-0.00001
	10	0.00000	-0.00145	0.00000	0.00000	0.00000	0.00000
	11	0.00000	-0.00026	0.00000	0.00000	0.00000	0.00002
	18	-0.00002	0.01895	0.00000	0.00000	0.00000	-0.00004
	19	0.00028	-0.00747	0.00000	0.00000	0.00000	0.00002
	20	0.00076	-0.00864	0.00000	0.00000	0.00000	0.00005
	100	-0.00001	-0.00704	0.00000	0.00000	0.00000	-0.00003
	101	-0.00018	-0.00743	0.00000	0.00000	0.00000	-0.00003
	102	-0.00043	-0.02422	0.00000	0.00000	0.00000	-0.00004
	103	-0.00042	-0.02568	0.00000	0.00000	0.00000	-0.00004
	104	-0.00042	-0.02448	0.00000	0.00000	0.00000	-0.00003
	105	-0.00014	-0.03315	0.00000	0.00000	0.00000	-0.00003
	106	-0.00014	-0.03196	0.00000	0.00000	0.00000	-0.00001
	107	0.00034	-0.03432	0.00000	0.00000	0.00000	0.00001
	108	0.00034	-0.03313	0.00000	0.00000	0.00000	0.00003
	111	-0.00026	-0.00763	0.00000	0.00000	0.00000	-0.00003
	112	-0.00064	-0.02918	0.00000	0.00000	0.00000	-0.00005
	113	-0.00064	-0.03063	0.00000	0.00000	0.00000	-0.00005
	114	-0.00064	-0.02944	0.00000	0.00000	0.00000	-0.00003
	115	-0.00037	-0.02882	0.00000	0.00000	0.00000	-0.00005
	116	-0.00037	-0.02763	0.00000	0.00000	0.00000	-0.00003
	117	0.00010	-0.02033	0.00000	0.00000	0.00000	-0.00003
	118	0.00010	-0.01913	0.00000	0.00000	0.00000	-0.00002
	121	-0.00034	-0.00782	0.00000	0.00000	0.00000	-0.00004
	122	-0.00088	-0.02541	0.00000	0.00000	0.00000	-0.00006
	123	-0.00088	-0.02687	0.00000	0.00000	0.00000	-0.00006
	124	-0.00088	-0.02567	0.00000	0.00000	0.00000	-0.00004

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	125	-0.00059	-0.03434	0.00000	0.00000	0.00000	-0.00004
	126	-0.00059	-0.03315	0.00000	0.00000	0.00000	-0.00002
	127	-0.00012	-0.03551	0.00000	0.00000	0.00000	0.00000
	128	-0.00012	-0.03432	0.00000	0.00000	0.00000	0.00001
	131	-0.00050	-0.00821	0.00000	0.00000	0.00000	-0.00004
	132	-0.00133	-0.03096	0.00000	0.00000	0.00000	-0.00007
	133	-0.00132	-0.03242	0.00000	0.00000	0.00000	-0.00007
	134	-0.00064	-0.02944	0.00000	0.00000	0.00000	-0.00003
	135	-0.00105	-0.03061	0.00000	0.00000	0.00000	-0.00007
	136	-0.00105	-0.02941	0.00000	0.00000	0.00000	-0.00005
	137	-0.00058	-0.02211	0.00000	0.00000	0.00000	-0.00005
	138	-0.00058	-0.02092	0.00000	0.00000	0.00000	-0.00003
13	1	-0.00002	-0.00850	0.00000	0.00000	0.00000	-0.00008
	2	0.00005	-0.01865	0.00000	0.00000	0.00000	-0.00019
	3	-0.00121	-0.00159	0.00000	0.00000	0.00000	0.00010
	13	-0.00043	-0.00040	0.00000	0.00000	0.00000	0.00004
	4	0.00007	-0.02374	0.00000	0.00000	0.00000	-0.00024
	5	-0.00182	-0.00239	0.00000	0.00000	0.00000	0.00014
	15	-0.00065	-0.00060	0.00000	0.00000	0.00000	0.00005
	10	0.00000	-0.00170	0.00000	0.00000	0.00000	-0.00002
	11	0.00000	0.00013	0.00000	0.00000	0.00000	0.00001
	18	-0.00003	0.01776	0.00000	0.00000	0.00000	-0.00005
	19	0.00038	-0.00729	0.00000	0.00000	0.00000	-0.00001
	20	0.00102	-0.00698	0.00000	0.00000	0.00000	0.00006
	100	-0.00002	-0.00850	0.00000	0.00000	0.00000	-0.00008
	101	-0.00023	-0.00870	0.00000	0.00000	0.00000	-0.00006
	102	-0.00057	-0.02795	0.00000	0.00000	0.00000	-0.00022
	103	-0.00057	-0.02965	0.00000	0.00000	0.00000	-0.00024
	104	-0.00057	-0.02782	0.00000	0.00000	0.00000	-0.00021
	105	-0.00019	-0.03694	0.00000	0.00000	0.00000	-0.00025
	106	-0.00019	-0.03511	0.00000	0.00000	0.00000	-0.00021
	107	0.00045	-0.03662	0.00000	0.00000	0.00000	-0.00018
	108	0.00045	-0.03480	0.00000	0.00000	0.00000	-0.00015
	111	-0.00034	-0.00880	0.00000	0.00000	0.00000	-0.00005
	112	-0.00086	-0.03344	0.00000	0.00000	0.00000	-0.00025
	113	-0.00085	-0.03513	0.00000	0.00000	0.00000	-0.00027
	114	-0.00086	-0.03331	0.00000	0.00000	0.00000	-0.00023
	115	-0.00049	-0.03372	0.00000	0.00000	0.00000	-0.00030
	116	-0.00049	-0.03190	0.00000	0.00000	0.00000	-0.00027
	117	0.00013	-0.02435	0.00000	0.00000	0.00000	-0.00026
	118	0.00013	-0.02253	0.00000	0.00000	0.00000	-0.00023
	121	-0.00045	-0.00890	0.00000	0.00000	0.00000	-0.00004
	122	-0.00118	-0.02875	0.00000	0.00000	0.00000	-0.00017
	123	-0.00117	-0.03044	0.00000	0.00000	0.00000	-0.00019
	124	-0.00117	-0.02862	0.00000	0.00000	0.00000	-0.00016
	125	-0.00079	-0.03774	0.00000	0.00000	0.00000	-0.00020
	126	-0.00079	-0.03591	0.00000	0.00000	0.00000	-0.00017
	127	-0.00016	-0.03742	0.00000	0.00000	0.00000	-0.00013

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	128	-0.00016	-0.03560	0.00000	0.00000	0.00000	-0.00010
	131	-0.00067	-0.00910	0.00000	0.00000	0.00000	-0.00002
	132	-0.00177	-0.03463	0.00000	0.00000	0.00000	-0.00018
	133	-0.00176	-0.03633	0.00000	0.00000	0.00000	-0.00019
	134	-0.00086	-0.03331	0.00000	0.00000	0.00000	-0.00023
	135	-0.00140	-0.03492	0.00000	0.00000	0.00000	-0.00023
	136	-0.00140	-0.03309	0.00000	0.00000	0.00000	-0.00020
	137	-0.00077	-0.02555	0.00000	0.00000	0.00000	-0.00019
	138	-0.00078	-0.02372	0.00000	0.00000	0.00000	-0.00016
14	1	-0.00002	-0.01070	0.00000	0.00000	0.00000	-0.00008
	2	0.00007	-0.02504	0.00000	0.00000	0.00000	-0.00026
	3	-0.00151	0.00341	0.00000	0.00000	0.00000	0.00030
	13	-0.00054	0.00138	0.00000	0.00000	0.00000	0.00010
	4	0.00008	-0.03187	0.00000	0.00000	0.00000	-0.00033
	5	-0.00227	0.00511	0.00000	0.00000	0.00000	0.00045
	15	-0.00082	0.00207	0.00000	0.00000	0.00000	0.00016
	10	0.00001	-0.00228	0.00000	0.00000	0.00000	-0.00002
	11	0.00000	0.00050	0.00000	0.00000	0.00000	0.00001
	18	-0.00003	0.01632	0.00000	0.00000	0.00000	-0.00005
	19	0.00047	-0.00818	0.00000	0.00000	0.00000	-0.00006
	20	0.00127	-0.00691	0.00000	0.00000	0.00000	-0.00008
	100	-0.00002	-0.01070	0.00000	0.00000	0.00000	-0.00008
	101	-0.00029	-0.01001	0.00000	0.00000	0.00000	-0.00003
	102	-0.00071	-0.03403	0.00000	0.00000	0.00000	-0.00019
	103	-0.00071	-0.03631	0.00000	0.00000	0.00000	-0.00022
	104	-0.00071	-0.03353	0.00000	0.00000	0.00000	-0.00018
	105	-0.00023	-0.04448	0.00000	0.00000	0.00000	-0.00028
	106	-0.00024	-0.04171	0.00000	0.00000	0.00000	-0.00024
	107	0.00056	-0.04321	0.00000	0.00000	0.00000	-0.00030
	108	0.00056	-0.04044	0.00000	0.00000	0.00000	-0.00026
	111	-0.00043	-0.00966	0.00000	0.00000	0.00000	0.00000
	112	-0.00107	-0.04001	0.00000	0.00000	0.00000	-0.00019
	113	-0.00107	-0.04228	0.00000	0.00000	0.00000	-0.00021
	114	-0.00107	-0.03951	0.00000	0.00000	0.00000	-0.00017
	115	-0.00061	-0.04246	0.00000	0.00000	0.00000	-0.00030
	116	-0.00061	-0.03969	0.00000	0.00000	0.00000	-0.00027
	117	0.00017	-0.03287	0.00000	0.00000	0.00000	-0.00035
	118	0.00016	-0.03009	0.00000	0.00000	0.00000	-0.00031
	121	-0.00056	-0.00932	0.00000	0.00000	0.00000	0.00002
	122	-0.00147	-0.03233	0.00000	0.00000	0.00000	-0.00004
	123	-0.00146	-0.03460	0.00000	0.00000	0.00000	-0.00007
	124	-0.00147	-0.03183	0.00000	0.00000	0.00000	-0.00003
	125	-0.00099	-0.04278	0.00000	0.00000	0.00000	-0.00013
	126	-0.00099	-0.04000	0.00000	0.00000	0.00000	-0.00009
	127	-0.00019	-0.04151	0.00000	0.00000	0.00000	-0.00015
	128	-0.00020	-0.03873	0.00000	0.00000	0.00000	-0.00011
	131	-0.00084	-0.00863	0.00000	0.00000	0.00000	0.00008
	132	-0.00221	-0.03745	0.00000	0.00000	0.00000	0.00004

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	133	-0.00220	-0.03973	0.00000	0.00000	0.00000	0.00001
	134	-0.00107	-0.03951	0.00000	0.00000	0.00000	-0.00017
	135	-0.00175	-0.03991	0.00000	0.00000	0.00000	-0.00008
	136	-0.00175	-0.03713	0.00000	0.00000	0.00000	-0.00004
	137	-0.00097	-0.03031	0.00000	0.00000	0.00000	-0.00012
	138	-0.00097	-0.02754	0.00000	0.00000	0.00000	-0.00008

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
5	1	0.00	1.34	0.00	0.00	0.00	0.00
	2	0.00	2.94	0.00	0.00	0.00	0.00
	3	0.00	0.25	0.00	0.00	0.00	0.00
	13	0.00	0.06	0.00	0.00	0.00	0.00
	4	0.00	3.75	0.00	0.00	0.00	0.00
	5	0.00	0.38	0.00	0.00	0.00	0.00
	15	0.00	0.09	0.00	0.00	0.00	0.00
	10	0.00	0.27	0.00	0.00	0.00	0.00
	11	0.00	0.29	0.00	0.00	0.00	0.00
	18	0.00	-2.80	0.00	0.00	0.00	0.00
	19	0.00	1.15	0.00	0.00	0.00	0.00
	20	0.00	1.10	0.00	0.00	0.00	0.00
	100	0.00	1.34	0.00	0.00	0.00	0.00
	101	0.00	1.37	0.00	0.00	0.00	0.00
	102	0.00	4.41	0.00	0.00	0.00	0.00
	103	0.00	4.68	0.00	0.00	0.00	0.00
	104	0.00	4.70	0.00	0.00	0.00	0.00
	105	0.00	5.83	0.00	0.00	0.00	0.00
	106	0.00	5.85	0.00	0.00	0.00	0.00
	107	0.00	5.78	0.00	0.00	0.00	0.00
	108	0.00	5.80	0.00	0.00	0.00	0.00
	111	0.00	1.39	0.00	0.00	0.00	0.00
	112	0.00	5.28	0.00	0.00	0.00	0.00
	113	0.00	5.55	0.00	0.00	0.00	0.00
	114	0.00	5.57	0.00	0.00	0.00	0.00
	115	0.00	5.32	0.00	0.00	0.00	0.00
	116	0.00	5.34	0.00	0.00	0.00	0.00
	117	0.00	3.84	0.00	0.00	0.00	0.00
	118	0.00	3.86	0.00	0.00	0.00	0.00
	121	0.00	1.41	0.00	0.00	0.00	0.00
	122	0.00	4.54	0.00	0.00	0.00	0.00
	123	0.00	4.81	0.00	0.00	0.00	0.00
	124	0.00	4.83	0.00	0.00	0.00	0.00
	125	0.00	5.96	0.00	0.00	0.00	0.00
	126	0.00	5.98	0.00	0.00	0.00	0.00
	127	0.00	5.91	0.00	0.00	0.00	0.00
	128	0.00	5.93	0.00	0.00	0.00	0.00
	131	0.00	1.44	0.00	0.00	0.00	0.00
	132	0.00	5.47	0.00	0.00	0.00	0.00
	133	0.00	5.73	0.00	0.00	0.00	0.00
	134	0.00	5.57	0.00	0.00	0.00	0.00
	135	0.00	5.51	0.00	0.00	0.00	0.00
	136	0.00	5.53	0.00	0.00	0.00	0.00
	137	0.00	4.03	0.00	0.00	0.00	0.00
	138	0.00	4.05	0.00	0.00	0.00	0.00
6	1	0.00	1.11	0.00	0.00	0.00	0.00
	2	0.00	2.52	0.00	0.00	0.00	0.00
	3	0.00	0.38	0.00	0.00	0.00	0.00
	13	0.00	0.12	0.00	0.00	0.00	0.00
	4	0.00	3.21	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	5	0.00	0.56	0.00	0.00	0.00	0.00
	15	0.00	0.18	0.00	0.00	0.00	0.00
	10	0.00	0.23	0.00	0.00	0.00	0.00
	11	0.00	0.19	0.00	0.00	0.00	0.00
	18	0.00	-2.99	0.00	0.00	0.00	0.00
	19	0.00	1.18	0.00	0.00	0.00	0.00
	20	0.00	1.36	0.00	0.00	0.00	0.00
	100	0.00	1.11	0.00	0.00	0.00	0.00
	101	0.00	1.17	0.00	0.00	0.00	0.00
	102	0.00	3.82	0.00	0.00	0.00	0.00
	103	0.00	4.05	0.00	0.00	0.00	0.00
	104	0.00	4.01	0.00	0.00	0.00	0.00
	105	0.00	5.23	0.00	0.00	0.00	0.00
	106	0.00	5.19	0.00	0.00	0.00	0.00
	107	0.00	5.42	0.00	0.00	0.00	0.00
	108	0.00	5.38	0.00	0.00	0.00	0.00
	111	0.00	1.20	0.00	0.00	0.00	0.00
	112	0.00	4.61	0.00	0.00	0.00	0.00
	113	0.00	4.83	0.00	0.00	0.00	0.00
	114	0.00	4.79	0.00	0.00	0.00	0.00
	115	0.00	4.55	0.00	0.00	0.00	0.00
	116	0.00	4.51	0.00	0.00	0.00	0.00
	117	0.00	3.21	0.00	0.00	0.00	0.00
	118	0.00	3.17	0.00	0.00	0.00	0.00
	121	0.00	1.23	0.00	0.00	0.00	0.00
	122	0.00	4.01	0.00	0.00	0.00	0.00
	123	0.00	4.24	0.00	0.00	0.00	0.00
	124	0.00	4.20	0.00	0.00	0.00	0.00
	125	0.00	5.42	0.00	0.00	0.00	0.00
	126	0.00	5.38	0.00	0.00	0.00	0.00
	127	0.00	5.60	0.00	0.00	0.00	0.00
	128	0.00	5.56	0.00	0.00	0.00	0.00
	131	0.00	1.30	0.00	0.00	0.00	0.00
	132	0.00	4.89	0.00	0.00	0.00	0.00
	133	0.00	5.12	0.00	0.00	0.00	0.00
	134	0.00	4.79	0.00	0.00	0.00	0.00
	135	0.00	4.83	0.00	0.00	0.00	0.00
	136	0.00	4.79	0.00	0.00	0.00	0.00
	137	0.00	3.49	0.00	0.00	0.00	0.00
	138	0.00	3.45	0.00	0.00	0.00	0.00
7	1	0.00	1.09	0.00	0.00	0.00	0.00
	2	0.00	2.93	0.00	0.00	0.00	0.00
	3	0.00	0.16	0.00	0.00	0.00	0.00
	13	0.00	0.07	0.00	0.00	0.00	0.00
	4	0.00	3.73	0.00	0.00	0.00	0.00
	5	0.00	0.23	0.00	0.00	0.00	0.00
	15	0.00	0.10	0.00	0.00	0.00	0.00
	10	0.00	0.27	0.00	0.00	0.00	0.00
	11	0.00	0.16	0.00	0.00	0.00	0.00
	18	0.00	-3.11	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	19	0.00	1.27	0.00	0.00	0.00	0.00
	20	0.00	1.47	0.00	0.00	0.00	0.00
	100	0.00	1.09	0.00	0.00	0.00	0.00
	101	0.00	1.12	0.00	0.00	0.00	0.00
	102	0.00	4.09	0.00	0.00	0.00	0.00
	103	0.00	4.36	0.00	0.00	0.00	0.00
	104	0.00	4.25	0.00	0.00	0.00	0.00
	105	0.00	5.63	0.00	0.00	0.00	0.00
	106	0.00	5.53	0.00	0.00	0.00	0.00
	107	0.00	5.83	0.00	0.00	0.00	0.00
	108	0.00	5.72	0.00	0.00	0.00	0.00
	111	0.00	1.13	0.00	0.00	0.00	0.00
	112	0.00	4.93	0.00	0.00	0.00	0.00
	113	0.00	5.20	0.00	0.00	0.00	0.00
	114	0.00	5.09	0.00	0.00	0.00	0.00
	115	0.00	4.95	0.00	0.00	0.00	0.00
	116	0.00	4.84	0.00	0.00	0.00	0.00
	117	0.00	3.56	0.00	0.00	0.00	0.00
	118	0.00	3.45	0.00	0.00	0.00	0.00
	121	0.00	1.15	0.00	0.00	0.00	0.00
	122	0.00	4.17	0.00	0.00	0.00	0.00
	123	0.00	4.44	0.00	0.00	0.00	0.00
	124	0.00	4.33	0.00	0.00	0.00	0.00
	125	0.00	5.71	0.00	0.00	0.00	0.00
	126	0.00	5.60	0.00	0.00	0.00	0.00
	127	0.00	5.91	0.00	0.00	0.00	0.00
	128	0.00	5.80	0.00	0.00	0.00	0.00
	131	0.00	1.18	0.00	0.00	0.00	0.00
	132	0.00	5.05	0.00	0.00	0.00	0.00
	133	0.00	5.31	0.00	0.00	0.00	0.00
	134	0.00	5.09	0.00	0.00	0.00	0.00
	135	0.00	5.07	0.00	0.00	0.00	0.00
	136	0.00	4.96	0.00	0.00	0.00	0.00
	137	0.00	3.68	0.00	0.00	0.00	0.00
	138	0.00	3.57	0.00	0.00	0.00	0.00
8	1	0.00	1.22	0.00	0.00	0.00	0.00
	2	0.00	3.88	0.00	0.00	0.00	0.00
	3	0.00	-0.15	0.00	0.00	0.00	0.00
	13	0.00	-0.02	0.00	0.00	0.00	0.00
	4	0.00	4.94	0.00	0.00	0.00	0.00
	5	0.00	-0.22	0.00	0.00	0.00	0.00
	15	0.00	-0.03	0.00	0.00	0.00	0.00
	10	0.00	0.35	0.00	0.00	0.00	0.00
	11	0.00	0.18	0.00	0.00	0.00	0.00
	18	0.00	-3.16	0.00	0.00	0.00	0.00
	19	0.00	1.37	0.00	0.00	0.00	0.00
	20	0.00	1.34	0.00	0.00	0.00	0.00
	100	0.00	1.22	0.00	0.00	0.00	0.00
	101	0.00	1.20	0.00	0.00	0.00	0.00
	102	0.00	5.02	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	103	0.00	5.37	0.00	0.00	0.00	0.00
	104	0.00	5.20	0.00	0.00	0.00	0.00
	105	0.00	6.74	0.00	0.00	0.00	0.00
	106	0.00	6.57	0.00	0.00	0.00	0.00
	107	0.00	6.71	0.00	0.00	0.00	0.00
	108	0.00	6.54	0.00	0.00	0.00	0.00
	111	0.00	1.20	0.00	0.00	0.00	0.00
	112	0.00	6.04	0.00	0.00	0.00	0.00
	113	0.00	6.39	0.00	0.00	0.00	0.00
	114	0.00	6.22	0.00	0.00	0.00	0.00
	115	0.00	6.21	0.00	0.00	0.00	0.00
	116	0.00	6.04	0.00	0.00	0.00	0.00
	117	0.00	4.57	0.00	0.00	0.00	0.00
	118	0.00	4.40	0.00	0.00	0.00	0.00
	121	0.00	1.19	0.00	0.00	0.00	0.00
	122	0.00	4.95	0.00	0.00	0.00	0.00
	123	0.00	5.30	0.00	0.00	0.00	0.00
	124	0.00	5.13	0.00	0.00	0.00	0.00
	125	0.00	6.67	0.00	0.00	0.00	0.00
	126	0.00	6.49	0.00	0.00	0.00	0.00
	127	0.00	6.64	0.00	0.00	0.00	0.00
	128	0.00	6.46	0.00	0.00	0.00	0.00
	131	0.00	1.18	0.00	0.00	0.00	0.00
	132	0.00	5.93	0.00	0.00	0.00	0.00
	133	0.00	6.28	0.00	0.00	0.00	0.00
	134	0.00	6.22	0.00	0.00	0.00	0.00
	135	0.00	6.10	0.00	0.00	0.00	0.00
	136	0.00	5.93	0.00	0.00	0.00	0.00
	137	0.00	4.46	0.00	0.00	0.00	0.00
	138	0.00	4.29	0.00	0.00	0.00	0.00
9	1	0.00	1.32	0.00	0.00	0.00	0.00
	2	0.00	4.51	0.00	0.00	0.00	0.00
	3	0.00	-0.30	0.00	0.00	0.00	0.00
	13	0.00	-0.07	0.00	0.00	0.00	0.00
	4	0.00	5.74	0.00	0.00	0.00	0.00
	5	0.00	-0.45	0.00	0.00	0.00	0.00
	15	0.00	-0.10	0.00	0.00	0.00	0.00
	10	0.00	0.41	0.00	0.00	0.00	0.00
	11	0.00	0.20	0.00	0.00	0.00	0.00
	18	0.00	-3.17	0.00	0.00	0.00	0.00
	19	0.00	1.41	0.00	0.00	0.00	0.00
	20	0.00	1.19	0.00	0.00	0.00	0.00
	100	0.00	1.32	0.00	0.00	0.00	0.00
	101	0.00	1.29	0.00	0.00	0.00	0.00
	102	0.00	5.68	0.00	0.00	0.00	0.00
	103	0.00	6.09	0.00	0.00	0.00	0.00
	104	0.00	5.88	0.00	0.00	0.00	0.00
	105	0.00	7.50	0.00	0.00	0.00	0.00
	106	0.00	7.29	0.00	0.00	0.00	0.00
	107	0.00	7.28	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	108	0.00	7.07	0.00	0.00	0.00	0.00
	111	0.00	1.27	0.00	0.00	0.00	0.00
	112	0.00	6.83	0.00	0.00	0.00	0.00
	113	0.00	7.24	0.00	0.00	0.00	0.00
	114	0.00	7.03	0.00	0.00	0.00	0.00
	115	0.00	7.10	0.00	0.00	0.00	0.00
	116	0.00	6.89	0.00	0.00	0.00	0.00
	117	0.00	5.26	0.00	0.00	0.00	0.00
	118	0.00	5.06	0.00	0.00	0.00	0.00
	121	0.00	1.25	0.00	0.00	0.00	0.00
	122	0.00	5.53	0.00	0.00	0.00	0.00
	123	0.00	5.93	0.00	0.00	0.00	0.00
	124	0.00	5.73	0.00	0.00	0.00	0.00
	125	0.00	7.34	0.00	0.00	0.00	0.00
	126	0.00	7.14	0.00	0.00	0.00	0.00
	127	0.00	7.13	0.00	0.00	0.00	0.00
	128	0.00	6.92	0.00	0.00	0.00	0.00
	131	0.00	1.22	0.00	0.00	0.00	0.00
	132	0.00	6.60	0.00	0.00	0.00	0.00
	133	0.00	7.01	0.00	0.00	0.00	0.00
	134	0.00	7.03	0.00	0.00	0.00	0.00
	135	0.00	6.87	0.00	0.00	0.00	0.00
	136	0.00	6.67	0.00	0.00	0.00	0.00
	137	0.00	5.04	0.00	0.00	0.00	0.00
	138	0.00	4.83	0.00	0.00	0.00	0.00
10	1	0.00	1.22	0.00	0.00	0.00	0.00
	2	0.00	3.88	0.00	0.00	0.00	0.00
	3	0.00	-0.15	0.00	0.00	0.00	0.00
	13	0.00	-0.02	0.00	0.00	0.00	0.00
	4	0.00	4.94	0.00	0.00	0.00	0.00
	5	0.00	-0.22	0.00	0.00	0.00	0.00
	15	0.00	-0.03	0.00	0.00	0.00	0.00
	10	0.00	0.35	0.00	0.00	0.00	0.00
	11	0.00	0.17	0.00	0.00	0.00	0.00
	18	0.00	-3.16	0.00	0.00	0.00	0.00
	19	0.00	1.37	0.00	0.00	0.00	0.00
	20	0.00	1.34	0.00	0.00	0.00	0.00
	100	0.00	1.22	0.00	0.00	0.00	0.00
	101	0.00	1.20	0.00	0.00	0.00	0.00
	102	0.00	5.02	0.00	0.00	0.00	0.00
	103	0.00	5.37	0.00	0.00	0.00	0.00
	104	0.00	5.19	0.00	0.00	0.00	0.00
	105	0.00	6.74	0.00	0.00	0.00	0.00
	106	0.00	6.56	0.00	0.00	0.00	0.00
	107	0.00	6.71	0.00	0.00	0.00	0.00
	108	0.00	6.53	0.00	0.00	0.00	0.00
	111	0.00	1.20	0.00	0.00	0.00	0.00
	112	0.00	6.04	0.00	0.00	0.00	0.00
	113	0.00	6.39	0.00	0.00	0.00	0.00
	114	0.00	6.21	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	115	0.00	6.21	0.00	0.00	0.00	0.00
	116	0.00	6.03	0.00	0.00	0.00	0.00
	117	0.00	4.57	0.00	0.00	0.00	0.00
	118	0.00	4.39	0.00	0.00	0.00	0.00
	121	0.00	1.19	0.00	0.00	0.00	0.00
	122	0.00	4.95	0.00	0.00	0.00	0.00
	123	0.00	5.30	0.00	0.00	0.00	0.00
	124	0.00	5.12	0.00	0.00	0.00	0.00
	125	0.00	6.67	0.00	0.00	0.00	0.00
	126	0.00	6.49	0.00	0.00	0.00	0.00
	127	0.00	6.64	0.00	0.00	0.00	0.00
	128	0.00	6.46	0.00	0.00	0.00	0.00
	131	0.00	1.18	0.00	0.00	0.00	0.00
	132	0.00	5.93	0.00	0.00	0.00	0.00
	133	0.00	6.28	0.00	0.00	0.00	0.00
	134	0.00	6.21	0.00	0.00	0.00	0.00
	135	0.00	6.10	0.00	0.00	0.00	0.00
	136	0.00	5.92	0.00	0.00	0.00	0.00
	137	0.00	4.46	0.00	0.00	0.00	0.00
	138	0.00	4.28	0.00	0.00	0.00	0.00
11	1	0.00	1.09	0.00	0.00	0.00	0.00
	2	0.00	2.93	0.00	0.00	0.00	0.00
	3	0.00	0.16	0.00	0.00	0.00	0.00
	13	0.00	0.07	0.00	0.00	0.00	0.00
	4	0.00	3.73	0.00	0.00	0.00	0.00
	5	0.00	0.23	0.00	0.00	0.00	0.00
	15	0.00	0.10	0.00	0.00	0.00	0.00
	10	0.00	0.27	0.00	0.00	0.00	0.00
	11	0.00	0.11	0.00	0.00	0.00	0.00
	18	0.00	-3.11	0.00	0.00	0.00	0.00
	19	0.00	1.27	0.00	0.00	0.00	0.00
	20	0.00	1.47	0.00	0.00	0.00	0.00
	100	0.00	1.09	0.00	0.00	0.00	0.00
	101	0.00	1.12	0.00	0.00	0.00	0.00
	102	0.00	4.09	0.00	0.00	0.00	0.00
	103	0.00	4.36	0.00	0.00	0.00	0.00
	104	0.00	4.20	0.00	0.00	0.00	0.00
	105	0.00	5.63	0.00	0.00	0.00	0.00
	106	0.00	5.47	0.00	0.00	0.00	0.00
	107	0.00	5.83	0.00	0.00	0.00	0.00
	108	0.00	5.67	0.00	0.00	0.00	0.00
	111	0.00	1.13	0.00	0.00	0.00	0.00
	112	0.00	4.93	0.00	0.00	0.00	0.00
	113	0.00	5.20	0.00	0.00	0.00	0.00
	114	0.00	5.04	0.00	0.00	0.00	0.00
	115	0.00	4.95	0.00	0.00	0.00	0.00
	116	0.00	4.79	0.00	0.00	0.00	0.00
	117	0.00	3.56	0.00	0.00	0.00	0.00
	118	0.00	3.40	0.00	0.00	0.00	0.00
	121	0.00	1.15	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	122	0.00	4.17	0.00	0.00	0.00	0.00
	123	0.00	4.44	0.00	0.00	0.00	0.00
	124	0.00	4.28	0.00	0.00	0.00	0.00
	125	0.00	5.71	0.00	0.00	0.00	0.00
	126	0.00	5.55	0.00	0.00	0.00	0.00
	127	0.00	5.91	0.00	0.00	0.00	0.00
	128	0.00	5.75	0.00	0.00	0.00	0.00
	131	0.00	1.18	0.00	0.00	0.00	0.00
	132	0.00	5.05	0.00	0.00	0.00	0.00
	133	0.00	5.31	0.00	0.00	0.00	0.00
	134	0.00	5.04	0.00	0.00	0.00	0.00
	135	0.00	5.07	0.00	0.00	0.00	0.00
	136	0.00	4.91	0.00	0.00	0.00	0.00
	137	0.00	3.68	0.00	0.00	0.00	0.00
	138	0.00	3.52	0.00	0.00	0.00	0.00
12	1	0.00	1.11	0.00	0.00	0.00	0.00
	2	0.00	2.52	0.00	0.00	0.00	0.00
	3	0.00	0.38	0.00	0.00	0.00	0.00
	13	0.00	0.12	0.00	0.00	0.00	0.00
	4	0.00	3.21	0.00	0.00	0.00	0.00
	5	0.00	0.56	0.00	0.00	0.00	0.00
	15	0.00	0.18	0.00	0.00	0.00	0.00
	10	0.00	0.23	0.00	0.00	0.00	0.00
	11	0.00	0.04	0.00	0.00	0.00	0.00
	18	0.00	-2.99	0.00	0.00	0.00	0.00
	19	0.00	1.18	0.00	0.00	0.00	0.00
	20	0.00	1.36	0.00	0.00	0.00	0.00
	100	0.00	1.11	0.00	0.00	0.00	0.00
	101	0.00	1.17	0.00	0.00	0.00	0.00
	102	0.00	3.82	0.00	0.00	0.00	0.00
	103	0.00	4.05	0.00	0.00	0.00	0.00
	104	0.00	3.86	0.00	0.00	0.00	0.00
	105	0.00	5.23	0.00	0.00	0.00	0.00
	106	0.00	5.04	0.00	0.00	0.00	0.00
	107	0.00	5.42	0.00	0.00	0.00	0.00
	108	0.00	5.23	0.00	0.00	0.00	0.00
	111	0.00	1.20	0.00	0.00	0.00	0.00
	112	0.00	4.61	0.00	0.00	0.00	0.00
	113	0.00	4.83	0.00	0.00	0.00	0.00
	114	0.00	4.65	0.00	0.00	0.00	0.00
	115	0.00	4.55	0.00	0.00	0.00	0.00
	116	0.00	4.36	0.00	0.00	0.00	0.00
	117	0.00	3.21	0.00	0.00	0.00	0.00
	118	0.00	3.02	0.00	0.00	0.00	0.00
	121	0.00	1.23	0.00	0.00	0.00	0.00
	122	0.00	4.01	0.00	0.00	0.00	0.00
	123	0.00	4.24	0.00	0.00	0.00	0.00
	124	0.00	4.05	0.00	0.00	0.00	0.00
	125	0.00	5.42	0.00	0.00	0.00	0.00
	126	0.00	5.23	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	127	0.00	5.60	0.00	0.00	0.00	0.00
	128	0.00	5.42	0.00	0.00	0.00	0.00
	131	0.00	1.30	0.00	0.00	0.00	0.00
	132	0.00	4.89	0.00	0.00	0.00	0.00
	133	0.00	5.12	0.00	0.00	0.00	0.00
	134	0.00	4.65	0.00	0.00	0.00	0.00
	135	0.00	4.83	0.00	0.00	0.00	0.00
	136	0.00	4.64	0.00	0.00	0.00	0.00
	137	0.00	3.49	0.00	0.00	0.00	0.00
	138	0.00	3.30	0.00	0.00	0.00	0.00
13	1	0.00	1.34	0.00	0.00	0.00	0.00
	2	0.00	2.94	0.00	0.00	0.00	0.00
	3	0.00	0.25	0.00	0.00	0.00	0.00
	13	0.00	0.06	0.00	0.00	0.00	0.00
	4	0.00	3.75	0.00	0.00	0.00	0.00
	5	0.00	0.38	0.00	0.00	0.00	0.00
	15	0.00	0.09	0.00	0.00	0.00	0.00
	10	0.00	0.27	0.00	0.00	0.00	0.00
	11	0.00	-0.02	0.00	0.00	0.00	0.00
	18	0.00	-2.80	0.00	0.00	0.00	0.00
	19	0.00	1.15	0.00	0.00	0.00	0.00
	20	0.00	1.10	0.00	0.00	0.00	0.00
	100	0.00	1.34	0.00	0.00	0.00	0.00
	101	0.00	1.37	0.00	0.00	0.00	0.00
	102	0.00	4.41	0.00	0.00	0.00	0.00
	103	0.00	4.68	0.00	0.00	0.00	0.00
	104	0.00	4.39	0.00	0.00	0.00	0.00
	105	0.00	5.83	0.00	0.00	0.00	0.00
	106	0.00	5.54	0.00	0.00	0.00	0.00
	107	0.00	5.78	0.00	0.00	0.00	0.00
	108	0.00	5.49	0.00	0.00	0.00	0.00
	111	0.00	1.39	0.00	0.00	0.00	0.00
	112	0.00	5.28	0.00	0.00	0.00	0.00
	113	0.00	5.55	0.00	0.00	0.00	0.00
	114	0.00	5.26	0.00	0.00	0.00	0.00
	115	0.00	5.32	0.00	0.00	0.00	0.00
	116	0.00	5.03	0.00	0.00	0.00	0.00
	117	0.00	3.84	0.00	0.00	0.00	0.00
	118	0.00	3.56	0.00	0.00	0.00	0.00
	121	0.00	1.41	0.00	0.00	0.00	0.00
	122	0.00	4.54	0.00	0.00	0.00	0.00
	123	0.00	4.81	0.00	0.00	0.00	0.00
	124	0.00	4.52	0.00	0.00	0.00	0.00
	125	0.00	5.96	0.00	0.00	0.00	0.00
	126	0.00	5.67	0.00	0.00	0.00	0.00
	127	0.00	5.91	0.00	0.00	0.00	0.00
	128	0.00	5.62	0.00	0.00	0.00	0.00
	131	0.00	1.44	0.00	0.00	0.00	0.00
	132	0.00	5.47	0.00	0.00	0.00	0.00
	133	0.00	5.73	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	134	0.00	5.26	0.00	0.00	0.00	0.00
	135	0.00	5.51	0.00	0.00	0.00	0.00
	136	0.00	5.22	0.00	0.00	0.00	0.00
	137	0.00	4.03	0.00	0.00	0.00	0.00
	138	0.00	3.74	0.00	0.00	0.00	0.00
4	1	0.00	1.52	0.00	0.00	0.00	0.00
	2	0.00	3.55	0.00	0.00	0.00	0.00
	3	-0.01	-0.48	0.00	0.00	0.00	0.00
	13	0.00	-0.20	0.00	0.00	0.00	0.00
	4	0.00	4.52	0.00	0.00	0.00	0.00
	5	-0.02	-0.73	0.00	0.00	0.00	0.00
	15	-0.01	-0.29	0.00	0.00	0.00	0.00
	10	0.00	0.32	0.00	0.00	0.00	0.00
	11	0.00	0.39	0.00	0.00	0.00	0.00
	18	0.00	-2.32	0.00	0.00	0.00	0.00
	19	0.00	1.16	0.00	0.00	0.00	0.00
	20	0.01	0.98	0.00	0.00	0.00	0.00
	100	0.00	1.52	0.00	0.00	0.00	0.00
	101	0.00	1.42	0.00	0.00	0.00	0.00
	102	-0.01	4.83	0.00	0.00	0.00	0.00
	103	-0.01	5.15	0.00	0.00	0.00	0.00
	104	-0.01	5.22	0.00	0.00	0.00	0.00
	105	0.00	6.31	0.00	0.00	0.00	0.00
	106	0.00	6.38	0.00	0.00	0.00	0.00
	107	0.00	6.13	0.00	0.00	0.00	0.00
	108	0.00	6.20	0.00	0.00	0.00	0.00
	111	0.00	1.37	0.00	0.00	0.00	0.00
	112	-0.01	5.68	0.00	0.00	0.00	0.00
	113	-0.01	6.00	0.00	0.00	0.00	0.00
	114	-0.01	6.07	0.00	0.00	0.00	0.00
	115	-0.01	6.03	0.00	0.00	0.00	0.00
	116	-0.01	6.10	0.00	0.00	0.00	0.00
	117	0.00	4.66	0.00	0.00	0.00	0.00
	118	0.00	4.74	0.00	0.00	0.00	0.00
	121	0.00	1.32	0.00	0.00	0.00	0.00
	122	-0.01	4.59	0.00	0.00	0.00	0.00
	123	-0.01	4.91	0.00	0.00	0.00	0.00
	124	-0.01	4.98	0.00	0.00	0.00	0.00
	125	-0.01	6.07	0.00	0.00	0.00	0.00
	126	-0.01	6.14	0.00	0.00	0.00	0.00
	127	0.00	5.89	0.00	0.00	0.00	0.00
	128	0.00	5.96	0.00	0.00	0.00	0.00
	131	-0.01	1.22	0.00	0.00	0.00	0.00
	132	-0.02	5.31	0.00	0.00	0.00	0.00
	133	-0.02	5.64	0.00	0.00	0.00	0.00
	134	-0.01	6.07	0.00	0.00	0.00	0.00
	135	-0.01	5.66	0.00	0.00	0.00	0.00
	136	-0.01	5.73	0.00	0.00	0.00	0.00
	137	-0.01	4.30	0.00	0.00	0.00	0.00
	138	-0.01	4.37	0.00	0.00	0.00	0.00

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
14	1	0.00	1.52	0.00	0.00	0.00	0.00
	2	0.00	3.55	0.00	0.00	0.00	0.00
	3	0.01	-0.48	0.00	0.00	0.00	0.00
	13	0.00	-0.20	0.00	0.00	0.00	0.00
	4	0.00	4.52	0.00	0.00	0.00	0.00
	5	0.02	-0.73	0.00	0.00	0.00	0.00
	15	0.01	-0.29	0.00	0.00	0.00	0.00
	10	0.00	0.32	0.00	0.00	0.00	0.00
	11	0.00	-0.07	0.00	0.00	0.00	0.00
	18	0.00	-2.32	0.00	0.00	0.00	0.00
	19	0.00	1.16	0.00	0.00	0.00	0.00
	20	-0.01	0.98	0.00	0.00	0.00	0.00
	100	0.00	1.52	0.00	0.00	0.00	0.00
	101	0.00	1.42	0.00	0.00	0.00	0.00
	102	0.01	4.83	0.00	0.00	0.00	0.00
	103	0.01	5.15	0.00	0.00	0.00	0.00
	104	0.01	4.76	0.00	0.00	0.00	0.00
	105	0.00	6.31	0.00	0.00	0.00	0.00
	106	0.00	5.92	0.00	0.00	0.00	0.00
	107	0.00	6.13	0.00	0.00	0.00	0.00
	108	0.00	5.74	0.00	0.00	0.00	0.00
	111	0.00	1.37	0.00	0.00	0.00	0.00
	112	0.01	5.68	0.00	0.00	0.00	0.00
	113	0.01	6.00	0.00	0.00	0.00	0.00
	114	0.01	5.61	0.00	0.00	0.00	0.00
	115	0.01	6.03	0.00	0.00	0.00	0.00
	116	0.01	5.63	0.00	0.00	0.00	0.00
	117	0.00	4.66	0.00	0.00	0.00	0.00
	118	0.00	4.27	0.00	0.00	0.00	0.00
	121	0.00	1.32	0.00	0.00	0.00	0.00
	122	0.01	4.59	0.00	0.00	0.00	0.00
	123	0.01	4.91	0.00	0.00	0.00	0.00
	124	0.01	4.52	0.00	0.00	0.00	0.00
	125	0.01	6.07	0.00	0.00	0.00	0.00
	126	0.01	5.68	0.00	0.00	0.00	0.00
	127	0.00	5.89	0.00	0.00	0.00	0.00
	128	0.00	5.50	0.00	0.00	0.00	0.00
	131	0.01	1.22	0.00	0.00	0.00	0.00
	132	0.02	5.31	0.00	0.00	0.00	0.00
	133	0.02	5.64	0.00	0.00	0.00	0.00
	134	0.01	5.61	0.00	0.00	0.00	0.00
	135	0.01	5.66	0.00	0.00	0.00	0.00
	136	0.01	5.27	0.00	0.00	0.00	0.00
	137	0.01	4.30	0.00	0.00	0.00	0.00
	138	0.01	3.91	0.00	0.00	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	-0.11	0.78	0.00	0.00	0.00	-0.06
		2	0.11	1.41	0.00	0.00	0.00	-3.38
	2	1	0.34	7.65	0.00	0.00	0.00	5.15
		2	-0.34	10.44	0.00	0.00	0.00	-20.44
	3	1	6.51	1.44	0.00	0.00	0.00	10.52
		2	-6.51	-1.44	0.00	0.00	0.00	5.31
	13	1	1.44	0.42	0.00	0.00	0.00	2.98
		2	-1.44	-0.42	0.00	0.00	0.00	1.61
	4	1	0.44	9.73	0.00	0.00	0.00	6.55
		2	-0.44	13.28	0.00	0.00	0.00	-26.01
	5	1	9.77	2.17	0.00	0.00	0.00	15.79
		2	-9.77	-2.17	0.00	0.00	0.00	7.97
	15	1	2.15	0.63	0.00	0.00	0.00	4.47
		2	-2.15	-0.63	0.00	0.00	0.00	2.42
	10	1	0.03	0.70	0.00	0.00	0.00	0.47
		2	-0.03	0.95	0.00	0.00	0.00	-1.86
	11	1	0.03	0.77	0.00	0.00	0.00	0.52
		2	-0.03	0.87	0.00	0.00	0.00	-1.06
	18	1	-0.18	-0.19	0.00	0.00	0.00	-0.85
		2	0.18	0.19	0.00	0.00	0.00	-1.19
	19	1	-1.03	-0.26	0.00	0.00	0.00	-2.06
		2	1.03	0.26	0.00	0.00	0.00	-0.82
	20	1	-5.32	-4.49	0.00	0.00	0.00	-10.24
		2	5.32	-3.72	0.00	0.00	0.00	5.99
	100	1	-0.11	0.78	0.00	0.00	0.00	-0.06
		2	0.11	1.41	0.00	0.00	0.00	-3.38
	101	1	0.61	0.99	0.00	0.00	0.00	1.43
		2	-0.61	1.20	0.00	0.00	0.00	-2.57
	102	1	3.49	9.15	0.00	0.00	0.00	10.35
		2	-3.49	11.12	0.00	0.00	0.00	-21.16
	103	1	3.52	9.84	0.00	0.00	0.00	10.82
		2	-3.52	12.07	0.00	0.00	0.00	-23.02
	104	1	3.52	9.92	0.00	0.00	0.00	10.86
		2	-3.52	12.00	0.00	0.00	0.00	-22.23
	105	1	2.49	9.58	0.00	0.00	0.00	8.75
		2	-2.49	12.33	0.00	0.00	0.00	-23.84
	106	1	2.49	9.66	0.00	0.00	0.00	8.80
		2	-2.49	12.26	0.00	0.00	0.00	-23.05
	107	1	-1.80	5.35	0.00	0.00	0.00	0.57
		2	1.80	8.36	0.00	0.00	0.00	-17.03
	108	1	-1.80	5.43	0.00	0.00	0.00	0.62
		2	1.80	8.28	0.00	0.00	0.00	-16.23
	111	1	0.97	1.10	0.00	0.00	0.00	2.17
		2	-0.97	1.10	0.00	0.00	0.00	-2.17
	112	1	5.21	11.60	0.00	0.00	0.00	14.38
		2	-5.21	13.61	0.00	0.00	0.00	-25.41
	113	1	5.24	12.29	0.00	0.00	0.00	14.85
		2	-5.24	14.56	0.00	0.00	0.00	-27.27

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	114	1	5.24	12.37	0.00	0.00	0.00	14.90
		2	-5.24	14.48	0.00	0.00	0.00	-26.47
	115	1	4.12	11.94	0.00	0.00	0.00	12.37
		2	-4.12	14.91	0.00	0.00	0.00	-28.67
	116	1	4.12	12.01	0.00	0.00	0.00	12.42
		2	-4.12	14.83	0.00	0.00	0.00	-27.88
	117	1	-0.26	7.61	0.00	0.00	0.00	3.76
		2	0.26	11.03	0.00	0.00	0.00	-22.46
	118	1	-0.26	7.69	0.00	0.00	0.00	3.81
		2	0.26	10.95	0.00	0.00	0.00	-21.67
	121	1	1.33	1.20	0.00	0.00	0.00	2.92
		2	-1.33	0.99	0.00	0.00	0.00	-1.77
	122	1	6.74	9.87	0.00	0.00	0.00	15.61
		2	-6.74	10.40	0.00	0.00	0.00	-18.51
	123	1	6.78	10.57	0.00	0.00	0.00	16.08
		2	-6.78	11.35	0.00	0.00	0.00	-20.36
	124	1	6.78	10.64	0.00	0.00	0.00	16.12
		2	-6.78	11.27	0.00	0.00	0.00	-19.57
	125	1	5.74	10.30	0.00	0.00	0.00	14.02
		2	-5.74	11.61	0.00	0.00	0.00	-21.18
	126	1	5.74	10.38	0.00	0.00	0.00	14.06
		2	-5.74	11.54	0.00	0.00	0.00	-20.39
	127	1	1.45	6.08	0.00	0.00	0.00	5.84
		2	-1.45	7.63	0.00	0.00	0.00	-14.37
	128	1	1.45	6.15	0.00	0.00	0.00	5.88
		2	-1.45	7.56	0.00	0.00	0.00	-13.58
	131	1	2.04	1.41	0.00	0.00	0.00	4.41
		2	-2.04	0.78	0.00	0.00	0.00	-0.96
	132	1	10.09	12.68	0.00	0.00	0.00	22.28
		2	-10.09	12.52	0.00	0.00	0.00	-21.42
	133	1	10.13	13.37	0.00	0.00	0.00	22.74
		2	-10.13	13.47	0.00	0.00	0.00	-23.28
	134	1	5.24	12.37	0.00	0.00	0.00	14.90
		2	-5.24	14.48	0.00	0.00	0.00	-26.47
	135	1	9.00	13.02	0.00	0.00	0.00	20.27
		2	-9.00	13.83	0.00	0.00	0.00	-24.69
	136	1	9.00	13.10	0.00	0.00	0.00	20.31
		2	-9.00	13.75	0.00	0.00	0.00	-23.89
	137	1	4.62	8.70	0.00	0.00	0.00	11.65
		2	-4.62	9.94	0.00	0.00	0.00	-18.48
	138	1	4.62	8.77	0.00	0.00	0.00	11.70
		2	-4.62	9.87	0.00	0.00	0.00	-17.69
2	1	2	-0.11	1.41	0.00	0.00	0.00	3.38
		3	0.11	0.78	0.00	0.00	0.00	0.06
	2	2	0.34	10.44	0.00	0.00	0.00	20.44
		3	-0.34	7.65	0.00	0.00	0.00	-5.15
	3	2	6.51	-1.44	0.00	0.00	0.00	-5.31
		3	-6.51	1.44	0.00	0.00	0.00	-10.52
	13	2	1.44	-0.42	0.00	0.00	0.00	-1.61
		3	-1.44	0.42	--	-	-	-2.95

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	2	0.44	13.28	0.00	0.00	0.00	26.01
		3	-0.44	9.73	0.00	0.00	0.00	-6.55
	5	2	9.77	-2.17	0.00	0.00	0.00	-7.97
		3	-9.77	2.17	0.00	0.00	0.00	-15.79
	15	2	2.15	-0.63	0.00	0.00	0.00	-2.42
		3	-2.15	0.63	0.00	0.00	0.00	-4.47
	10	2	0.03	0.95	0.00	0.00	0.00	1.86
		3	-0.03	0.70	0.00	0.00	0.00	-0.47
	11	2	0.00	0.08	0.00	0.00	0.00	0.79
		3	0.00	-0.08	0.00	0.00	0.00	0.05
	18	2	-0.18	0.19	0.00	0.00	0.00	1.19
		3	0.18	-0.19	0.00	0.00	0.00	0.85
	19	2	-1.03	0.26	0.00	0.00	0.00	0.82
		3	1.03	-0.26	0.00	0.00	0.00	2.06
	20	2	-5.32	-3.72	0.00	0.00	0.00	-5.99
		3	5.32	-4.49	0.00	0.00	0.00	10.24
	100	2	-0.11	1.41	0.00	0.00	0.00	3.38
		3	0.11	0.78	0.00	0.00	0.00	0.06
	101	2	0.61	1.20	0.00	0.00	0.00	2.57
		3	-0.61	0.99	0.00	0.00	0.00	-1.43
	102	2	3.49	11.12	0.00	0.00	0.00	21.16
		3	-3.49	9.15	0.00	0.00	0.00	-10.35
	103	2	3.52	12.07	0.00	0.00	0.00	23.02
		3	-3.52	9.84	0.00	0.00	0.00	-10.82
	104	2	3.49	11.20	0.00	0.00	0.00	21.95
		3	-3.49	9.07	0.00	0.00	0.00	-10.30
	105	2	2.49	12.34	0.00	0.00	0.00	23.84
		3	-2.49	9.58	0.00	0.00	0.00	-8.75
	106	2	2.45	11.46	0.00	0.00	0.00	22.78
		3	-2.45	8.81	0.00	0.00	0.00	-8.24
	107	2	-1.80	8.36	0.00	0.00	0.00	17.03
		3	1.80	5.35	0.00	0.00	0.00	-0.57
	108	2	-1.83	7.48	0.00	0.00	0.00	15.96
		3	1.83	4.58	0.00	0.00	0.00	-0.06
	111	2	0.97	1.10	0.00	0.00	0.00	2.17
		3	-0.97	1.10	0.00	0.00	0.00	-2.17
	112	2	5.21	13.61	0.00	0.00	0.00	25.41
		3	-5.21	11.60	0.00	0.00	0.00	-14.38
	113	2	5.24	14.56	0.00	0.00	0.00	27.27
		3	-5.24	12.29	0.00	0.00	0.00	-14.85
	114	2	5.21	13.68	0.00	0.00	0.00	26.20
		3	-5.21	11.52	0.00	0.00	0.00	-14.34
	115	2	4.12	14.91	0.00	0.00	0.00	28.67
		3	-4.12	11.94	0.00	0.00	0.00	-12.37
	116	2	4.09	14.04	0.00	0.00	0.00	27.60
		3	-4.09	11.17	0.00	0.00	0.00	-11.86
	117	2	-0.26	11.03	0.00	0.00	0.00	22.46
		3	0.26	7.61	0.00	0.00	0.00	-3.76
	118	2	-0.29	10.15	0.00	0.00	0.00	21.40
		3	0.29	6.84	0.00	0.00	0.00	-3.25

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	121	2	1.33	0.99	0.00	0.00	0.00	1.77
		3	-1.33	1.20	0.00	0.00	0.00	-2.92
	122	2	6.74	10.40	0.00	0.00	0.00	18.51
		3	-6.74	9.87	0.00	0.00	0.00	-15.61
	123	2	6.78	11.35	0.00	0.00	0.00	20.36
		3	-6.78	10.57	0.00	0.00	0.00	-16.08
	124	2	6.74	10.48	0.00	0.00	0.00	19.30
		3	-6.74	9.80	0.00	0.00	0.00	-15.56
	125	2	5.74	11.61	0.00	0.00	0.00	21.18
		3	-5.74	10.30	0.00	0.00	0.00	-14.02
	126	2	5.71	10.74	0.00	0.00	0.00	20.12
		3	-5.71	9.53	0.00	0.00	0.00	-13.50
	127	2	1.45	7.63	0.00	0.00	0.00	14.37
		3	-1.45	6.08	0.00	0.00	0.00	-5.84
	128	2	1.42	6.76	0.00	0.00	0.00	13.31
		3	-1.42	5.30	0.00	0.00	0.00	-5.32
	131	2	2.04	0.78	0.00	0.00	0.00	0.96
		3	-2.04	1.41	0.00	0.00	0.00	-4.41
	132	2	10.09	12.52	0.00	0.00	0.00	21.42
		3	-10.09	12.68	0.00	0.00	0.00	-22.28
	133	2	10.13	13.47	0.00	0.00	0.00	23.28
		3	-10.13	13.37	0.00	0.00	0.00	-22.74
	134	2	5.21	13.68	0.00	0.00	0.00	26.20
		3	-5.21	11.52	0.00	0.00	0.00	-14.34
	135	2	9.00	13.83	0.00	0.00	0.00	24.69
		3	-9.00	13.02	0.00	0.00	0.00	-20.27
	136	2	8.97	12.96	0.00	0.00	0.00	23.62
		3	-8.97	12.25	0.00	0.00	0.00	-19.75
	137	2	4.62	9.94	0.00	0.00	0.00	18.48
		3	-4.62	8.70	0.00	0.00	0.00	-11.65
	138	2	4.59	9.07	0.00	0.00	0.00	17.41
		3	-4.59	7.93	0.00	0.00	0.00	-11.14
3	1	1	0.78	0.11	0.00	0.00	0.00	0.06
		4	-2.62	-0.11	0.00	0.00	0.00	1.19
	2	1	7.65	-0.34	0.00	0.00	0.00	-5.15
		4	-7.65	0.34	0.00	0.00	0.00	1.25
	3	1	1.44	-6.51	0.00	0.00	0.00	-10.52
		4	-1.44	-7.99	0.00	0.00	0.00	11.65
	13	1	0.42	-1.44	0.00	0.00	0.00	-2.98
		4	-0.42	-2.87	0.00	0.00	0.00	3.82
	4	1	9.73	-0.44	0.00	0.00	0.00	-6.55
		4	-9.73	0.44	0.00	0.00	0.00	1.59
	5	1	2.17	-9.77	0.00	0.00	0.00	-15.79
		4	-2.17	-11.99	0.00	0.00	0.00	17.47
	15	1	0.63	-2.15	0.00	0.00	0.00	-4.47
		4	-0.63	-4.31	0.00	0.00	0.00	5.74
	10	1	0.70	-0.03	0.00	0.00	0.00	-0.47
		4	-0.70	0.03	0.00	0.00	0.00	0.11
	11	1	0.77	-0.03	0.00	0.00	0.00	-0.52
		4	-0.77	0.03	-	-	-	0.16

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	18	1	-0.19	0.18	0.00	0.00	0.00	0.85
		4	0.19	-0.18	0.00	0.00	0.00	1.18
	19	1	-0.26	1.03	0.00	0.00	0.00	2.06
		4	0.26	2.50	0.00	0.00	0.00	-3.70
	20	1	-4.49	5.32	0.00	0.00	0.00	10.24
		4	4.49	6.70	0.00	0.00	0.00	-11.38
	100	1	0.78	0.11	0.00	0.00	0.00	0.06
		4	-2.62	-0.11	0.00	0.00	0.00	1.19
	101	1	0.99	-0.61	0.00	0.00	0.00	-1.43
		4	-2.83	-1.55	0.00	0.00	0.00	3.10
	102	1	9.15	-3.49	0.00	0.00	0.00	-10.35
		4	-10.99	-3.76	0.00	0.00	0.00	8.27
	103	1	9.84	-3.52	0.00	0.00	0.00	-10.82
		4	-11.69	-3.73	0.00	0.00	0.00	8.38
	104	1	9.92	-3.52	0.00	0.00	0.00	-10.86
		4	-11.76	-3.73	0.00	0.00	0.00	8.43
	105	1	9.58	-2.49	0.00	0.00	0.00	-8.75
		4	-11.42	-1.23	0.00	0.00	0.00	4.69
	106	1	9.66	-2.49	0.00	0.00	0.00	-8.80
		4	-11.50	-1.23	0.00	0.00	0.00	4.73
	107	1	5.35	1.80	0.00	0.00	0.00	-0.57
		4	-7.19	2.97	0.00	0.00	0.00	-3.00
	108	1	5.43	1.80	0.00	0.00	0.00	-0.62
		4	-7.27	2.97	0.00	0.00	0.00	-2.95
	111	1	1.10	-0.97	0.00	0.00	0.00	-2.17
		4	-2.94	-2.26	0.00	0.00	0.00	4.06
	112	1	11.60	-5.21	0.00	0.00	0.00	-14.38
		4	-13.44	-5.67	0.00	0.00	0.00	11.52
	113	1	12.29	-5.24	0.00	0.00	0.00	-14.85
		4	-14.13	-5.64	0.00	0.00	0.00	11.63
	114	1	12.37	-5.24	0.00	0.00	0.00	-14.90
		4	-14.21	-5.64	0.00	0.00	0.00	11.68
	115	1	11.94	-4.12	0.00	0.00	0.00	-12.37
		4	-13.78	-3.22	0.00	0.00	0.00	8.52
	116	1	12.01	-4.12	0.00	0.00	0.00	-12.42
		4	-13.86	-3.22	0.00	0.00	0.00	8.57
	117	1	7.61	0.26	0.00	0.00	0.00	-3.76
		4	-9.46	0.89	0.00	0.00	0.00	1.43
	118	1	7.69	0.26	0.00	0.00	0.00	-3.81
		4	-9.53	0.89	0.00	0.00	0.00	1.48
	121	1	1.20	-1.33	0.00	0.00	0.00	-2.92
		4	-3.04	-2.98	0.00	0.00	0.00	5.02
	122	1	9.87	-6.74	0.00	0.00	0.00	-15.61
		4	-11.71	-7.76	0.00	0.00	0.00	14.09
	123	1	10.57	-6.78	0.00	0.00	0.00	-16.08
		4	-12.41	-7.73	0.00	0.00	0.00	14.20
	124	1	10.64	-6.78	0.00	0.00	0.00	-16.12
		4	-12.49	-7.73	0.00	0.00	0.00	14.25
	125	1	10.30	-5.74	0.00	0.00	0.00	-14.02
		4	-12.15	-5.23	0.00	0.00	0.00	10.51

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	126	1	10.38	-5.74	0.00	0.00	0.00	-14.06
		4	-12.22	-5.23	0.00	0.00	0.00	10.56
	127	1	6.08	-1.45	0.00	0.00	0.00	-5.84
		4	-7.92	-1.03	0.00	0.00	0.00	2.82
	128	1	6.15	-1.45	0.00	0.00	0.00	-5.88
		4	-7.99	-1.03	0.00	0.00	0.00	2.87
	131	1	1.41	-2.04	0.00	0.00	0.00	-4.41
		4	-3.25	-4.42	0.00	0.00	0.00	6.93
	132	1	12.68	-10.09	0.00	0.00	0.00	-22.28
		4	-14.52	-11.67	0.00	0.00	0.00	20.26
	133	1	13.37	-10.13	0.00	0.00	0.00	-22.74
		4	-15.22	-11.63	0.00	0.00	0.00	20.37
	134	1	12.37	-5.24	0.00	0.00	0.00	-14.90
		4	-14.21	-5.64	0.00	0.00	0.00	11.68
	135	1	13.02	-9.00	0.00	0.00	0.00	-20.27
		4	-14.86	-9.22	0.00	0.00	0.00	17.25
	136	1	13.10	-9.00	0.00	0.00	0.00	-20.31
		4	-14.94	-9.22	0.00	0.00	0.00	17.30
	137	1	8.70	-4.62	0.00	0.00	0.00	-11.65
		4	-10.54	-5.11	0.00	0.00	0.00	10.17
	138	1	8.77	-4.62	0.00	0.00	0.00	-11.70
		4	-10.62	-5.11	0.00	0.00	0.00	10.22
4	1	2	2.82	0.00	0.00	0.00	0.00	0.00
		9	-4.24	0.00	0.00	0.00	0.00	0.00
	2	2	20.87	0.00	0.00	0.00	0.00	0.00
		9	-20.87	0.00	0.00	0.00	0.00	0.00
	3	2	-2.89	0.00	0.00	0.00	0.00	0.00
		9	2.89	0.00	0.00	0.00	0.00	0.00
	13	2	-0.84	0.00	0.00	0.00	0.00	0.00
		9	0.84	0.00	0.00	0.00	0.00	0.00
	4	2	26.56	0.00	0.00	0.00	0.00	0.00
		9	-26.56	0.00	0.00	0.00	0.00	0.00
	5	2	-4.34	0.00	0.00	0.00	0.00	0.00
		9	4.34	0.00	0.00	0.00	0.00	0.00
	15	2	-1.26	0.00	0.00	0.00	0.00	0.00
		9	1.26	0.00	0.00	0.00	0.00	0.00
	10	2	1.90	0.00	0.00	0.00	0.00	0.00
		9	-1.90	0.00	0.00	0.00	0.00	0.00
	11	2	0.95	0.03	0.00	0.00	0.00	0.27
		9	-0.95	-0.03	0.00	0.00	0.00	0.08
	18	2	0.37	0.00	0.00	0.00	0.00	0.00
		9	-0.37	0.00	0.00	0.00	0.00	0.00
	19	2	0.53	0.00	0.00	0.00	0.00	0.00
		9	-0.53	0.00	0.00	0.00	0.00	0.00
	20	2	-7.43	0.00	0.00	0.00	0.00	0.00
		9	7.43	0.00	0.00	0.00	0.00	0.00
	100	2	2.82	0.00	0.00	0.00	0.00	0.00
		9	-4.24	0.00	0.00	0.00	0.00	0.00
	101	2	2.40	0.00	0.00	0.00	0.00	0.00
		9	-2.40	–	–	–	–	–

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	102	2	22.25	0.00	0.00	0.00	0.00	0.00
		9	-23.66	0.00	0.00	0.00	0.00	0.00
	103	2	24.14	0.00	0.00	0.00	0.00	0.00
		9	-25.56	0.00	0.00	0.00	0.00	0.00
	104	2	23.20	0.03	0.00	0.00	0.00	0.27
		9	-24.61	-0.03	0.00	0.00	0.00	0.08
	105	2	24.67	0.00	0.00	0.00	0.00	0.00
		9	-26.09	0.00	0.00	0.00	0.00	0.00
	106	2	23.72	0.03	0.00	0.00	0.00	0.27
		9	-25.14	-0.03	0.00	0.00	0.00	0.08
	107	2	16.71	0.00	0.00	0.00	0.00	0.00
		9	-18.13	0.00	0.00	0.00	0.00	0.00
	108	2	15.76	0.03	0.00	0.00	0.00	0.27
		9	-17.18	-0.03	0.00	0.00	0.00	0.08
	111	2	2.19	0.00	0.00	0.00	0.00	0.00
		9	-3.61	0.00	0.00	0.00	0.00	0.00
	112	2	27.22	0.00	0.00	0.00	0.00	0.00
		9	-28.63	0.00	0.00	0.00	0.00	0.00
	113	2	29.11	0.00	0.00	0.00	0.00	0.00
		9	-30.53	0.00	0.00	0.00	0.00	0.00
	114	2	28.16	0.03	0.00	0.00	0.00	0.27
		9	-29.58	-0.03	0.00	0.00	0.00	0.08
	115	2	29.82	0.00	0.00	0.00	0.00	0.00
		9	-31.24	0.00	0.00	0.00	0.00	0.00
	116	2	28.87	0.03	0.00	0.00	0.00	0.27
		9	-30.29	-0.03	0.00	0.00	0.00	0.08
	117	2	22.05	0.00	0.00	0.00	0.00	0.00
		9	-23.47	0.00	0.00	0.00	0.00	0.00
	118	2	21.10	0.03	0.00	0.00	0.00	0.27
		9	-22.52	-0.03	0.00	0.00	0.00	0.08
	121	2	1.98	0.00	0.00	0.00	0.00	0.00
		9	-3.40	0.00	0.00	0.00	0.00	0.00
	122	2	20.80	0.00	0.00	0.00	0.00	0.00
		9	-22.22	0.00	0.00	0.00	0.00	0.00
	123	2	22.70	0.00	0.00	0.00	0.00	0.00
		9	-24.12	0.00	0.00	0.00	0.00	0.00
	124	2	21.75	0.03	0.00	0.00	0.00	0.27
		9	-23.17	-0.03	0.00	0.00	0.00	0.08
	125	2	23.23	0.00	0.00	0.00	0.00	0.00
		9	-24.64	0.00	0.00	0.00	0.00	0.00
	126	2	22.28	0.03	0.00	0.00	0.00	0.27
		9	-23.69	-0.03	0.00	0.00	0.00	0.08
	127	2	15.27	0.00	0.00	0.00	0.00	0.00
		9	-16.68	0.00	0.00	0.00	0.00	0.00
	128	2	14.32	0.03	0.00	0.00	0.00	0.27
		9	-15.73	-0.03	0.00	0.00	0.00	0.08
	131	2	1.56	0.00	0.00	0.00	0.00	0.00
		9	-2.98	0.00	0.00	0.00	0.00	0.00
	132	2	25.05	0.00	0.00	0.00	0.00	0.00
		9	-26.47	0.00	0.00	0.00	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	133	2	26.95	0.00	0.00	0.00	0.00	0.00
		9	-28.36	0.00	0.00	0.00	0.00	0.00
	134	2	28.16	0.03	0.00	0.00	0.00	0.27
		9	-29.58	-0.03	0.00	0.00	0.00	0.08
	135	2	27.65	0.00	0.00	0.00	0.00	0.00
		9	-29.07	0.00	0.00	0.00	0.00	0.00
	136	2	26.71	0.03	0.00	0.00	0.00	0.27
		9	-28.12	-0.03	0.00	0.00	0.00	0.08
	137	2	19.89	0.00	0.00	0.00	0.00	0.00
		9	-21.30	0.00	0.00	0.00	0.00	0.00
	138	2	18.94	0.03	0.00	0.00	0.00	0.27
		9	-20.35	-0.03	0.00	0.00	0.00	0.08
5	1	3	0.78	-0.11	0.00	0.00	0.00	-0.06
		14	-2.62	0.11	0.00	0.00	0.00	-1.19
	2	3	7.65	0.34	0.00	0.00	0.00	5.15
		14	-7.65	-0.34	0.00	0.00	0.00	-1.25
	3	3	1.44	6.51	0.00	0.00	0.00	10.52
		14	-1.44	7.99	0.00	0.00	0.00	-11.65
	13	3	0.42	1.44	0.00	0.00	0.00	2.98
		14	-0.42	2.87	0.00	0.00	0.00	-3.82
	4	3	9.73	0.44	0.00	0.00	0.00	6.55
		14	-9.73	-0.44	0.00	0.00	0.00	-1.59
	5	3	2.17	9.77	0.00	0.00	0.00	15.79
		14	-2.17	11.99	0.00	0.00	0.00	-17.47
	15	3	0.63	2.15	0.00	0.00	0.00	4.47
		14	-0.63	4.31	0.00	0.00	0.00	-5.74
	10	3	0.70	0.03	0.00	0.00	0.00	0.47
		14	-0.70	-0.03	0.00	0.00	0.00	-0.11
	11	3	-0.08	0.00	0.00	0.00	0.00	-0.05
		14	0.08	0.00	0.00	0.00	0.00	0.05
	18	3	-0.19	-0.18	0.00	0.00	0.00	-0.85
		14	0.19	0.18	0.00	0.00	0.00	-1.18
	19	3	-0.26	-1.03	0.00	0.00	0.00	-2.06
		14	0.26	-2.50	0.00	0.00	0.00	3.70
	20	3	-4.49	-5.32	0.00	0.00	0.00	-10.24
		14	4.49	-6.70	0.00	0.00	0.00	11.38
	100	3	0.78	-0.11	0.00	0.00	0.00	-0.06
		14	-2.62	0.11	0.00	0.00	0.00	-1.19
	101	3	0.99	0.61	0.00	0.00	0.00	1.43
		14	-2.83	1.55	0.00	0.00	0.00	-3.10
	102	3	9.15	3.49	0.00	0.00	0.00	10.35
		14	-10.99	3.76	0.00	0.00	0.00	-8.27
	103	3	9.84	3.52	0.00	0.00	0.00	10.82
		14	-11.69	3.73	0.00	0.00	0.00	-8.38
	104	3	9.07	3.49	0.00	0.00	0.00	10.30
		14	-10.91	3.76	0.00	0.00	0.00	-8.22
	105	3	9.58	2.49	0.00	0.00	0.00	8.75
		14	-11.42	1.23	0.00	0.00	0.00	-4.69
	106	3	8.81	2.45	0.00	0.00	0.00	8.24
		14	-10.62	1.26	-	-	-	-4.52

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	107	3	5.35	-1.80	0.00	0.00	0.00	0.57
		14	-7.19	-2.97	0.00	0.00	0.00	3.00
	108	3	4.58	-1.83	0.00	0.00	0.00	0.06
		14	-6.42	-2.94	0.00	0.00	0.00	3.16
	111	3	1.10	0.97	0.00	0.00	0.00	2.17
		14	-2.94	2.26	0.00	0.00	0.00	-4.06
	112	3	11.60	5.21	0.00	0.00	0.00	14.38
		14	-13.44	5.67	0.00	0.00	0.00	-11.52
	113	3	12.29	5.24	0.00	0.00	0.00	14.85
		14	-14.13	5.64	0.00	0.00	0.00	-11.63
	114	3	11.52	5.21	0.00	0.00	0.00	14.34
		14	-13.36	5.67	0.00	0.00	0.00	-11.47
	115	3	11.94	4.12	0.00	0.00	0.00	12.37
		14	-13.78	3.22	0.00	0.00	0.00	-8.52
	116	3	11.17	4.09	0.00	0.00	0.00	11.86
		14	-13.01	3.26	0.00	0.00	0.00	-8.35
	117	3	7.61	-0.26	0.00	0.00	0.00	3.76
		14	-9.46	-0.89	0.00	0.00	0.00	-1.43
	118	3	6.84	-0.29	0.00	0.00	0.00	3.25
		14	-8.68	-0.85	0.00	0.00	0.00	-1.27
	121	3	1.20	1.33	0.00	0.00	0.00	2.92
		14	-3.04	2.98	0.00	0.00	0.00	-5.02
	122	3	9.87	6.74	0.00	0.00	0.00	15.61
		14	-11.71	7.76	0.00	0.00	0.00	-14.09
	123	3	10.57	6.78	0.00	0.00	0.00	16.08
		14	-12.41	7.73	0.00	0.00	0.00	-14.20
	124	3	9.80	6.74	0.00	0.00	0.00	15.56
		14	-11.64	7.76	0.00	0.00	0.00	-14.04
	125	3	10.30	5.74	0.00	0.00	0.00	14.02
		14	-12.15	5.23	0.00	0.00	0.00	-10.51
	126	3	9.53	5.71	0.00	0.00	0.00	13.50
		14	-11.37	5.26	0.00	0.00	0.00	-10.35
	127	3	6.08	1.45	0.00	0.00	0.00	5.84
		14	-7.92	1.03	0.00	0.00	0.00	-2.82
	128	3	5.30	1.42	0.00	0.00	0.00	5.32
		14	-7.15	1.06	0.00	0.00	0.00	-2.66
	131	3	1.41	2.04	0.00	0.00	0.00	4.41
		14	-3.25	4.42	0.00	0.00	0.00	-6.93
	132	3	12.68	10.09	0.00	0.00	0.00	22.28
		14	-14.52	11.67	0.00	0.00	0.00	-20.26
	133	3	13.37	10.13	0.00	0.00	0.00	22.74
		14	-15.22	11.63	0.00	0.00	0.00	-20.37
	134	3	11.52	5.21	0.00	0.00	0.00	14.34
		14	-13.36	5.67	0.00	0.00	0.00	-11.47
	135	3	13.02	9.00	0.00	0.00	0.00	20.27
		14	-14.86	9.22	0.00	0.00	0.00	-17.25
	136	3	12.25	8.97	0.00	0.00	0.00	19.75
		14	-14.09	9.25	0.00	0.00	0.00	-17.09
	137	3	8.70	4.62	0.00	0.00	0.00	11.65
		14	-10.54	5.11	0.00	0.00	0.00	-10.17

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	138	3	7.93	4.59	0.00	0.00	0.00	11.14
		14	-9.77	5.14	0.00	0.00	0.00	-10.01
6	1	4	0.11	-1.11	0.00	0.00	0.00	-1.19
		5	-0.11	1.54	0.00	0.00	0.00	-1.71
	2	4	-0.34	-4.09	0.00	0.00	0.00	-1.25
		5	0.34	4.09	0.00	0.00	0.00	-7.72
	3	4	7.98	-1.93	0.00	0.00	0.00	-11.65
		5	-7.98	1.93	0.00	0.00	0.00	7.42
	13	4	2.87	-0.61	0.00	0.00	0.00	-3.82
		5	-2.87	0.61	0.00	0.00	0.00	2.48
	4	4	-0.44	-5.21	0.00	0.00	0.00	-1.59
		5	0.44	5.21	0.00	0.00	0.00	-9.82
	5	4	11.97	-2.89	0.00	0.00	0.00	-17.47
		5	-11.97	2.89	0.00	0.00	0.00	11.13
	15	4	4.30	-0.92	0.00	0.00	0.00	-5.74
		5	-4.30	0.92	0.00	0.00	0.00	3.72
	10	4	-0.03	-0.37	0.00	0.00	0.00	-0.11
		5	0.03	0.37	0.00	0.00	0.00	-0.70
	11	4	-0.03	-0.38	0.00	0.00	0.00	-0.16
		5	0.03	0.38	0.00	0.00	0.00	-0.67
	18	4	0.18	-2.13	0.00	0.00	0.00	-1.18
		5	-0.18	-1.06	0.00	0.00	0.00	0.01
	19	4	-2.50	1.42	0.00	0.00	0.00	3.70
		5	2.50	-0.06	0.00	0.00	0.00	-2.08
	20	4	-6.69	5.47	0.00	0.00	0.00	11.38
		5	6.69	-2.46	0.00	0.00	0.00	-2.69
	100	4	0.11	-1.11	0.00	0.00	0.00	-1.19
		5	-0.11	1.54	0.00	0.00	0.00	-1.71
	101	4	1.54	-1.41	0.00	0.00	0.00	-3.10
		5	-1.54	1.85	0.00	0.00	0.00	-0.47
	102	4	3.76	-6.16	0.00	0.00	0.00	-8.27
		5	-3.76	6.60	0.00	0.00	0.00	-5.72
	103	4	3.73	-6.53	0.00	0.00	0.00	-8.38
		5	-3.73	6.97	0.00	0.00	0.00	-6.42
	104	4	3.73	-6.54	0.00	0.00	0.00	-8.43
		5	-3.73	6.98	0.00	0.00	0.00	-6.38
	105	4	1.23	-5.11	0.00	0.00	0.00	-4.69
		5	-1.23	6.92	0.00	0.00	0.00	-8.49
	106	4	1.23	-5.12	0.00	0.00	0.00	-4.73
		5	-1.23	6.92	0.00	0.00	0.00	-8.46
	107	4	-2.96	-1.06	0.00	0.00	0.00	3.00
		5	2.96	4.51	0.00	0.00	0.00	-9.11
	108	4	-2.96	-1.07	0.00	0.00	0.00	2.95
		5	2.96	4.52	0.00	0.00	0.00	-9.07
	111	4	2.26	-1.57	0.00	0.00	0.00	-4.06
		5	-2.26	2.01	0.00	0.00	0.00	0.15
	112	4	5.66	-7.76	0.00	0.00	0.00	-11.52
		5	-5.66	8.20	0.00	0.00	0.00	-5.97
	113	4	5.63	-8.13	0.00	0.00	0.00	-11.63
		5	-5.63	8.57	—	—	—	6.67

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	114	4	5.63	-8.14	0.00	0.00	0.00	-11.68
		5	-5.63	8.58	0.00	0.00	0.00	-6.63
	115	4	3.22	-7.75	0.00	0.00	0.00	-8.52
		5	-3.22	7.99	0.00	0.00	0.00	-8.74
	116	4	3.22	-7.76	0.00	0.00	0.00	-8.57
		5	-3.22	8.00	0.00	0.00	0.00	-8.70
	117	4	-0.88	-4.79	0.00	0.00	0.00	-1.43
		5	0.88	5.05	0.00	0.00	0.00	-9.35
	118	4	-0.88	-4.80	0.00	0.00	0.00	-1.48
		5	0.88	5.05	0.00	0.00	0.00	-9.31
	121	4	2.98	-1.72	0.00	0.00	0.00	-5.02
		5	-2.98	2.16	0.00	0.00	0.00	0.77
	122	4	7.75	-7.13	0.00	0.00	0.00	-14.09
		5	-7.75	7.56	0.00	0.00	0.00	-2.01
	123	4	7.72	-7.50	0.00	0.00	0.00	-14.20
		5	-7.72	7.94	0.00	0.00	0.00	-2.71
	124	4	7.72	-7.50	0.00	0.00	0.00	-14.25
		5	-7.72	7.94	0.00	0.00	0.00	-2.67
	125	4	5.22	-6.07	0.00	0.00	0.00	-10.51
		5	-5.22	7.88	0.00	0.00	0.00	-4.78
	126	4	5.22	-6.08	0.00	0.00	0.00	-10.56
		5	-5.22	7.89	0.00	0.00	0.00	-4.75
	127	4	1.03	-2.03	0.00	0.00	0.00	-2.82
		5	-1.03	5.48	0.00	0.00	0.00	-5.40
	128	4	1.03	-2.03	0.00	0.00	0.00	-2.87
		5	-1.03	5.48	0.00	0.00	0.00	-5.36
	131	4	4.41	-2.03	0.00	0.00	0.00	-6.93
		5	-4.41	2.47	0.00	0.00	0.00	2.00
	132	4	11.65	-9.21	0.00	0.00	0.00	-20.26
		5	-11.65	9.64	0.00	0.00	0.00	-0.40
	133	4	11.62	-9.58	0.00	0.00	0.00	-20.37
		5	-11.62	10.02	0.00	0.00	0.00	-1.10
	134	4	5.63	-8.14	0.00	0.00	0.00	-11.68
		5	-5.63	8.58	0.00	0.00	0.00	-6.63
	135	4	9.21	-9.20	0.00	0.00	0.00	-17.25
		5	-9.21	9.44	0.00	0.00	0.00	-3.17
	136	4	9.21	-9.20	0.00	0.00	0.00	-17.30
		5	-9.21	9.45	0.00	0.00	0.00	-3.14
	137	4	5.10	-6.24	0.00	0.00	0.00	-10.17
		5	-5.10	6.50	0.00	0.00	0.00	-3.78
	138	4	5.10	-6.24	0.00	0.00	0.00	-10.22
		5	-5.10	6.50	0.00	0.00	0.00	-3.75
7	1	5	0.11	-0.20	0.00	0.00	0.00	1.71
		6	-0.11	0.64	0.00	0.00	0.00	-2.63
	2	5	-0.34	-1.15	0.00	0.00	0.00	7.72
		6	0.34	1.15	0.00	0.00	0.00	-10.23
	3	5	7.98	-1.68	0.00	0.00	0.00	-7.42
		6	-7.98	1.68	0.00	0.00	0.00	3.74
	13	5	2.87	-0.55	0.00	0.00	0.00	-2.48
		6	-2.87	0.55				

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	5	-0.44	-1.46	0.00	0.00	0.00	9.82
		6	0.44	1.46	0.00	0.00	0.00	-13.02
	5	5	11.97	-2.52	0.00	0.00	0.00	-11.13
		6	-11.97	2.52	0.00	0.00	0.00	5.62
	15	5	4.30	-0.83	0.00	0.00	0.00	-3.72
		6	-4.30	0.83	0.00	0.00	0.00	1.90
	10	5	-0.03	-0.10	0.00	0.00	0.00	0.70
		6	0.03	0.10	0.00	0.00	0.00	-0.93
	11	5	-0.03	-0.09	0.00	0.00	0.00	0.67
		6	0.03	0.09	0.00	0.00	0.00	-0.86
	18	5	0.18	-1.74	0.00	0.00	0.00	-0.01
		6	-0.18	-1.45	0.00	0.00	0.00	-0.31
	19	5	-2.50	1.21	0.00	0.00	0.00	2.08
		6	2.50	0.16	0.00	0.00	0.00	-0.93
	20	5	-6.69	3.56	0.00	0.00	0.00	2.69
		6	6.69	-0.55	0.00	0.00	0.00	1.81
	100	5	0.11	-0.20	0.00	0.00	0.00	1.71
		6	-0.11	0.64	0.00	0.00	0.00	-2.63
	101	5	1.54	-0.48	0.00	0.00	0.00	0.47
		6	-1.54	0.92	0.00	0.00	0.00	-2.00
	102	5	3.76	-2.19	0.00	0.00	0.00	5.72
		6	-3.76	2.63	0.00	0.00	0.00	-10.99
	103	5	3.73	-2.29	0.00	0.00	0.00	6.42
		6	-3.73	2.73	0.00	0.00	0.00	-11.92
	104	5	3.73	-2.28	0.00	0.00	0.00	6.38
		6	-3.73	2.72	0.00	0.00	0.00	-11.86
	105	5	1.23	-1.09	0.00	0.00	0.00	8.49
		6	-1.23	2.89	0.00	0.00	0.00	-12.85
	106	5	1.23	-1.07	0.00	0.00	0.00	8.46
		6	-1.23	2.88	0.00	0.00	0.00	-12.79
	107	5	-2.96	1.27	0.00	0.00	0.00	9.11
		6	2.96	2.18	0.00	0.00	0.00	-10.11
	108	5	-2.96	1.28	0.00	0.00	0.00	9.07
		6	2.96	2.17	0.00	0.00	0.00	-10.04
	111	5	2.26	-0.62	0.00	0.00	0.00	-0.15
		6	-2.26	1.05	0.00	0.00	0.00	-1.68
	112	5	5.66	-2.92	0.00	0.00	0.00	5.97
		6	-5.66	3.36	0.00	0.00	0.00	-12.85
	113	5	5.63	-3.03	0.00	0.00	0.00	6.67
		6	-5.63	3.46	0.00	0.00	0.00	-13.78
	114	5	5.63	-3.01	0.00	0.00	0.00	6.63
		6	-5.63	3.45	0.00	0.00	0.00	-13.71
	115	5	3.22	-2.67	0.00	0.00	0.00	8.74
		6	-3.22	2.91	0.00	0.00	0.00	-14.86
	116	5	3.22	-2.66	0.00	0.00	0.00	8.70
		6	-3.22	2.90	0.00	0.00	0.00	-14.79
	117	5	-0.88	-1.21	0.00	0.00	0.00	9.35
		6	0.88	1.46	0.00	0.00	0.00	-12.27
	118	5	-0.88	-1.19	0.00	0.00	0.00	9.31
		6	0.88	1.45	0.00	0.00	0.00	-12.21

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	121	5	2.98	-0.75	0.00	0.00	0.00	-0.77
		6	-2.98	1.19	0.00	0.00	0.00	-1.37
	122	5	7.75	-3.03	0.00	0.00	0.00	2.01
		6	-7.75	3.47	0.00	0.00	0.00	-9.12
	123	5	7.72	-3.13	0.00	0.00	0.00	2.71
		6	-7.72	3.57	0.00	0.00	0.00	-10.05
	124	5	7.72	-3.12	0.00	0.00	0.00	2.67
		6	-7.72	3.55	0.00	0.00	0.00	-9.98
	125	5	5.22	-1.92	0.00	0.00	0.00	4.78
		6	-5.22	3.73	0.00	0.00	0.00	-10.98
	126	5	5.22	-1.91	0.00	0.00	0.00	4.75
		6	-5.22	3.72	0.00	0.00	0.00	-10.91
	127	5	1.03	0.43	0.00	0.00	0.00	5.40
		6	-1.03	3.02	0.00	0.00	0.00	-8.24
	128	5	1.03	0.44	0.00	0.00	0.00	5.36
		6	-1.03	3.00	0.00	0.00	0.00	-8.17
	131	5	4.41	-1.03	0.00	0.00	0.00	-2.00
		6	-4.41	1.47	0.00	0.00	0.00	-0.73
	132	5	11.65	-4.18	0.00	0.00	0.00	0.40
		6	-11.65	4.62	0.00	0.00	0.00	-10.04
	133	5	11.62	-4.28	0.00	0.00	0.00	1.10
		6	-11.62	4.72	0.00	0.00	0.00	-10.97
	134	5	5.63	-3.01	0.00	0.00	0.00	6.63
		6	-5.63	3.45	0.00	0.00	0.00	-13.71
	135	5	9.21	-3.93	0.00	0.00	0.00	3.17
		6	-9.21	4.17	0.00	0.00	0.00	-12.05
	136	5	9.21	-3.92	0.00	0.00	0.00	3.14
		6	-9.21	4.16	0.00	0.00	0.00	-11.98
	137	5	5.10	-2.46	0.00	0.00	0.00	3.78
		6	-5.10	2.72	0.00	0.00	0.00	-9.47
	138	5	5.10	-2.45	0.00	0.00	0.00	3.75
		6	-5.10	2.71	0.00	0.00	0.00	-9.40
8	1	6	0.11	0.47	0.00	0.00	0.00	2.63
		7	-0.11	-0.03	0.00	0.00	0.00	-2.08
	2	6	-0.34	1.38	0.00	0.00	0.00	10.23
		7	0.34	-1.38	0.00	0.00	0.00	-7.22
	3	6	7.98	-1.30	0.00	0.00	0.00	-3.74
		7	-7.98	1.30	0.00	0.00	0.00	0.89
	13	6	2.87	-0.43	0.00	0.00	0.00	-1.27
		7	-2.87	0.43	0.00	0.00	0.00	0.33
	4	6	-0.44	1.75	0.00	0.00	0.00	13.02
		7	0.44	-1.75	0.00	0.00	0.00	-9.19
	5	6	11.97	-1.95	0.00	0.00	0.00	-5.62
		7	-11.97	1.95	0.00	0.00	0.00	1.34
	15	6	4.30	-0.64	0.00	0.00	0.00	-1.90
		7	-4.30	0.64	0.00	0.00	0.00	0.49
	10	6	-0.03	0.13	0.00	0.00	0.00	0.93
		7	0.03	-0.13	0.00	0.00	0.00	-0.66
	11	6	-0.03	0.10	0.00	0.00	0.00	0.86
		7	0.03	-0.10	-	-	-	-0.65

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	18	6	0.18	-1.54	0.00	0.00	0.00	0.31
		7	-0.18	-1.65	0.00	0.00	0.00	-0.19
	19	6	-2.50	1.02	0.00	0.00	0.00	0.93
		7	2.50	0.35	0.00	0.00	0.00	-0.20
	20	6	-6.69	1.91	0.00	0.00	0.00	-1.81
		7	6.69	1.10	0.00	0.00	0.00	2.71
	100	6	0.11	0.47	0.00	0.00	0.00	2.63
		7	-0.11	-0.03	0.00	0.00	0.00	-2.08
	101	6	1.54	0.26	0.00	0.00	0.00	2.00
		7	-1.54	0.18	0.00	0.00	0.00	-1.92
	102	6	3.76	1.20	0.00	0.00	0.00	10.99
		7	-3.76	-0.76	0.00	0.00	0.00	-8.85
	103	6	3.73	1.32	0.00	0.00	0.00	11.92
		7	-3.73	-0.88	0.00	0.00	0.00	-9.51
	104	6	3.73	1.30	0.00	0.00	0.00	11.86
		7	-3.73	-0.86	0.00	0.00	0.00	-9.50
	105	6	1.23	2.34	0.00	0.00	0.00	12.85
		7	-1.23	-0.53	0.00	0.00	0.00	-9.70
	106	6	1.23	2.31	0.00	0.00	0.00	12.79
		7	-1.23	-0.51	0.00	0.00	0.00	-9.69
	107	6	-2.96	3.24	0.00	0.00	0.00	10.11
		7	2.96	0.21	0.00	0.00	0.00	-6.80
	108	6	-2.96	3.21	0.00	0.00	0.00	10.04
		7	2.96	0.24	0.00	0.00	0.00	-6.79
	111	6	2.26	0.15	0.00	0.00	0.00	1.68
		7	-2.26	0.29	0.00	0.00	0.00	-1.83
	112	6	5.66	1.25	0.00	0.00	0.00	12.85
		7	-5.66	-0.81	0.00	0.00	0.00	-10.60
	113	6	5.63	1.37	0.00	0.00	0.00	13.78
		7	-5.63	-0.93	0.00	0.00	0.00	-11.25
	114	6	5.63	1.34	0.00	0.00	0.00	13.71
		7	-5.63	-0.91	0.00	0.00	0.00	-11.24
	115	6	3.22	1.63	0.00	0.00	0.00	14.86
		7	-3.22	-1.39	0.00	0.00	0.00	-11.54
	116	6	3.22	1.61	0.00	0.00	0.00	14.79
		7	-3.22	-1.37	0.00	0.00	0.00	-11.53
	117	6	-0.88	1.74	0.00	0.00	0.00	12.27
		7	0.88	-1.49	0.00	0.00	0.00	-8.73
	118	6	-0.88	1.72	0.00	0.00	0.00	12.21
		7	0.88	-1.46	0.00	0.00	0.00	-8.72
	121	6	2.98	0.04	0.00	0.00	0.00	1.37
		7	-2.98	0.40	0.00	0.00	0.00	-1.75
	122	6	7.75	0.55	0.00	0.00	0.00	9.12
		7	-7.75	-0.11	0.00	0.00	0.00	-8.41
	123	6	7.72	0.67	0.00	0.00	0.00	10.05
		7	-7.72	-0.23	0.00	0.00	0.00	-9.06
	124	6	7.72	0.64	0.00	0.00	0.00	9.98
		7	-7.72	-0.21	0.00	0.00	0.00	-9.05
	125	6	5.22	1.69	0.00	0.00	0.00	10.98
		7	-5.22	0.12	0.00	0.00	0.00	-9.26

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	126	6	5.22	1.66	0.00	0.00	0.00	10.91
		7	-5.22	0.14	0.00	0.00	0.00	-9.25
	127	6	1.03	2.58	0.00	0.00	0.00	8.24
		7	-1.03	0.86	0.00	0.00	0.00	-6.35
	128	6	1.03	2.56	0.00	0.00	0.00	8.17
		7	-1.03	0.89	0.00	0.00	0.00	-6.34
	131	6	4.41	-0.17	0.00	0.00	0.00	0.73
		7	-4.41	0.61	0.00	0.00	0.00	-1.59
	132	6	11.65	0.27	0.00	0.00	0.00	10.04
		7	-11.65	0.17	0.00	0.00	0.00	-9.93
	133	6	11.62	0.40	0.00	0.00	0.00	10.97
		7	-11.62	0.04	0.00	0.00	0.00	-10.58
	134	6	5.63	1.34	0.00	0.00	0.00	13.71
		7	-5.63	-0.91	0.00	0.00	0.00	-11.24
	135	6	9.21	0.66	0.00	0.00	0.00	12.05
		7	-9.21	-0.42	0.00	0.00	0.00	-10.87
	136	6	9.21	0.63	0.00	0.00	0.00	11.98
		7	-9.21	-0.39	0.00	0.00	0.00	-10.86
	137	6	5.10	0.77	0.00	0.00	0.00	9.47
		7	-5.10	-0.51	0.00	0.00	0.00	-8.07
	138	6	5.10	0.74	0.00	0.00	0.00	9.40
		7	-5.10	-0.48	0.00	0.00	0.00	-8.06
9	1	7	0.11	1.12	0.00	0.00	0.00	2.08
		8	-0.11	-0.68	0.00	0.00	0.00	-0.11
	2	7	-0.34	4.30	0.00	0.00	0.00	7.22
		8	0.34	-4.30	0.00	0.00	0.00	2.22
	3	7	7.98	-1.15	0.00	0.00	0.00	-0.89
		8	-7.98	1.15	0.00	0.00	0.00	-1.62
	13	7	2.87	-0.36	0.00	0.00	0.00	-0.33
		8	-2.87	0.36	0.00	0.00	0.00	-0.47
	4	7	-0.44	5.48	0.00	0.00	0.00	9.19
		8	0.44	-5.48	0.00	0.00	0.00	2.82
	5	7	11.97	-1.72	0.00	0.00	0.00	-1.34
		8	-11.97	1.72	0.00	0.00	0.00	-2.43
	15	7	4.30	-0.54	0.00	0.00	0.00	-0.49
		8	-4.30	0.54	0.00	0.00	0.00	-0.70
	10	7	-0.03	0.39	0.00	0.00	0.00	0.66
		8	0.03	-0.39	0.00	0.00	0.00	0.20
	11	7	-0.03	0.26	0.00	0.00	0.00	0.65
		8	0.03	-0.26	0.00	0.00	0.00	-0.08
	18	7	0.18	-1.46	0.00	0.00	0.00	0.19
		8	-0.18	-1.73	0.00	0.00	0.00	0.11
	19	7	-2.50	0.93	0.00	0.00	0.00	0.20
		8	2.50	0.44	0.00	0.00	0.00	0.33
	20	7	-6.69	0.37	0.00	0.00	0.00	-2.71
		8	6.69	2.64	0.00	0.00	0.00	0.23
	100	7	0.11	1.12	0.00	0.00	0.00	2.08
		8	-0.11	-0.68	0.00	0.00	0.00	-0.11
	101	7	1.54	0.94	0.00	0.00	0.00	1.92
		8	-1.54	-0.50	—	—	—	[illegible]

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	102	7	3.76	4.85	0.00	0.00	0.00	8.85
		8	-3.76	-4.41	0.00	0.00	0.00	1.30
	103	7	3.73	5.24	0.00	0.00	0.00	9.51
		8	-3.73	-4.80	0.00	0.00	0.00	1.50
	104	7	3.73	5.11	0.00	0.00	0.00	9.50
		8	-3.73	-4.67	0.00	0.00	0.00	1.21
	105	7	1.23	6.17	0.00	0.00	0.00	9.70
		8	-1.23	-4.36	0.00	0.00	0.00	1.83
	106	7	1.23	6.03	0.00	0.00	0.00	9.69
		8	-1.23	-4.23	0.00	0.00	0.00	1.55
	107	7	-2.96	5.61	0.00	0.00	0.00	6.80
		8	2.96	-2.16	0.00	0.00	0.00	1.73
	108	7	-2.96	5.48	0.00	0.00	0.00	6.79
		8	2.96	-2.03	0.00	0.00	0.00	1.44
	111	7	2.26	0.85	0.00	0.00	0.00	1.83
		8	-2.26	-0.41	0.00	0.00	0.00	-0.46
	112	7	5.66	5.74	0.00	0.00	0.00	10.60
		8	-5.66	-5.30	0.00	0.00	0.00	1.50
	113	7	5.63	6.13	0.00	0.00	0.00	11.25
		8	-5.63	-5.69	0.00	0.00	0.00	1.70
	114	7	5.63	5.99	0.00	0.00	0.00	11.24
		8	-5.63	-5.56	0.00	0.00	0.00	1.41
	115	7	3.22	6.34	0.00	0.00	0.00	11.54
		8	-3.22	-6.10	0.00	0.00	0.00	2.09
	116	7	3.22	6.21	0.00	0.00	0.00	11.53
		8	-3.22	-5.96	0.00	0.00	0.00	1.80
	117	7	-0.88	5.05	0.00	0.00	0.00	8.73
		8	0.88	-4.79	0.00	0.00	0.00	2.04
	118	7	-0.88	4.91	0.00	0.00	0.00	8.72
		8	0.88	-4.65	0.00	0.00	0.00	1.76
	121	7	2.98	0.76	0.00	0.00	0.00	1.75
		8	-2.98	-0.32	0.00	0.00	0.00	-0.58
	122	7	7.75	4.28	0.00	0.00	0.00	8.41
		8	-7.75	-3.84	0.00	0.00	0.00	0.49
	123	7	7.72	4.67	0.00	0.00	0.00	9.06
		8	-7.72	-4.23	0.00	0.00	0.00	0.69
	124	7	7.72	4.53	0.00	0.00	0.00	9.05
		8	-7.72	-4.10	0.00	0.00	0.00	0.41
	125	7	5.22	5.59	0.00	0.00	0.00	9.26
		8	-5.22	-3.79	0.00	0.00	0.00	1.02
	126	7	5.22	5.46	0.00	0.00	0.00	9.25
		8	-5.22	-3.65	0.00	0.00	0.00	0.74
	127	7	1.03	5.04	0.00	0.00	0.00	6.35
		8	-1.03	-1.59	0.00	0.00	0.00	0.92
	128	7	1.03	4.91	0.00	0.00	0.00	6.34
		8	-1.03	-1.46	0.00	0.00	0.00	0.63
	131	7	4.41	0.57	0.00	0.00	0.00	1.59
		8	-4.41	-0.14	0.00	0.00	0.00	-0.81
	132	7	11.65	4.88	0.00	0.00	0.00	9.93
		8	-11.65	-4.44	0.00	0.00	0.00	0.28

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	133	7	11.62	5.27	0.00	0.00	0.00	10.58
		8	-11.62	-4.83	0.00	0.00	0.00	0.48
	134	7	5.63	5.99	0.00	0.00	0.00	11.24
		8	-5.63	-5.56	0.00	0.00	0.00	1.41
	135	7	9.21	5.48	0.00	0.00	0.00	10.87
		8	-9.21	-5.24	0.00	0.00	0.00	0.87
	136	7	9.21	5.35	0.00	0.00	0.00	10.86
		8	-9.21	-5.11	0.00	0.00	0.00	0.59
	137	7	5.10	4.19	0.00	0.00	0.00	8.07
		8	-5.10	-3.93	0.00	0.00	0.00	0.83
	138	7	5.10	4.05	0.00	0.00	0.00	8.06
		8	-5.10	-3.79	0.00	0.00	0.00	0.54
10	1	8	0.11	1.90	0.00	0.00	0.00	0.11
		9	-0.11	-1.46	0.00	0.00	0.00	3.56
	2	8	-0.34	8.18	0.00	0.00	0.00	-2.22
		9	0.34	-8.18	0.00	0.00	0.00	20.15
	3	8	7.98	-1.29	0.00	0.00	0.00	1.62
		9	-7.98	1.29	0.00	0.00	0.00	-4.45
	13	8	2.87	-0.39	0.00	0.00	0.00	0.47
		9	-2.87	0.39	0.00	0.00	0.00	-1.31
	4	8	-0.44	10.41	0.00	0.00	0.00	-2.82
		9	0.44	-10.41	0.00	0.00	0.00	25.65
	5	8	11.97	-1.94	0.00	0.00	0.00	2.43
		9	-11.97	1.94	0.00	0.00	0.00	-6.68
	15	8	4.30	-0.58	0.00	0.00	0.00	0.70
		9	-4.30	0.58	0.00	0.00	0.00	-1.97
	10	8	-0.03	0.74	0.00	0.00	0.00	-0.20
		9	0.03	-0.74	0.00	0.00	0.00	1.83
	11	8	-0.03	0.44	0.00	0.00	0.00	0.08
		9	0.03	-0.44	0.00	0.00	0.00	0.88
	18	8	0.18	-1.42	0.00	0.00	0.00	-0.11
		9	-0.18	-1.77	0.00	0.00	0.00	0.49
	19	8	-2.50	0.93	0.00	0.00	0.00	-0.33
		9	2.50	0.44	0.00	0.00	0.00	0.87
	20	8	-6.69	-1.30	0.00	0.00	0.00	-0.23
		9	6.69	4.31	0.00	0.00	0.00	-5.92
	100	8	0.11	1.90	0.00	0.00	0.00	0.11
		9	-0.11	-1.46	0.00	0.00	0.00	3.56
	101	8	1.54	1.70	0.00	0.00	0.00	0.34
		9	-1.54	-1.26	0.00	0.00	0.00	2.91
	102	8	3.76	9.43	0.00	0.00	0.00	-1.30
		9	-3.76	-8.99	0.00	0.00	0.00	21.49
	103	8	3.73	10.18	0.00	0.00	0.00	-1.50
		9	-3.73	-9.74	0.00	0.00	0.00	23.32
	104	8	3.73	9.87	0.00	0.00	0.00	-1.21
		9	-3.73	-9.43	0.00	0.00	0.00	22.36
	105	8	1.23	11.10	0.00	0.00	0.00	-1.83
		9	-1.23	-9.30	0.00	0.00	0.00	24.19
	106	8	1.23	10.80	0.00	0.00	0.00	-1.55
		9	-1.23	9.99				

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	107	8	-2.96	8.88	0.00	0.00	0.00	-1.73
		9	2.96	-5.43	0.00	0.00	0.00	17.40
	108	8	-2.96	8.57	0.00	0.00	0.00	-1.44
		9	2.96	-5.12	0.00	0.00	0.00	16.44
	111	8	2.26	1.61	0.00	0.00	0.00	0.46
		9	-2.26	-1.17	0.00	0.00	0.00	2.58
	112	8	5.66	11.34	0.00	0.00	0.00	-1.50
		9	-5.66	-10.90	0.00	0.00	0.00	25.87
	113	8	5.63	12.08	0.00	0.00	0.00	-1.70
		9	-5.63	-11.65	0.00	0.00	0.00	27.70
	114	8	5.63	11.78	0.00	0.00	0.00	-1.41
		9	-5.63	-11.34	0.00	0.00	0.00	26.75
	115	8	3.22	12.31	0.00	0.00	0.00	-2.09
		9	-3.22	-12.07	0.00	0.00	0.00	28.81
	116	8	3.22	12.01	0.00	0.00	0.00	-1.80
		9	-3.22	-11.76	0.00	0.00	0.00	27.85
	117	8	-0.88	9.36	0.00	0.00	0.00	-2.04
		9	0.88	-9.10	0.00	0.00	0.00	22.27
	118	8	-0.88	9.06	0.00	0.00	0.00	-1.76
		9	0.88	-8.80	0.00	0.00	0.00	21.32
	121	8	2.98	1.51	0.00	0.00	0.00	0.58
		9	-2.98	-1.07	0.00	0.00	0.00	2.25
	122	8	7.75	8.78	0.00	0.00	0.00	-0.49
		9	-7.75	-8.35	0.00	0.00	0.00	19.26
	123	8	7.72	9.53	0.00	0.00	0.00	-0.69
		9	-7.72	-9.09	0.00	0.00	0.00	21.09
	124	8	7.72	9.22	0.00	0.00	0.00	-0.41
		9	-7.72	-8.78	0.00	0.00	0.00	20.14
	125	8	5.22	10.45	0.00	0.00	0.00	-1.02
		9	-5.22	-8.65	0.00	0.00	0.00	21.96
	126	8	5.22	10.15	0.00	0.00	0.00	-0.74
		9	-5.22	-8.34	0.00	0.00	0.00	21.00
	127	8	1.03	8.23	0.00	0.00	0.00	-0.92
		9	-1.03	-4.78	0.00	0.00	0.00	15.17
	128	8	1.03	7.92	0.00	0.00	0.00	-0.63
		9	-1.03	-4.47	0.00	0.00	0.00	14.22
	131	8	4.41	1.32	0.00	0.00	0.00	0.81
		9	-4.41	-0.88	0.00	0.00	0.00	1.60
	132	8	11.65	10.37	0.00	0.00	0.00	-0.28
		9	-11.65	-9.93	0.00	0.00	0.00	22.53
	133	8	11.62	11.11	0.00	0.00	0.00	-0.48
		9	-11.62	-10.68	0.00	0.00	0.00	24.36
	134	8	5.63	11.78	0.00	0.00	0.00	-1.41
		9	-5.63	-11.34	0.00	0.00	0.00	26.75
	135	8	9.21	11.34	0.00	0.00	0.00	-0.87
		9	-9.21	-11.10	0.00	0.00	0.00	25.47
	136	8	9.21	11.04	0.00	0.00	0.00	-0.59
		9	-9.21	-10.79	0.00	0.00	0.00	24.51
	137	8	5.10	8.39	0.00	0.00	0.00	-0.83
		9	-5.10	-8.13	0.00	0.00	0.00	18.93

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	138	8	5.10	8.09	0.00	0.00	0.00	-0.54
		9	-5.10	-7.83	0.00	0.00	0.00	17.98
11	1	9	0.11	-1.46	0.00	0.00	0.00	-3.56
		10	-0.11	1.90	0.00	0.00	0.00	-0.11
	2	9	-0.34	-8.18	0.00	0.00	0.00	-20.15
		10	0.34	8.18	0.00	0.00	0.00	2.22
	3	9	7.98	1.29	0.00	0.00	0.00	4.45
		10	-7.98	-1.29	0.00	0.00	0.00	-1.62
	13	9	2.87	0.39	0.00	0.00	0.00	1.31
		10	-2.87	-0.39	0.00	0.00	0.00	-0.47
	4	9	-0.44	-10.41	0.00	0.00	0.00	-25.65
		10	0.44	10.41	0.00	0.00	0.00	2.82
	5	9	11.97	1.94	0.00	0.00	0.00	6.68
		10	-11.97	-1.94	0.00	0.00	0.00	-2.43
	15	9	4.30	0.58	0.00	0.00	0.00	1.97
		10	-4.30	-0.58	0.00	0.00	0.00	-0.70
	10	9	-0.03	-0.74	0.00	0.00	0.00	-1.83
		10	0.03	0.74	0.00	0.00	0.00	0.20
	11	9	0.00	-0.31	0.00	0.00	0.00	-0.96
		10	0.00	0.31	0.00	0.00	0.00	0.29
	18	9	0.18	-1.77	0.00	0.00	0.00	-0.49
		10	-0.18	-1.42	0.00	0.00	0.00	0.11
	19	9	-2.50	0.44	0.00	0.00	0.00	-0.86
		10	2.50	0.93	0.00	0.00	0.00	0.33
	20	9	-6.69	4.31	0.00	0.00	0.00	5.92
		10	6.69	-1.30	0.00	0.00	0.00	0.23
	100	9	0.11	-1.46	0.00	0.00	0.00	-3.56
		10	-0.11	1.90	0.00	0.00	0.00	-0.11
	101	9	1.54	-1.26	0.00	0.00	0.00	-2.91
		10	-1.54	1.70	0.00	0.00	0.00	-0.34
	102	9	3.76	-8.99	0.00	0.00	0.00	-21.49
		10	-3.76	9.43	0.00	0.00	0.00	1.30
	103	9	3.73	-9.74	0.00	0.00	0.00	-23.32
		10	-3.73	10.18	0.00	0.00	0.00	1.50
	104	9	3.76	-9.30	0.00	0.00	0.00	-22.44
		10	-3.76	9.74	0.00	0.00	0.00	1.58
	105	9	1.23	-9.30	0.00	0.00	0.00	-24.19
		10	-1.23	11.10	0.00	0.00	0.00	1.83
	106	9	1.26	-8.86	0.00	0.00	0.00	-23.31
		10	-1.26	10.66	0.00	0.00	0.00	1.92
	107	9	-2.96	-5.43	0.00	0.00	0.00	-17.40
		10	2.96	8.88	0.00	0.00	0.00	1.73
	108	9	-2.93	-4.99	0.00	0.00	0.00	-16.52
		10	2.93	8.44	0.00	0.00	0.00	1.81
	111	9	2.26	-1.17	0.00	0.00	0.00	-2.58
		10	-2.26	1.61	0.00	0.00	0.00	-0.46
	112	9	5.66	-10.90	0.00	0.00	0.00	-25.87
		10	-5.66	11.34	0.00	0.00	0.00	1.50
	113	9	5.63	-11.65	0.00	0.00	0.00	-27.70
		10	-5.63	12.08				

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	114	9	5.66	-11.21	0.00	0.00	0.00	-26.83
		10	-5.66	11.65	0.00	0.00	0.00	1.78
	115	9	3.22	-12.07	0.00	0.00	0.00	-28.81
		10	-3.22	12.31	0.00	0.00	0.00	2.09
	116	9	3.25	-11.63	0.00	0.00	0.00	-27.93
		10	-3.25	11.87	0.00	0.00	0.00	2.17
	117	9	-0.88	-9.10	0.00	0.00	0.00	-22.27
		10	0.88	9.36	0.00	0.00	0.00	2.04
	118	9	-0.85	-8.66	0.00	0.00	0.00	-21.40
		10	0.85	8.92	0.00	0.00	0.00	2.12
	121	9	2.98	-1.07	0.00	0.00	0.00	-2.25
		10	-2.98	1.51	0.00	0.00	0.00	-0.58
	122	9	7.75	-8.35	0.00	0.00	0.00	-19.26
		10	-7.75	8.78	0.00	0.00	0.00	0.49
	123	9	7.72	-9.09	0.00	0.00	0.00	-21.09
		10	-7.72	9.53	0.00	0.00	0.00	0.69
	124	9	7.75	-8.65	0.00	0.00	0.00	-20.22
		10	-7.75	9.09	0.00	0.00	0.00	0.77
	125	9	5.22	-8.65	0.00	0.00	0.00	-21.96
		10	-5.22	10.45	0.00	0.00	0.00	1.02
	126	9	5.25	-8.21	0.00	0.00	0.00	-21.08
		10	-5.25	10.02	0.00	0.00	0.00	1.11
	127	9	1.03	-4.78	0.00	0.00	0.00	-15.17
		10	-1.03	8.23	0.00	0.00	0.00	0.92
	128	9	1.06	-4.34	0.00	0.00	0.00	-14.30
		10	-1.06	7.79	0.00	0.00	0.00	1.00
	131	9	4.41	-0.88	0.00	0.00	0.00	-1.60
		10	-4.41	1.32	0.00	0.00	0.00	-0.81
	132	9	11.65	-9.93	0.00	0.00	0.00	-22.53
		10	-11.65	10.37	0.00	0.00	0.00	0.28
	133	9	11.62	-10.68	0.00	0.00	0.00	-24.36
		10	-11.62	11.11	0.00	0.00	0.00	0.48
	134	9	5.66	-11.21	0.00	0.00	0.00	-26.83
		10	-5.66	11.65	0.00	0.00	0.00	1.78
	135	9	9.21	-11.10	0.00	0.00	0.00	-25.47
		10	-9.21	11.34	0.00	0.00	0.00	0.87
	136	9	9.24	-10.66	0.00	0.00	0.00	-24.59
		10	-9.24	10.90	0.00	0.00	0.00	0.96
	137	9	5.10	-8.13	0.00	0.00	0.00	-18.93
		10	-5.10	8.39	0.00	0.00	0.00	0.83
	138	9	5.13	-7.69	0.00	0.00	0.00	-18.06
		10	-5.13	7.95	0.00	0.00	0.00	0.91
12	1	10	0.11	-0.68	0.00	0.00	0.00	0.11
		11	-0.11	1.12	0.00	0.00	0.00	-2.08
	2	10	-0.34	-4.30	0.00	0.00	0.00	-2.22
		11	0.34	4.30	0.00	0.00	0.00	-7.22
	3	10	7.98	1.15	0.00	0.00	0.00	1.62
		11	-7.98	-1.15	0.00	0.00	0.00	0.89
	13	10	2.87	0.36	0.00	0.00	0.00	0.47
		11	-2.87	-0.36	-	-	-	0.33

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	10	-0.44	-5.48	0.00	0.00	0.00	-2.82
		11	0.44	5.48	0.00	0.00	0.00	-9.19
	5	10	11.97	1.72	0.00	0.00	0.00	2.43
		11	-11.97	-1.72	0.00	0.00	0.00	1.34
	15	10	4.30	0.54	0.00	0.00	0.00	0.70
		11	-4.30	-0.54	0.00	0.00	0.00	0.49
	10	10	-0.03	-0.39	0.00	0.00	0.00	-0.20
		11	0.03	0.39	0.00	0.00	0.00	-0.66
	11	10	0.00	-0.13	0.00	0.00	0.00	-0.29
		11	0.00	0.13	0.00	0.00	0.00	-0.01
	18	10	0.18	-1.73	0.00	0.00	0.00	-0.11
		11	-0.18	-1.46	0.00	0.00	0.00	-0.19
	19	10	-2.50	0.44	0.00	0.00	0.00	-0.33
		11	2.50	0.93	0.00	0.00	0.00	-0.20
	20	10	-6.69	2.64	0.00	0.00	0.00	-0.23
		11	6.69	0.37	0.00	0.00	0.00	2.71
	100	10	0.11	-0.68	0.00	0.00	0.00	0.11
		11	-0.11	1.12	0.00	0.00	0.00	-2.08
	101	10	1.54	-0.50	0.00	0.00	0.00	0.34
		11	-1.54	0.94	0.00	0.00	0.00	-1.92
	102	10	3.76	-4.41	0.00	0.00	0.00	-1.30
		11	-3.76	4.85	0.00	0.00	0.00	-8.85
	103	10	3.73	-4.80	0.00	0.00	0.00	-1.50
		11	-3.73	5.24	0.00	0.00	0.00	-9.51
	104	10	3.76	-4.55	0.00	0.00	0.00	-1.58
		11	-3.76	4.98	0.00	0.00	0.00	-8.86
	105	10	1.23	-4.36	0.00	0.00	0.00	-1.83
		11	-1.23	6.17	0.00	0.00	0.00	-9.70
	106	10	1.26	-4.10	0.00	0.00	0.00	-1.92
		11	-1.26	5.91	0.00	0.00	0.00	-9.06
	107	10	-2.96	-2.16	0.00	0.00	0.00	-1.73
		11	2.96	5.61	0.00	0.00	0.00	-6.80
	108	10	-2.93	-1.91	0.00	0.00	0.00	-1.81
		11	2.93	5.36	0.00	0.00	0.00	-6.15
	111	10	2.26	-0.41	0.00	0.00	0.00	0.46
		11	-2.26	0.85	0.00	0.00	0.00	-1.83
	112	10	5.66	-5.30	0.00	0.00	0.00	-1.50
		11	-5.66	5.74	0.00	0.00	0.00	-10.60
	113	10	5.63	-5.69	0.00	0.00	0.00	-1.70
		11	-5.63	6.13	0.00	0.00	0.00	-11.25
	114	10	5.66	-5.43	0.00	0.00	0.00	-1.78
		11	-5.66	5.87	0.00	0.00	0.00	-10.61
	115	10	3.22	-6.10	0.00	0.00	0.00	-2.09
		11	-3.22	6.34	0.00	0.00	0.00	-11.54
	116	10	3.25	-5.84	0.00	0.00	0.00	-2.17
		11	-3.25	6.08	0.00	0.00	0.00	-10.90
	117	10	-0.88	-4.79	0.00	0.00	0.00	-2.04
		11	0.88	5.05	0.00	0.00	0.00	-8.73
	118	10	-0.85	-4.53	0.00	0.00	0.00	-2.12
		11	0.85	4.79	0.00	0.00	0.00	-8.09

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	121	10	2.98	-0.32	0.00	0.00	0.00	0.58
		11	-2.98	0.76	0.00	0.00	0.00	-1.75
	122	10	7.75	-3.84	0.00	0.00	0.00	-0.49
		11	-7.75	4.28	0.00	0.00	0.00	-8.41
	123	10	7.72	-4.23	0.00	0.00	0.00	-0.69
		11	-7.72	4.67	0.00	0.00	0.00	-9.06
	124	10	7.75	-3.97	0.00	0.00	0.00	-0.77
		11	-7.75	4.41	0.00	0.00	0.00	-8.42
	125	10	5.22	-3.79	0.00	0.00	0.00	-1.02
		11	-5.22	5.59	0.00	0.00	0.00	-9.26
	126	10	5.25	-3.53	0.00	0.00	0.00	-1.11
		11	-5.25	5.34	0.00	0.00	0.00	-8.61
	127	10	1.03	-1.59	0.00	0.00	0.00	-0.92
		11	-1.03	5.04	0.00	0.00	0.00	-6.35
	128	10	1.06	-1.34	0.00	0.00	0.00	-1.00
		11	-1.06	4.78	0.00	0.00	0.00	-5.71
	131	10	4.41	-0.14	0.00	0.00	0.00	0.81
		11	-4.41	0.57	0.00	0.00	0.00	-1.59
	132	10	11.65	-4.44	0.00	0.00	0.00	-0.28
		11	-11.65	4.88	0.00	0.00	0.00	-9.93
	133	10	11.62	-4.83	0.00	0.00	0.00	-0.48
		11	-11.62	5.27	0.00	0.00	0.00	-10.59
	134	10	5.66	-5.43	0.00	0.00	0.00	-1.78
		11	-5.66	5.87	0.00	0.00	0.00	-10.61
	135	10	9.21	-5.24	0.00	0.00	0.00	-0.87
		11	-9.21	5.48	0.00	0.00	0.00	-10.87
	136	10	9.24	-4.98	0.00	0.00	0.00	-0.96
		11	-9.24	5.22	0.00	0.00	0.00	-10.23
	137	10	5.10	-3.93	0.00	0.00	0.00	-0.83
		11	-5.10	4.19	0.00	0.00	0.00	-8.07
	138	10	5.13	-3.67	0.00	0.00	0.00	-0.91
		11	-5.13	3.93	0.00	0.00	0.00	-7.42
13	1	11	0.11	-0.03	0.00	0.00	0.00	2.08
		12	-0.11	0.47	0.00	0.00	0.00	-2.63
	2	11	-0.34	-1.38	0.00	0.00	0.00	7.22
		12	0.34	1.38	0.00	0.00	0.00	-10.23
	3	11	7.98	1.30	0.00	0.00	0.00	-0.89
		12	-7.98	-1.30	0.00	0.00	0.00	3.74
	13	11	2.87	0.43	0.00	0.00	0.00	-0.33
		12	-2.87	-0.43	0.00	0.00	0.00	1.27
	4	11	-0.44	-1.75	0.00	0.00	0.00	9.19
		12	0.44	1.75	0.00	0.00	0.00	-13.02
	5	11	11.97	1.95	0.00	0.00	0.00	-1.34
		12	-11.97	-1.95	0.00	0.00	0.00	5.62
	15	11	4.30	0.64	0.00	0.00	0.00	-0.49
		12	-4.30	-0.64	0.00	0.00	0.00	1.90
	10	11	-0.03	-0.13	0.00	0.00	0.00	0.66
		12	0.03	0.13	0.00	0.00	0.00	-0.93
	11	11	0.00	-0.03	0.00	0.00	0.00	0.01
		12	—	0.03	—	—	—	-0.07

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	18	11	0.18	-1.65	0.00	0.00	0.00	0.19
		12	-0.18	-1.54	0.00	0.00	0.00	-0.31
	19	11	-2.50	0.35	0.00	0.00	0.00	0.20
		12	2.50	1.02	0.00	0.00	0.00	-0.93
	20	11	-6.69	1.10	0.00	0.00	0.00	-2.71
		12	6.69	1.91	0.00	0.00	0.00	1.81
	100	11	0.11	-0.03	0.00	0.00	0.00	2.08
		12	-0.11	0.47	0.00	0.00	0.00	-2.63
	101	11	1.54	0.18	0.00	0.00	0.00	1.92
		12	-1.54	0.26	0.00	0.00	0.00	-2.00
	102	11	3.76	-0.76	0.00	0.00	0.00	8.85
		12	-3.76	1.20	0.00	0.00	0.00	-10.99
	103	11	3.73	-0.88	0.00	0.00	0.00	9.51
		12	-3.73	1.32	0.00	0.00	0.00	-11.92
	104	11	3.76	-0.78	0.00	0.00	0.00	8.86
		12	-3.76	1.22	0.00	0.00	0.00	-11.06
	105	11	1.23	-0.53	0.00	0.00	0.00	9.70
		12	-1.23	2.34	0.00	0.00	0.00	-12.85
	106	11	1.26	-0.44	0.00	0.00	0.00	9.06
		12	-1.26	2.24	0.00	0.00	0.00	-11.99
	107	11	-2.96	0.21	0.00	0.00	0.00	6.80
		12	2.96	3.24	0.00	0.00	0.00	-10.11
	108	11	-2.93	0.31	0.00	0.00	0.00	6.15
		12	2.93	3.14	0.00	0.00	0.00	-9.25
	111	11	2.26	0.29	0.00	0.00	0.00	1.83
		12	-2.26	0.15	0.00	0.00	0.00	-1.68
	112	11	5.66	-0.81	0.00	0.00	0.00	10.60
		12	-5.66	1.25	0.00	0.00	0.00	-12.85
	113	11	5.63	-0.93	0.00	0.00	0.00	11.25
		12	-5.63	1.37	0.00	0.00	0.00	-13.78
	114	11	5.66	-0.83	0.00	0.00	0.00	10.61
		12	-5.66	1.27	0.00	0.00	0.00	-12.92
	115	11	3.22	-1.39	0.00	0.00	0.00	11.54
		12	-3.22	1.63	0.00	0.00	0.00	-14.86
	116	11	3.25	-1.29	0.00	0.00	0.00	10.90
		12	-3.25	1.54	0.00	0.00	0.00	-14.00
	117	11	-0.88	-1.49	0.00	0.00	0.00	8.73
		12	0.88	1.74	0.00	0.00	0.00	-12.27
	118	11	-0.85	-1.39	0.00	0.00	0.00	8.09
		12	0.85	1.65	0.00	0.00	0.00	-11.41
	121	11	2.98	0.40	0.00	0.00	0.00	1.75
		12	-2.98	0.04	0.00	0.00	0.00	-1.37
	122	11	7.75	-0.11	0.00	0.00	0.00	8.41
		12	-7.75	0.55	0.00	0.00	0.00	-9.12
	123	11	7.72	-0.23	0.00	0.00	0.00	9.06
		12	-7.72	0.67	0.00	0.00	0.00	-10.05
	124	11	7.75	-0.13	0.00	0.00	0.00	8.42
		12	-7.75	0.57	0.00	0.00	0.00	-9.19
	125	11	5.22	0.12	0.00	0.00	0.00	9.26
		12	-5.22	1.69	0.00	0.00	0.00	-10.98

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	126	11	5.25	0.22	0.00	0.00	0.00	8.61
		12	-5.25	1.59	0.00	0.00	0.00	-10.12
	127	11	1.03	0.86	0.00	0.00	0.00	6.35
		12	-1.03	2.58	0.00	0.00	0.00	-8.24
	128	11	1.06	0.96	0.00	0.00	0.00	5.71
		12	-1.06	2.49	0.00	0.00	0.00	-7.37
	131	11	4.41	0.61	0.00	0.00	0.00	1.59
		12	-4.41	-0.17	0.00	0.00	0.00	-0.73
	132	11	11.65	0.17	0.00	0.00	0.00	9.93
		12	-11.65	0.27	0.00	0.00	0.00	-10.04
	133	11	11.62	0.04	0.00	0.00	0.00	10.59
		12	-11.62	0.40	0.00	0.00	0.00	-10.97
	134	11	5.66	-0.83	0.00	0.00	0.00	10.61
		12	-5.66	1.27	0.00	0.00	0.00	-12.92
	135	11	9.21	-0.42	0.00	0.00	0.00	10.87
		12	-9.21	0.66	0.00	0.00	0.00	-12.05
	136	11	9.24	-0.32	0.00	0.00	0.00	10.23
		12	-9.24	0.56	0.00	0.00	0.00	-11.19
	137	11	5.10	-0.51	0.00	0.00	0.00	8.07
		12	-5.10	0.77	0.00	0.00	0.00	-9.47
	138	11	5.13	-0.41	0.00	0.00	0.00	7.42
		12	-5.13	0.67	0.00	0.00	0.00	-8.60
14	1	12	0.11	0.64	0.00	0.00	0.00	2.63
		13	-0.11	-0.20	0.00	0.00	0.00	-1.71
	2	12	-0.34	1.15	0.00	0.00	0.00	10.23
		13	0.34	-1.15	0.00	0.00	0.00	-7.72
	3	12	7.98	1.68	0.00	0.00	0.00	-3.74
		13	-7.98	-1.68	0.00	0.00	0.00	7.42
	13	12	2.87	0.55	0.00	0.00	0.00	-1.27
		13	-2.87	-0.55	0.00	0.00	0.00	2.48
	4	12	-0.44	1.46	0.00	0.00	0.00	13.02
		13	0.44	-1.46	0.00	0.00	0.00	-9.82
	5	12	11.97	2.52	0.00	0.00	0.00	-5.62
		13	-11.97	-2.52	0.00	0.00	0.00	11.13
	15	12	4.30	0.83	0.00	0.00	0.00	-1.90
		13	-4.30	-0.83	0.00	0.00	0.00	3.72
	10	12	-0.03	0.10	0.00	0.00	0.00	0.93
		13	0.03	-0.10	0.00	0.00	0.00	-0.70
	11	12	0.00	0.01	0.00	0.00	0.00	0.07
		13	0.00	-0.01	0.00	0.00	0.00	-0.04
	18	12	0.18	-1.45	0.00	0.00	0.00	0.31
		13	-0.18	-1.74	0.00	0.00	0.00	0.01
	19	12	-2.50	0.16	0.00	0.00	0.00	0.93
		13	2.50	1.21	0.00	0.00	0.00	-2.08
	20	12	-6.69	-0.55	0.00	0.00	0.00	-1.81
		13	6.69	3.56	0.00	0.00	0.00	-2.69
	100	12	0.11	0.64	0.00	0.00	0.00	2.63
		13	-0.11	-0.20	0.00	0.00	0.00	-1.71
	101	12	1.54	0.92	0.00	0.00	0.00	2.00
		13	-1.54	-0.45	—	—	—	-0.41

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	102	12	3.76	2.63	0.00	0.00	0.00	10.99
		13	-3.76	-2.19	0.00	0.00	0.00	-5.72
	103	12	3.73	2.73	0.00	0.00	0.00	11.92
		13	-3.73	-2.29	0.00	0.00	0.00	-6.42
	104	12	3.76	2.64	0.00	0.00	0.00	11.06
		13	-3.76	-2.20	0.00	0.00	0.00	-5.75
	105	12	1.23	2.89	0.00	0.00	0.00	12.85
		13	-1.23	-1.09	0.00	0.00	0.00	-8.49
	106	12	1.26	2.80	0.00	0.00	0.00	11.99
		13	-1.26	-1.00	0.00	0.00	0.00	-7.83
	107	12	-2.96	2.18	0.00	0.00	0.00	10.11
		13	2.96	1.27	0.00	0.00	0.00	-9.11
	108	12	-2.93	2.09	0.00	0.00	0.00	9.25
		13	2.93	1.36	0.00	0.00	0.00	-8.44
	111	12	2.26	1.05	0.00	0.00	0.00	1.68
		13	-2.26	-0.62	0.00	0.00	0.00	0.15
	112	12	5.66	3.36	0.00	0.00	0.00	12.85
		13	-5.66	-2.92	0.00	0.00	0.00	-5.97
	113	12	5.63	3.46	0.00	0.00	0.00	13.78
		13	-5.63	-3.03	0.00	0.00	0.00	-6.67
	114	12	5.66	3.37	0.00	0.00	0.00	12.92
		13	-5.66	-2.94	0.00	0.00	0.00	-6.00
	115	12	3.22	2.91	0.00	0.00	0.00	14.86
		13	-3.22	-2.67	0.00	0.00	0.00	-8.74
	116	12	3.25	2.82	0.00	0.00	0.00	14.00
		13	-3.25	-2.58	0.00	0.00	0.00	-8.07
	117	12	-0.88	1.46	0.00	0.00	0.00	12.27
		13	0.88	-1.21	0.00	0.00	0.00	-9.35
	118	12	-0.85	1.37	0.00	0.00	0.00	11.41
		13	0.85	-1.12	0.00	0.00	0.00	-8.68
	121	12	2.98	1.19	0.00	0.00	0.00	1.37
		13	-2.98	-0.75	0.00	0.00	0.00	0.77
	122	12	7.75	3.47	0.00	0.00	0.00	9.12
		13	-7.75	-3.03	0.00	0.00	0.00	-2.01
	123	12	7.72	3.57	0.00	0.00	0.00	10.05
		13	-7.72	-3.13	0.00	0.00	0.00	-2.71
	124	12	7.75	3.48	0.00	0.00	0.00	9.19
		13	-7.75	-3.04	0.00	0.00	0.00	-2.04
	125	12	5.22	3.73	0.00	0.00	0.00	10.98
		13	-5.22	-1.92	0.00	0.00	0.00	-4.78
	126	12	5.25	3.64	0.00	0.00	0.00	10.12
		13	-5.25	-1.84	0.00	0.00	0.00	-4.12
	127	12	1.03	3.02	0.00	0.00	0.00	8.24
		13	-1.03	0.43	0.00	0.00	0.00	-5.40
	128	12	1.06	2.93	0.00	0.00	0.00	7.37
		13	-1.06	0.52	0.00	0.00	0.00	-4.73
	131	12	4.41	1.47	0.00	0.00	0.00	0.73
		13	-4.41	-1.03	0.00	0.00	0.00	2.00
	132	12	11.65	4.62	0.00	0.00	0.00	10.04
		13	-11.65	-4.18	0.00	0.00	0.00	-0.40

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	133	12	11.62	4.72	0.00	0.00	0.00	10.97
		13	-11.62	-4.28	0.00	0.00	0.00	-1.10
	134	12	5.66	3.37	0.00	0.00	0.00	12.92
		13	-5.66	-2.94	0.00	0.00	0.00	-6.00
	135	12	9.21	4.17	0.00	0.00	0.00	12.05
		13	-9.21	-3.93	0.00	0.00	0.00	-3.17
	136	12	9.24	4.08	0.00	0.00	0.00	11.19
		13	-9.24	-3.84	0.00	0.00	0.00	-2.51
	137	12	5.10	2.72	0.00	0.00	0.00	9.47
		13	-5.10	-2.46	0.00	0.00	0.00	-3.79
	138	12	5.13	2.63	0.00	0.00	0.00	8.60
		13	-5.13	-2.37	0.00	0.00	0.00	-3.12
15	1	13	0.11	1.54	0.00	0.00	0.00	1.71
		14	-0.11	-1.11	0.00	0.00	0.00	1.19
	2	13	-0.34	4.09	0.00	0.00	0.00	7.72
		14	0.34	-4.09	0.00	0.00	0.00	1.25
	3	13	7.98	1.93	0.00	0.00	0.00	-7.42
		14	-7.98	-1.93	0.00	0.00	0.00	11.65
	13	13	2.87	0.61	0.00	0.00	0.00	-2.48
		14	-2.87	-0.61	0.00	0.00	0.00	3.82
	4	13	-0.44	5.21	0.00	0.00	0.00	9.82
		14	0.44	-5.21	0.00	0.00	0.00	1.59
	5	13	11.97	2.89	0.00	0.00	0.00	-11.13
		14	-11.97	-2.89	0.00	0.00	0.00	17.47
	15	13	4.30	0.92	0.00	0.00	0.00	-3.72
		14	-4.30	-0.92	0.00	0.00	0.00	5.74
	10	13	-0.03	0.37	0.00	0.00	0.00	0.70
		14	0.03	-0.37	0.00	0.00	0.00	0.11
	11	13	0.00	-0.01	0.00	0.00	0.00	0.04
		14	0.00	0.01	0.00	0.00	0.00	-0.05
	18	13	0.18	-1.06	0.00	0.00	0.00	-0.01
		14	-0.18	-2.13	0.00	0.00	0.00	1.18
	19	13	-2.50	-0.06	0.00	0.00	0.00	2.08
		14	2.50	1.42	0.00	0.00	0.00	-3.70
	20	13	-6.69	-2.46	0.00	0.00	0.00	2.69
		14	6.69	5.47	0.00	0.00	0.00	-11.38
	100	13	0.11	1.54	0.00	0.00	0.00	1.71
		14	-0.11	-1.11	0.00	0.00	0.00	1.19
	101	13	1.54	1.85	0.00	0.00	0.00	0.47
		14	-1.54	-1.41	0.00	0.00	0.00	3.10
	102	13	3.76	6.60	0.00	0.00	0.00	5.72
		14	-3.76	-6.16	0.00	0.00	0.00	8.27
	103	13	3.73	6.97	0.00	0.00	0.00	6.42
		14	-3.73	-6.53	0.00	0.00	0.00	8.38
	104	13	3.76	6.59	0.00	0.00	0.00	5.75
		14	-3.76	-6.16	0.00	0.00	0.00	8.22
	105	13	1.23	6.92	0.00	0.00	0.00	8.49
		14	-1.23	-5.11	0.00	0.00	0.00	4.69
	106	13	1.26	6.54	0.00	0.00	0.00	7.83
		14	-1.26	-4.73	—	—	—	0.52

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	107	13	-2.96	4.51	0.00	0.00	0.00	9.11
		14	2.96	-1.06	0.00	0.00	0.00	-3.00
	108	13	-2.93	4.13	0.00	0.00	0.00	8.44
		14	2.93	-0.68	0.00	0.00	0.00	-3.16
	111	13	2.26	2.01	0.00	0.00	0.00	-0.15
		14	-2.26	-1.57	0.00	0.00	0.00	4.06
	112	13	5.66	8.20	0.00	0.00	0.00	5.97
		14	-5.66	-7.76	0.00	0.00	0.00	11.52
	113	13	5.63	8.57	0.00	0.00	0.00	6.67
		14	-5.63	-8.13	0.00	0.00	0.00	11.63
	114	13	5.66	8.19	0.00	0.00	0.00	6.00
		14	-5.66	-7.75	0.00	0.00	0.00	11.47
	115	13	3.22	7.99	0.00	0.00	0.00	8.74
		14	-3.22	-7.75	0.00	0.00	0.00	8.52
	116	13	3.25	7.62	0.00	0.00	0.00	8.07
		14	-3.25	-7.37	0.00	0.00	0.00	8.35
	117	13	-0.88	5.05	0.00	0.00	0.00	9.35
		14	0.88	-4.79	0.00	0.00	0.00	1.43
	118	13	-0.85	4.67	0.00	0.00	0.00	8.68
		14	0.85	-4.41	0.00	0.00	0.00	1.27
	121	13	2.98	2.16	0.00	0.00	0.00	-0.77
		14	-2.98	-1.72	0.00	0.00	0.00	5.02
	122	13	7.75	7.56	0.00	0.00	0.00	2.01
		14	-7.75	-7.13	0.00	0.00	0.00	14.09
	123	13	7.72	7.94	0.00	0.00	0.00	2.71
		14	-7.72	-7.50	0.00	0.00	0.00	14.20
	124	13	7.75	7.56	0.00	0.00	0.00	2.04
		14	-7.75	-7.12	0.00	0.00	0.00	14.04
	125	13	5.22	7.88	0.00	0.00	0.00	4.78
		14	-5.22	-6.07	0.00	0.00	0.00	10.51
	126	13	5.25	7.50	0.00	0.00	0.00	4.12
		14	-5.25	-5.70	0.00	0.00	0.00	10.35
	127	13	1.03	5.48	0.00	0.00	0.00	5.40
		14	-1.03	-2.03	0.00	0.00	0.00	2.82
	128	13	1.06	5.10	0.00	0.00	0.00	4.73
		14	-1.06	-1.65	0.00	0.00	0.00	2.66
	131	13	4.41	2.47	0.00	0.00	0.00	-2.00
		14	-4.41	-2.03	0.00	0.00	0.00	6.93
	132	13	11.65	9.64	0.00	0.00	0.00	0.40
		14	-11.65	-9.21	0.00	0.00	0.00	20.26
	133	13	11.62	10.02	0.00	0.00	0.00	1.10
		14	-11.62	-9.58	0.00	0.00	0.00	20.37
	134	13	5.66	8.19	0.00	0.00	0.00	6.00
		14	-5.66	-7.75	0.00	0.00	0.00	11.47
	135	13	9.21	9.44	0.00	0.00	0.00	3.17
		14	-9.21	-9.20	0.00	0.00	0.00	17.25
	136	13	9.24	9.06	0.00	0.00	0.00	2.51
		14	-9.24	-8.82	0.00	0.00	0.00	17.09
	137	13	5.10	6.50	0.00	0.00	0.00	3.79
		14	-5.10	-6.24	0.00	0.00	0.00	10.17

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	138	13	5.13	6.12	0.00	0.00	0.00	3.12
		14	-5.13	-5.86	0.00	0.00	0.00	10.01

********** END OF LATEST ANALYSIS RESULT **********

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*=================================================================
LOAD LIST 100 TO 118
*=================================================================
PRINT FORCE ENV NSECTION 10 LIST 1
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Results from p57 to p67 provide max. values for +M with provision using 1/2 of lateral Lo

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
1	0.00	MAX.	12.37	114	14.90	114	0.00	118	0.00	118
		MIN.	0.78	100	-0.06	100	0.00	118	0.00	118
	1.10	MAX.	9.68	114	3.06	112	0.00	118	0.00	118
		MIN.	0.56	100	-4.58	108	0.00	118	0.00	118
	2.19	MAX.	7.00	114	0.25	111	0.00	118	0.00	118
		MIN.	0.34	100	-8.96	118	0.00	118	0.00	118
	3.29	MAX.	4.31	114	-0.35	111	0.00	118	0.00	118
		MIN.	0.12	100	-13.83	116	0.00	118	0.00	118
	4.38	MAX.	1.63	114	-0.71	111	0.00	118	0.00	118
		MIN.	-0.13	107	-16.70	116	0.00	118	0.00	118
	5.48	MAX.	0.00	111	-0.83	111	0.00	118	0.00	118
		MIN.	-1.71	117	-16.63	116	0.00	118	0.00	118
	6.57	MAX.	-0.22	111	-0.71	111	0.00	118	0.00	118
		MIN.	-4.17	115	-13.61	116	0.00	118	0.00	118
	7.67	MAX.	-0.44	111	-0.17	100	0.00	118	0.00	118
		MIN.	-6.86	115	-7.89	114	0.00	118	0.00	118
	8.77	MAX.	-0.66	111	2.38	117	0.00	118	0.00	118
		MIN.	-9.54	115	0.25	111	0.00	118	0.00	118
	9.86	MAX.	-0.88	111	13.80	115	0.00	118	0.00	118
		MIN.	-12.23	115	1.09	111	0.00	118	0.00	118
	10.96	MAX.	-1.10	111	28.67	115	0.00	118	0.00	118
		MIN.	-14.91	115	2.17	111	0.00	118	0.00	118

+M TOP SLAB

MAX/MIN FORCE VALUES FOR MEMB 1,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	12.37	0.00	114	28.67	10.96	115			
	0.00	0.00	100	0.00	0.00	100	5.24 C	0.00	113
MIN.	-14.91	10.96	115	-16.70	4.38	116			
	0.00	10.96	118	0.00	10.96	118	1.80 T	10.96	108

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

171. PRINT FORCE ENV NSECTION 10 LIST 2

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
2	0.00	MAX.	14.91	115	28.67	115	0.00	118	0.00	118
		MIN.	1.10	111	2.17	111	0.00	118	0.00	118
	1.10	MAX.	12.23	115	13.80	115	0.00	118	0.00	118
		MIN.	0.88	111	1.09	111	0.00	118	0.00	118
	2.19	MAX.	9.54	115	2.87	118	0.00	118	0.00	118
		MIN.	0.66	111	0.25	111	0.00	118	0.00	118
	3.29	MAX.	6.86	115	-0.17	100	0.00	118	0.00	118
		MIN.	0.44	111	-7.35	113	0.00	118	0.00	118
	4.38	MAX.	4.17	115	-0.71	111	0.00	118	0.00	118
		MIN.	0.22	111	-13.15	115	0.00	118	0.00	118
	5.48	MAX.	1.71	117	-0.83	111	0.00	118	0.00	118
		MIN.	0.00	111	-16.26	115	0.00	118	0.00	118
	6.58	MAX.	0.24	108	-0.71	111	0.00	118	0.00	118
		MIN.	-1.55	113	-16.41	115	0.00	118	0.00	118
	7.67	MAX.	-0.12	100	-0.35	111	0.00	118	0.00	118
		MIN.	-4.24	113	-13.63	115	0.00	118	0.00	118
	8.77	MAX.	-0.34	100	0.25	111	0.00	118	0.00	118
		MIN.	-6.92	113	-8.84	117	0.00	118	0.00	118
	9.86	MAX.	-0.56	100	3.09	114	0.00	118	0.00	118
		MIN.	-9.61	113	-4.54	107	0.00	118	0.00	118
	10.96	MAX.	-0.78	100	14.85	113	0.00	118	0.00	118
		MIN.	-12.29	113	-0.06	100	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 2,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	14.91	0.00	115	28.67	0.00	115			
	0.00	0.00	100	0.00	0.00	100	5.24 C	0.00	113
MIN.	-12.29	10.96	113	-16.41	6.58	115			
	0.00	10.96	118	0.00	10.96	118	1.83 T	10.96	108

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

172. PRINT FORCE ENV NSECTION 2 LIST 6 7 8 9 10

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
6	0.00	MAX.	-1.06	107	3.00	107	0.00	118	0.00	118
		MIN.	-8.14	114	-11.68	114	0.00	118	0.00	118
	1.10	MAX.	-1.32	100	5.11	107	0.00	118	0.00	118
		MIN.	-8.36	114	-2.90	112	0.00	118	0.00	118
	2.19	MAX.	-1.54	100	9.35	117	0.00	118	0.00	118
		MIN.	-8.58	114	-0.15	111	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 6,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	-1.06	0.00	107	9.35	2.19	117			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-8.58	2.19	114	-11.68	0.00	114			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

7	0.00	MAX.	1.28	108	9.35	117	0.00	118	0.00	118
		MIN.	-3.03	113	-0.15	111	0.00	118	0.00	118
	1.10	MAX.	-0.42	100	11.73	115	0.00	118	0.00	118
		MIN.	-3.24	113	0.65	111	0.00	118	0.00	118
	2.19	MAX.	-0.64	100	14.86	115	0.00	118	0.00	118
		MIN.	-3.46	113	1.68	111	0.00	118	0.00	118

HM BOT SLAL

MAX/MIN FORCE VALUES FOR MEMB 7,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	1.28	0.00	108	14.86	2.19	115			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-3.46	2.19	113	-0.15	0.00	111			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

8	0.00	MAX.	3.24	107	14.86	115	0.00	118	0.00	118
		MIN.	0.15	111	1.68	111	0.00	118	0.00	118
	1.10	MAX.	1.62	117	13.13	115	0.00	118	0.00	118
		MIN.	-0.07	111	1.64	111	0.00	118	0.00	118
	2.19	MAX.	1.49	117	11.54	115	0.00	118	0.00	118
		MIN.	-0.29	111	1.83	111	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 8,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	3.24	0.00	107	14.86	0.00	115			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-0.29	2.19	111	1.64	1.10	111			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

9	0.00	MAX.	6.34	115	11.54	115	0.00	118	0.00	118
		MIN.	0.85	111	1.83	111	0.00	118	0.00	118
	1.10	MAX.	6.22	115	4.80	116	0.00	118	0.00	118
		MIN.	0.63	111	0.97	100	0.00	118	0.00	118
	2.19	MAX.	6.10	115	0.46	111	0.00	118	0.00	118
		MIN.	0.41	111	-2.09	115	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 9,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	6.34	0.00	115	11.54	0.00	115			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	0.41	2.19	111	-2.09	2.19	115			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

10	0.00	MAX.	12.31	115	0.46	111	0.00	118	0.00	118
		MIN.	1.61	111	-2.09	115	0.00	118	0.00	118
	1.10	MAX.	12.19	115	-1.18	111	0.00	118	0.00	118
		MIN.	1.39	111	-15.52	115	0.00	118	0.00	118
	2.19	MAX.	12.07	115	-2.58	111	0.00	118	0.00	118
		MIN.	1.17	111	-28.81	115	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 10,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	12.31	0.00	115	0.46	0.00	111			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	1.17	2.19	111	-28.81	2.19	115			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

173. PRINT FORCE ENV NSECTION 2 LIST 11 12 13 14 15.

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
11	0.00	MAX.	-1.17	111	-2.58	111	0.00	118	0.00	118
		MIN.	-12.07	115	-28.81	115	0.00	118	0.00	118
	1.10	MAX.	-1.39	111	-1.18	111	0.00	118	0.00	118
		MIN.	-12.19	115	-15.52	115	0.00	118	0.00	118
	2.19	MAX.	-1.61	111	0.46	111	0.00	118	0.00	118
		MIN.	-12.31	115	-2.17	116	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 11,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	-1.17	0.00	111	0.46	2.19	111			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-12.31	2.19	115	-28.81	0.00	115			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

12	0.00	MAX.	-0.41	111	0.46	111	0.00	118	0.00	118
		MIN.	-6.10	115	-2.17	116	0.00	118	0.00	118
	1.10	MAX.	-0.63	111	4.66	115	0.00	118	0.00	118
		MIN.	-6.22	115	0.97	100	0.00	118	0.00	118
	2.19	MAX.	-0.85	111	11.54	115	0.00	118	0.00	118
		MIN.	-6.34	115	1.83	111	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 12,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	-0.41	0.00	111	11.54	2.19	115			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-6.34	2.19	115	-2.17	0.00	116			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

13	0.00	MAX.	0.31	108	11.54	115	0.00	118	0.00	118
		MIN.	-1.49	117	1.83	111	0.00	118	0.00	118
	1.10	MAX.	0.07	111	13.14	115	0.00	118	0.00	118
		MIN.	-1.62	117	1.64	111	0.00	118	0.00	118
	2.19	MAX.	-0.15	111	14.86	115	0.00	118	0.00	118
		MIN.	-3.24	107	1.68	111	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 13,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	0.31	0.00	108	14.86	2.19	115			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-3.24	2.19	107	1.64	1.10	111			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

14	0.00	MAX.	3.46	113	14.86	115	0.00	118	0.00	118
		MIN.	0.64	100	1.68	111	0.00	118	0.00	118
	1.10	MAX.	3.24	113	11.73	115	0.00	118	0.00	118
		MIN.	0.37	108	0.65	111	0.00	118	0.00	118
	2.19	MAX.	3.03	113	9.35	117	0.00	118	0.00	118
		MIN.	-1.36	108	-0.15	111	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 14,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	3.46	0.00	113	14.86	0.00	115			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	-1.36	2.19	108	-0.15	2.19	111			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

15	0.00	MAX.	8.57	113	9.35	117	0.00	118	0.00	118
		MIN.	1.54	100	-0.15	111	0.00	118	0.00	118
	1.10	MAX.	8.35	113	5.11	107	0.00	118	0.00	118
		MIN.	1.32	100	-2.90	112	0.00	118	0.00	118
	2.19	MAX.	8.13	113	3.16	108	0.00	118	0.00	118
		MIN.	0.68	108	-11.63	113	0.00	118	0.00	118

MAX/MIN FORCE VALUES FOR MEMB 15,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	8.57	0.00	113	9.35	0.00	117			
	0.00	0.00	100	0.00	0.00	100	5.66 C	0.00	112
MIN.	0.68	2.19	108	-11.63	2.19	113			
	0.00	2.19	118	0.00	2.19	118	2.96 T	2.19	107

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

174. MSDR ENVELOPE FY MZ LIST 1

```
|
|
|      12.3
|L116+ 11.6
|L112+..
|    | 9.84  9.61
|L106+ 9.15+ 9.8
|L102+ 7.61+.7.65
|L118+  .. + 7.12  6.92
|    | .. + 5.83+ 6.56
|    | 5.35+ 5.75+ 5.10
|L108+     + 4.6 + ...   4.3
|    |  .  + 3.98| 3.89+ 3.27
|    |     +  .  + 2.61+ 3.7
|    |     |     +  .  + 2.2   1.51
|    |.782 |.563 |.553 + 1.24+ 1.4
|L111+-----+-----+.344 +.124 + 947E-4     .324
|    +=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+ 1.20
|     .                          .. + 1.38+-----+-----+-----+-----+ 1.41
|                                  + ..  | 3.1 |     |     |     +
|                                    ... + 3.31|     |     |     |
|                                      . + 4.17| 4.24|     |     |
|                                        + ... + 5.4 | 5.61|     |
|                                          . . + 5.76+     |     |
|                                            . + 6.86| 7.7 | 6.98|
|                                              + ... + 7.69+     | 8.28
|                                                . . + 8.57| 9.10+ 8.36
|                                                  . + 9.54+ 9.88+
|                                                    +.. . + 10.1| 10.9
|                                                      ... + 11.1+ 11.1
|                                                        . + 11.9+ 12.1
|                                                          +..   +
|                                                            ... | 13.6
|                                                              . + 14.6
|                                                                +
|
```

FY S H E A R F O R C E E N V E L O P E

MEMBER 1. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 14.9 AT 11.0 FROM START.FOR LOAD 115.

UPPER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

12.37	9.68	7.00	4.31	1.63	0.00
-0.22	-0.44	-0.66	-0.88	-1.10	

CORRESPONDING LOAD NUMBERS

114.	114.	114.	114.	114.	111.
111.	111.	111.	111.	111.	

LOWER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

0.78	0.56	0.34	0.12	-0.13	-1.71
-4.17	-6.86	-9.54	-12.23	-14.91	

CORRESPONDING LOAD NUMBERS

100.	100.	100.	100.	107.	117.
115.	115.	115.	115.	115.	

```
|                                                                                |
|                                                                                |
|                                                                   28.7         |
|                                                                 + 27.3         |
|                                                                 + 25.4         |
|                                                                .+ 23.8         |
|                                                               ./+ 23.0         |
|                                                               ./+ 21.2         |
|                                                              .//+              |
|                                                              ///|              |
|                                                              .// | 17.0       |
|      14.9                                                   ./// +             |
|L114+ 14.4                                                   .13.8|             |
|L112+ 12.4                                                  + 11.9|             |
|L116+\10.8                                                 /+/11.0|             |
|L104+\10.3                                                 /+/10.1|             |
|L102+ 8.75                                                //+/8.62|             |
|L106+\\\                                                 ///+    |             |
|    |\\\\   .                                            ///.|    |             |
|    | 3.76  3.6                                          /// |    | 3.38        |
|L118+ 2.17+ 2.85                                        /1.61| 1.95+ 2.57        |
|L111+\1.43+.462  .251                                   +.770 + 1.38+           |
|L108+-602E+4----+ 1.29 .750  .996   1.0  .879  .174/+-----+     |               |
|L100+=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+                |
|       . \| 3.56|     +-----+-----+     |     | 3.68                            |
|        . + 4.54| 5.26|     |     |     |     +/5.41                            |
|          +.  \\+ 5.96|     |     |     |   . +/5.86                            |
|             . \+.7.44|     |     |     | 7.58+/7.35                            |
|              . + 8.84| 9.73|     | 9.98+ 9.82+                                |
|                +.... + 10.7| 10.9+ 10.4+ 10.7                                 |
|                   .. +-11.9+-12.0+ 12.0+ 12.1                                 |
|                    . + 13.6+ 13.1+ 13.1+/13.5                                 |
|                      +  .  + 15.5+ 14.6+                                      |
|                         .  + 16.4+ 16.1                                       |
|                            +-----+                                            |
|                                                                                |
|                                                                                |
|                                                                                |
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MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 1. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 28.7 AT 11.0 FROM START.FOR LOAD 115.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

14.90	3.06	0.25	-0.35	-0.71	-0.83
-0.71	-0.17	2.38	13.80	28.67	

CORRESPONDING LOAD NUMBERS

114.	112.	111.	111.	111.	111.
111.	100.	117.	115.	115.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

-0.06	-4.58	-8.96	-13.83	-16.70	-16.63
-13.61	-7.89	0.25	1.09	2.17	

CORRESPONDING LOAD NUMBERS

100.	108.	118.	116.	116.	116.
116.	114.	111.	111.	111.	

175. MSDR ENVELOPE FY MZ LIST 2

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 ------------------------------------------------------------------------------
|                                                                              |
|                                                                              |
|     14.6                                                                     |
|L115+ 13.6                                                                    |
|L116+ .                                                                       |
|    | 12.1  11.9                                                              |
|L105+ 11.1+ 11.1                                                              |
|L117+ 10.2+.10.1                                                              |
|L118+ ... + 9.88  9.54                                                        |
|    | 8.36+ 9.10+ 8.57                                                         |
|L107+ 7.48+ ... + 7.69                                                        |
|L108+  .  | 6.98+ 7.7   6.86                                                  |
|    |  .  + 6.28+ ... + 5.76                                                  |
|    |     +  .  | 5.61+ 5.4                                                   |
|    |     |     +     + 4.24  4.17                                            |
|    |     |     |  .  + 3.86+ 3.31                                            |
|    |     |     |     +  .. + 3.1                                             |
|    | 1.41|     |     |     + ...   1.38                                     |
|L100+ 1.20| 1.19|.971 |.752 |.533 +.987                                      |
|L111+-----+-----+-----+-----+.324 +.314  947E-4     .344                      |
|    +=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+.782         |
|                                        . + 1.51+ 2.2 +-2.17+-----+     -     |
|                                          + ..  + 3.7 + 2.61|     |           |
|                                            . . + 3.27+ 3.89| 3.37|           |
|                                              . + 4.3 + 4.76+ 3.98| 4.58      |
|                                                + ... + 5.10+ 5.14+ 5.35      |
|                                                  ... + 6.56+ 5.75+           |
|                                                    . + 6.92+ 7.12| 6.84      |
|                                                      +.. . + 7.65+ 7.61      |
|                                                        ... + 9.8 + 9.15      |
|                                                          . + 9.61+ 9.84      |
|                                                            + .   +           |
|                                                              . . | 11.6      |
|                                                                . + 12.3      |
|                                                                  +           |
|                                                                              |
|                                                                              |
|______________________________________________________________________________|
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FY S H E A R F O R C E E N V E L O P E

MEMBER 2. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 14.9 AT 0.0 FROM START.FOR LOAD 115.

UPPER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

14.91	12.23	9.54	6.86	4.17	1.71
0.24	-0.12	-0.34	-0.56	-0.78	

CORRESPONDING LOAD NUMBERS

115.	115.	115.	115.	115.	117.
108.	100.	100.	100.	100.	

LOWER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

1.10	0.88	0.66	0.44	0.22	0.00
-1.55	-4.24	-6.92	-9.61	-12.29	

CORRESPONDING LOAD NUMBERS

111.	111.	111.	111.	111.	111.
113.	113.	113.	113.	113.	

```
|
|
|      28.7
|L115+ 27.3
|L116+ 25.4
|L114+.23.8
|L105+.23.0
|L117+.21.2
|L118+\..
|    |\\.
|    | 17.0
|L107+ 16.0
|L108+\ \\.  13.8                                                  14.4
|    |\\ \.+ 12.8                                                + 12.4
|    | \\ \+\11.0                                               /+ 10.8
|    |   \\+\10.1                                               /+ 10.3
|    |    \+\8.62                                              //+ 8.75
|    |     +\\\                                               ///+
|    |     |\\\\                                              ////|
|    | 3.38| \\\                                              /// | 3.76
|L100+ 2.57| 1.95  1.85                                     /3.6 + 2.17
|L111+     + 1.38+.770                                     +.462/+ 1.43
|    |     +-----+.248  .174  .879   1.0  .996  .750  .264/+.797-+ 601E-4
|    +=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+
|                 \.\ | 3.68|     +-----+-----+-----+ /.//|/3.56
|                  \.\+ 5.41|     |     |     |     |/5.26+ 4.54
|                   \\+ 5.86| 6.26|     |     |     +/5.96+
|                    \+ 7.35+ 7.58|     |     |   ..+/7.44
|                     +.. . + 9.82| 8.52| 9.45| 9.73+ 8.84
|                      . .. + 10.7+-9.98+-10.9+ 10.7+
|                        .. + 12.1+-12.0+-12.0+ 11.9
|                         . + 13.0+-13.1+ 13.1+ 13.6
|                           +  .  + 14.6+ 14.4+
|                              .  +-15.7+ 16.4
|                                 +-----+
|
|
```

MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 2. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 28.7 AT 0.0 FROM START.FOR LOAD 115.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

28.67	13.80	2.87	-0.17	-0.71	-0.83
-0.71	-0.35	0.25	3.09	14.85	

CORRESPONDING LOAD NUMBERS

115.	115.	118.	100.	111.	111.
111.	111.	111.	114.	113.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

2.17	1.09	0.25	-7.35	-13.15	-16.26
-16.41	-13.63	-8.84	-4.54	-0.06	

CORRESPONDING LOAD NUMBERS

111.	111.	111.	113.	115.	115.
115.	115.	117.	107.	100.	

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*=================================================================
LOAD LIST 121 TO 138
*=================================================================
PRINT FORCE ENV NSECTION 10 LIST 1
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MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
1	0.00	MAX.	13.37	133	22.74	133	0.00	138	0.00	138
		MIN.	1.20	121	2.92	121	0.00	138	0.00	138
	1.10	MAX.	10.69	133	9.76	132	0.00	138	0.00	138
		MIN.	0.98	121	-0.11	128	0.00	138	0.00	138
	2.19	MAX.	8.01	133	1.80	131	0.00	138	0.00	138
		MIN.	0.76	121	-6.32	134	0.00	138	0.00	138
	3.29	MAX.	5.32	133	0.85	131	0.00	138	0.00	138
		MIN.	0.54	121	-12.52	134	0.00	138	0.00	138
	4.38	MAX.	2.64	133	0.15	131	0.00	138	0.00	138
		MIN.	0.32	121	-15.78	134	0.00	138	0.00	138
	5.48	MAX.	0.31	131	-0.32	131	0.00	138	0.00	138
		MIN.	-1.06	134	-16.09	134	0.00	138	0.00	138
	6.57	MAX.	0.10	131	-0.54	131	0.00	138	0.00	138
		MIN.	-3.74	134	-13.46	134	0.00	138	0.00	138
	7.67	MAX.	-0.12	131	-0.41	121	0.00	138	0.00	138
		MIN.	-6.43	134	-8.07	136	0.00	138	0.00	138
.2L	8.77	MAX.	-0.34	131	0.77	137	0.00	138	0.00	138
		MIN.	-9.11	134	-0.50	132	0.00	138	0.00	138
.1L	9.86	MAX.	-0.56	131	12.08	134	0.00	138	0.00	138
		MIN.	-11.80	134	0.22	131	0.00	138	0.00	138
℄	10.96	MAX.	-0.78	131	26.47	134	0.00	138	0.00	138
		MIN.	-14.48	134	0.96	131	0.00	138	0.00	138

-M @ SIDEWALL for TOP SLAB

MEMBER FORCES FOR TOP SLAB -M

MAX/MIN FORCE VALUES FOR MEMB 1,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	13.37	0.00	133	26.47	10.96	134			
	0.00	0.00	121	0.00	0.00	121	10.13 C	0.00	133
MIN.	-14.48	10.96	134	-16.09	5.48	134			
	0.00	10.96	138	0.00	10.96	138	1.33 C	10.96	121

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

180. PRINT FORCE ENV NSECTION 10 LIST 2

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
2	0.00	MAX.	13.83	135	26.20	134	0.00	138	0.00	138
		MIN.	0.78	131	0.96	131	0.00	138	0.00	138
	1.10	MAX.	11.16	134	12.58	134	0.00	138	0.00	138
		MIN.	0.56	131	0.22	131	0.00	138	0.00	138
	2.19	MAX.	8.64	134	1.73	134	0.00	138	0.00	138
		MIN.	0.34	131	-0.50	132	0.00	138	0.00	138
	3.29	MAX.	6.12	134	-0.41	121	0.00	138	0.00	138
		MIN.	0.12	131	-7.77	133	0.00	138	0.00	138
	4.38	MAX.	3.60	134	-0.54	131	0.00	138	0.00	138
		MIN.	-0.10	131	-12.39	135	0.00	138	0.00	138
	5.48	MAX.	1.08	134	-0.32	131	0.00	138	0.00	138
		MIN.	-0.31	131	-14.30	135	0.00	138	0.00	138
	6.58	MAX.	-0.32	121	0.15	131	0.00	138	0.00	138
		MIN.	-2.64	133	-14.06	134	0.00	138	0.00	138
	7.67	MAX.	-0.54	121	0.85	131	0.00	138	0.00	138
		MIN.	-5.32	133	-11.11	134	0.00	138	0.00	138
	8.77	MAX.	-0.76	121	1.80	131	0.00	138	0.00	138
		MIN.	-8.01	133	-5.39	134	0.00	138	0.00	138
	9.86	MAX.	-0.98	121	9.76	132	0.00	138	0.00	138
		MIN.	-10.69	133	-0.07	127	0.00	138	0.00	138
	10.96	MAX.	-1.20	121	22.74	133	0.00	138	0.00	138
		MIN.	-13.37	133	2.92	121	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 2 AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	13.83	0.00	135	26.20	0.00	134			
	0.00	0.00	121	0.00	0.00	121	10.13 C	0.00	133
MIN.	-13.37	10.96	133	-14.30	5.48	135			
	0.00	10.96	138	0.00	10.96	138	1.33 C	10.96	121

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

181. PRINT FORCE ENV NSECTION 10 LIST 3

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
3	0.00	MAX.	-1.33	121	-2.92	121	0.00	138	0.00	138
		MIN.	-10.13	133	-22.74	133	0.00	138	0.00	138
	1.13	MAX.	-1.24	128	-1.44	121	0.00	138	0.00	138
		MIN.	-8.53	133	-12.17	133	0.00	138	0.00	138
	2.27	MAX.	-1.02	128	0.07	131	0.00	138	0.00	138
		MIN.	-6.93	133	-4.83	134	0.00	138	0.00	138
	3.40	MAX.	-0.76	121	3.33	132	0.00	138	0.00	138
		MIN.	-4.69	133	-2.08	128	0.00	138	0.00	138
	4.53	MAX.	-0.55	128	7.71	132	0.00	138	0.00	138
		MIN.	-3.09	133	-1.33	128	0.00	138	0.00	138
	5.67	MAX.	-0.34	128	10.27	132	0.00	138	0.00	138
		MIN.	-1.49	133	-0.82	128	0.00	138	0.00	138
	6.80	MAX.	2.06	132	9.24	132	0.00	138	0.00	138
		MIN.	-0.01	127	-0.66	128	0.00	138	0.00	138
	7.93	MAX.	3.66	132	6.00	132	0.00	138	0.00	138
		MIN.	0.20	127	-0.77	128	0.00	138	0.00	138
	9.07	MAX.	5.26	132	1.31	131	0.00	138	0.00	138
		MIN.	0.42	127	-1.52	134	0.00	138	0.00	138
	10.20	MAX.	10.07	132	-1.66	121	0.00	138	0.00	138
		MIN.	0.81	127	-8.09	133	0.00	138	0.00	138
	11.33	MAX.	11.67	132	-2.82	127	0.00	138	0.00	138
		MIN.	1.03	127	-20.37	133	0.00	138	0.00	138

-M @ TOP OF SIDE WALL

+M @ SIDE WALL

-M @ BOT OF SIDE WALL

MAX/MIN FORCE VALUES FOR MEMB 3,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	11.67	11.33	132	10.27	5.67	132			
	0.00	0.00	121	0.00	0.00	121	15.22 C	11.33	133
MIN.	-10.13	0.00	133	-22.74	0.00	133			
	0.00	11.33	138	0.00	11.33	138	1.20 C	0.00	121

AXIAL

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

182. PRINT FORCE ENV NSECTION 10 LIST 4

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
4	0.00	MAX.	0.03	128	0.27	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	1.13	MAX.	0.03	128	0.24	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	2.27	MAX.	0.03	128	0.20	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	3.40	MAX.	0.03	128	0.17	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	4.53	MAX.	0.03	128	0.13	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	5.67	MAX.	0.03	128	0.10	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	6.80	MAX.	0.03	128	0.06	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	133	0.00	138	0.00	138
	7.93	MAX.	0.03	128	0.03	128	0.00	138	0.00	138
		MIN.	0.00	135	0.00	132	0.00	138	0.00	138
	9.07	MAX.	0.03	128	0.00	127	0.00	138	0.00	138
		MIN.	0.00	135	-0.01	124	0.00	138	0.00	138
	10.20	MAX.	0.03	128	0.00	127	0.00	138	0.00	138
		MIN.	0.00	135	-0.04	138	0.00	138	0.00	138
	11.33	MAX.	0.03	128	0.00	125	0.00	138	0.00	138
		MIN.	0.00	135	-0.08	138	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 4,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	0.03	0.00	128	0.27	0.00	128			
	0.00	0.00	121	0.00	0.00	121	29.58 C	11.33	134
MIN.	0.00	11.33	135	-0.08	11.33	138			
	0.00	11.33	138	0.00	11.33	138	1.56 C	0.00	131

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

183. PRINT FORCE ENV NSECTION 10 LIST 5

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
5	0.00	MAX.	10.13	133	22.74	133	0.00	138	0.00	138
		MIN.	1.33	121	2.92	121	0.00	138	0.00	138
	1.13	MAX.	8.53	133	12.17	133	0.00	138	0.00	138
		MIN.	1.21	128	1.44	121	0.00	138	0.00	138
	2.27	MAX.	6.93	133	4.33	134	0.00	138	0.00	138
		MIN.	0.99	128	-0.07	131	0.00	138	0.00	138
	3.40	MAX.	4.69	133	2.03	127	0.00	138	0.00	138
		MIN.	0.74	128	-3.33	132	0.00	138	0.00	138
	4.53	MAX.	3.09	133	1.28	127	0.00	138	0.00	138
		MIN.	0.52	128	-7.71	132	0.00	138	0.00	138
	5.67	MAX.	1.49	133	0.78	127	0.00	138	0.00	138
		MIN.	0.31	128	-10.27	132	0.00	138	0.00	138
	6.80	MAX.	0.01	127	0.61	127	0.00	138	0.00	138
		MIN.	-2.06	132	-9.24	132	0.00	138	0.00	138
	7.93	MAX.	-0.20	127	0.72	127	0.00	138	0.00	138
		MIN.	-3.66	132	-6.00	132	0.00	138	0.00	138
	9.07	MAX.	-0.42	127	1.24	134	0.00	138	0.00	138
		MIN.	-5.26	132	-1.31	131	0.00	138	0.00	138
	10.20	MAX.	-0.81	127	8.09	133	0.00	138	0.00	138
		MIN.	-10.07	132	1.58	128	0.00	138	0.00	138
	11.33	MAX.	-1.03	127	20.37	133	0.00	138	0.00	138
		MIN.	-11.67	132	2.66	128	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 5,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	10.13	0.00	133	22.74	0.00	133			
	0.00	0.00	121	0.00	0.00	121	15.22 C	11.33	133
MIN.	-11.67	11.33	132	-10.27	5.67	132			
	0.00	11.33	138	0.00	11.33	138	1.20 C	0.00	121

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

184. PRINT FORCE ENV NSECTION 2 LIST 6 TO 10

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
6	0.00	MAX.	-1.72	121	-2.82	127	0.00	138	0.00	138
		MIN.	-9.58	133	-20.37	133	0.00	138	0.00	138
	1.10	MAX.	-1.94	121	0.34	127	0.00	138	0.00	138
		MIN.	-9.80	133	-10.05	132	0.00	138	0.00	138
	2.19	MAX.	-2.16	121	6.63	134	0.00	138	0.00	138
		MIN.	-10.02	133	-2.00	131	0.00	138	0.00	138

-M @ BOT OF SIDE WALL

MAX/MIN FORCE VALUES FOR MEMB 6,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	-1.72	0.00	121	6.63	2.19	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-10.02	2.19	133	-20.37	0.00	133			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

7	0.00	MAX.	0.44	128	6.63	134	0.00	138	0.00	138
		MIN.	-4.28	133	-2.00	131	0.00	138	0.00	138
	1.10	MAX.	-0.97	121	10.05	134	0.00	138	0.00	138
		MIN.	-4.50	133	-0.76	131	0.00	138	0.00	138
	2.19	MAX.	-1.19	121	13.71	134	0.00	138	0.00	138
		MIN.	-4.72	133	0.73	131	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 7,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	0.44	0.00	128	13.71	2.19	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-4.72	2.19	133	-2.00	0.00	131			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

8	0.00	MAX.	2.58	127	13.71	134	0.00	138	0.00	138
		MIN.	-0.17	131	0.73	131	0.00	138	0.00	138
	1.10	MAX.	1.13	134	12.36	134	0.00	138	0.00	138
		MIN.	-0.39	131	1.04	131	0.00	138	0.00	138
	2.19	MAX.	0.91	134	11.24	134	0.00	138	0.00	138
		MIN.	-0.89	128	1.59	131	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 8,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	2.58	0.00	127	13.71	0.00	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-0.89	2.19	128	0.73	0.00	131			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

9	0.00	MAX.	5.99	134	11.24	134	0.00	138	0.00 138
		MIN.	0.57	131	1.59	131	0.00	138	0.00 138
	1.10	MAX.	5.78	134	5.07	136	0.00	138	0.00 138
		MIN.	0.35	131	1.04	121	0.00	138	0.00 138
	2.19	MAX.	5.56	134	0.81	131	0.00	138	0.00 138
		MIN.	0.14	131	-1.41	134	0.00	138	0.00 138

MAX/MIN FORCE VALUES FOR MEMB 9,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	5.99	0.00	134	11.24	0.00	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	0.14	2.19	131	-1.41	2.19	134			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

10	0.00	MAX.	11.78	134	0.81	131	0.00	138	0.00 138
		MIN.	1.32	131	-1.41	134	0.00	138	0.00 138
	1.10	MAX.	11.56	134	-0.51	131	0.00	138	0.00 138
		MIN.	1.10	131	-14.20	134	0.00	138	0.00 138
	2.19	MAX.	11.34	134	-1.60	131	0.00	138	0.00 138
		MIN.	0.88	131	-26.75	134	0.00	138	0.00 138

MAX/MIN FORCE VALUES FOR MEMB 10,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	11.78	0.00	134	0.81	0.00	131			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	0.88	2.19	131	-26.75	2.19	134			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

185. PRINT FORCE ENV NSECTION 2 LIST 11 TO 15

MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
11	0.00	MAX.	-0.88	131	-1.60	131	0.00	138	0.00	138
		MIN.	-11.21	134	-26.83	134	0.00	138	0.00	138
.1L	1.10	MAX.	-1.10	131	-0.51	131	0.00	138	0.00	138
		MIN.	-11.43	134	-14.42	134	0.00	138	0.00	138
.2L	2.19	MAX.	-1.32	131	0.81	131	0.00	138	0.00	138
		MIN.	-11.65	134	-1.78	134	0.00	138	0.00	138

MEMBER FORCES FOR BOT SLAB - M

MAX/MIN FORCE VALUES FOR MEMB 11,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	-0.88	0.00	131	0.81	2.19	131			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-11.65	2.19	134	-26.83	0.00	134			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

12	0.00	MAX.	-0.14	131	0.81	131	0.00	138	0.00	138
		MIN.	-5.43	134	-1.78	134	0.00	138	0.00	138
	1.10	MAX.	-0.35	131	4.93	135	0.00	138	0.00	138
		MIN.	-5.65	134	1.04	121	0.00	138	0.00	138
	2.19	MAX.	-0.57	131	10.87	135	0.00	138	0.00	138
		MIN.	-5.87	134	1.59	131	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 12,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	-0.14	0.00	131	10.87	2.19	135			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-5.87	2.19	134	-1.78	0.00	134			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

13	0.00	MAX.	0.96	128	10.87	135	0.00	138	0.00	138
		MIN.	-0.83	134	1.59	131	0.00	138	0.00	138
	1.10	MAX.	0.39	131	11.64	134	0.00	138	0.00	138
		MIN.	-1.05	134	1.04	131	0.00	138	0.00	138
	2.19	MAX.	0.17	131	12.92	134	0.00	138	0.00	138
		MIN.	-2.58	127	0.73	131	0.00	138	0.00	138

MAX/MIN FORCE VALUES FOR MEMB 13,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	0.96	0.00	128	12.92	2.19	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-2.58	2.19	127	0.73	2.19	131			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

14	0.00	MAX.	4.72	133	12.92	134	0.00	138	0.00 138
		MIN.	1.19	121	0.73	131	0.00	138	0.00 138
	1.10	MAX.	4.50	133	9.34	134	0.00	138	0.00 138
		MIN.	0.97	121	-0.76	131	0.00	138	0.00 138
	2.19	MAX.	4.28	133	6.00	134	0.00	138	0.00 138
		MIN.	-0.52	128	-2.00	131	0.00	138	0.00 138

MAX/MIN FORCE VALUES FOR MEMB 14,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	4.72	0.00	133	12.92	0.00	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	-0.52	2.19	128	-2.00	2.19	131			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

15	0.00	MAX.	10.02	133	6.00	134	0.00	138	0.00 138
		MIN.	2.16	121	-2.00	131	0.00	138	0.00 138
	1.10	MAX.	9.80	133	0.34	127	0.00	138	0.00 138
		MIN.	1.94	121	-10.05	132	0.00	138	0.00 138
	2.19	MAX.	9.58	133	-2.66	128	0.00	138	0.00 138
		MIN.	1.65	128	-20.37	133	0.00	138	0.00 138

MAX/MIN FORCE VALUES FOR MEMB 15,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	10.02	0.00	133	6.00	0.00	134			
	0.00	0.00	121	0.00	0.00	121	11.65 C	0.00	132
MIN.	1.65	2.19	128	-20.37	2.19	133			
	0.00	2.19	138	0.00	2.19	138	1.03 C	2.19	127

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

186. MSDR ENVELOPE FY MZ LIST 1

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 _____________________________________________________________________________
|                                                                             |
|                                                                             |
|     13.4                                                                    |
|L136+ 12.7                                                                   |
|L134+ .                                                                      |
|    | 10.6  10.7                                                            |
|L126+ 9.87+ 10.2                                                             |
|L122+ 8.70+ 8.45                                                             |
|L138+  .. + 7.84  7.64                                                       |
|    |  .  + 6.83+ 7.0                                                         |
|    | 6.8 +  .. + 5.82                                                       |
|L128+      |  .  + 4.97  5.12                                                |
|    |  .   | 4.70+ ... + 3.99                                                |
|    |      +     | 3.33+ 3.79                                                |
|    |      |     +     + . .   2.60                                          |
|    | 1.41|     |  .  | 1.96+ 1.76                                          |
|L131+ 1.20|.982 |.763 +.543 +.592                                           |
|L121+-----+-----+-----+-----+.324  .105  .114  .333  .552                    |
|    +=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+.991        |
|                                  + ..  | 2.29|     |     +-----+            |
|                                    ... + 2.58|     |     |     |            |
|                                      . + 3.74| 3.52|     |     |            |
|                                        + ... + 4.32| 4.89|     |            |
|                                          . . + 5.42+     |     |            |
|                                            . + 6.43| 6.35| 6.26|            |
|                                              + . . + 6.97+     | 7.63       |
|                                                . . + 8.10| 8.37+            |
|                                                  . + 9.11+ 9.16|            |
|                                                    + . . + 10.0| 10.4       |
|                                                      . . + 10.8+ 11.3       |
|                                                        . + 11.8+ 11.3       |
|                                                          + . . + 12.5       |
|                                                            . . + 13.5       |
|                                                              . + 14.5       |
|                                                                +            |
|                                                                             |
|                                                                             |
|_____________________________________________________________________________|
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FY S H E A R F O R C E E N V E L O P E

MEMBER 1. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 14.5 AT 11.0 FROM START.FOR LOAD 134.

UPPER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

13.37	10.69	8.01	5.32	2.64	0.31
0.10	-0.12	-0.34	-0.56	-0.78	

CORRESPONDING LOAD NUMBERS

133.	133.	133.	133.	133.	131.
131.	131.	131.	131.	131.	

LOWER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

1.20	0.98	0.76	0.54	0.32	-1.06
-3.74	-6.43	-9.11	-11.80	-14.48	

CORRESPONDING LOAD NUMBERS

121.	121.	121.	121.	121.	134.
134.	134.	134.	134.	134.	

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|                                                                              |
|                                                                   26.5       |
|                                                                 + 24.7       |
|                                                                 + 23.3       |
|      22.3                                                      .+            |
|L133+ 20.3                                                    ..| 20.4        |
|L136+ 20.3                                                    ..+ 19.6        |
|L135+\                                                       ../+ 18.5        |
|    |.\                                                       . /+           |
|    |\15.6                                                   ..//|           |
|L134+ 14.0                                                  ..// | 14.4       |
|L126+\ .\                                                  .12.1+            |
|    | 11.7                                                 +.11.0|            |
|L138+ \\\\  9.76                                          /+/9.66|           |
|    |\ \ .+                                               /+/8.22|           |
|    | \\\\| 7.47                                          //+/6.76|           |
|    | 5.84+ 5.90                                        ///+/6.5 |           |
|L128+ 4.41+\3.92                                        ///+     |           |
|L131+.2.92+ 2.98                                        ///.|    |           |
|L121+  .  +\1.72  1.80                                  ///  |    | 1.77     |
|    |   . +\702E+4765   498E-4                         /742E-4   +.958      |
|    +=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+             |
|           . \\\+\2.28|     +-----+-----+-----+   ..+                        |
|             . \+\3.76|     |     |     |     | 3.96                         |
|              . +\4.47|     |     |     |     + 5.69                         |
|                \+ 6.32| 6.85|     |     | 7.7 +/6.14                        |
|               +   ..\+ 7.85|     |    + 7.53+/7.32                         |
|                 .   .\+ 9.5 | 9.89| 8.67+ 9.31+                            |
|                    .  + ... +-11.0+ 10.7+ 10.2                             |
|                     . | 12.5+-11.3+ 11.8+ 11.4                             |
|                       +    . + 13.3+ 12.8+ 13.5                            |
|                          .   +     + 14.3+                                 |
|                             . | 15.8+ 16.1                                 |
|                               +-----+                                      |
|                                                                              |
 ------------------------------------------------------------------------------
```

MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 1. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 26.5 AT 11.0 FROM START.FOR LOAD 134.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

22.74	9.76	1.80	0.85	0.15	-0.32
-0.54	-0.41	0.77	12.08	26.47	

CORRESPONDING LOAD NUMBERS

133.	132.	131.	131.	131.	131.
131.	121.	137.	134.	134.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

2.92	-0.11	-6.32	-12.52	-15.78	-16.09
-13.46	-8.07	-0.50	0.22	0.96	

CORRESPONDING LOAD NUMBERS

121.	128.	134.	134.	134.	134.
134.	136.	132.	131.	131.	

187. MSDR ENVELOPE FY MZ LIST 2

```
 ________________________________________________________________________
|                                                                        |
|                                                                        |
|     13.5                                                               |
|L135+ 12.5                                                              |
|L136+ .                                                                 |
|    | 11.3  10.8                                                       |
|L125+ 10.4+ 10.0                                                        |
|L137+ 9.7 +.9.16                                                        |
|L138+ ..  + 8.37  8.64                                                  |
|    | 7.63+ 8.8 + 7.48                                                  |
|L127+ 6.76+ ... + 6.97                                                  |
|L128+  .  | 6.26+ 6.35  6.12                                            |
|    |     +     + 4.89+ 4.77                                            |
|    |     |  .  + 4.35+ 4.32                                            |
|    |     |     +  .  + 3.52  3.60                                      |
|    |     |     |     +  .. + 2.29                                      |
|    |     |     |     |  .  + 1.94                                      |
|    |.991 |.772 |.552 |.333 + ...   .264                                |
|L131+-----+-----+-----+.124 |.114 +.105  .324  .543                     |
|   +=====+=====+=====+=====+=====+=====+ 1.13+=====+=====+=====+ 1.20   |
|                                    . . + 1.76+-1.96+-----+-----+      |
|                                      . + 2.60+ 3.11| 2.89|     |      |
|                                        + ... + 3.79+ 3.33| 4.10|      |
|                                          . . + 4.97+ 4.97+ 4.70|      |
|                                            . + 5.12+ 5.82+  .  | 5.30 |
|                                              + . . + 6.18| 6.23+ 6.8  |
|                                                ... + 7.64+ 7.51+      |
|                                                  . + 8.1 + 7.84| 7.93 |
|                                                    +.. . + 9.0 + 8.70 |
|                                                      ... + 10.2+ 9.87 |
|                                                        . + 10.7+ 10.6 |
|                                                          + . . + 11.5 |
|                                                            . . + 12.7 |
|                                                              . + 13.4 |
|                                                                +      |
|                                                                        |
|                                                                        |
|________________________________________________________________________|
```

FY SHEAR FORCE ENVELOPE

MEMBER 2. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 13.8 AT 0.0 FROM START.FOR LOAD 135.

UPPER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

13.83	11.16	8.64	6.12	3.60	1.08
-0.32	-0.54	-0.76	-0.98	-1.20	

CORRESPONDING LOAD NUMBERS

135.	134.	134.	134.	134.	134.
121.	121.	121.	121.	121.	

LOWER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

0.78	0.56	0.34	0.12	-0.10	-0.31
-2.64	-5.32	-8.01	-10.69	-13.37	

CORRESPONDING LOAD NUMBERS

131.	131.	131.	131.	131.	131.
133.	133.	133.	133.	133.	

```
|                                                                                |
|                                                                                |
|      26.2                                                                      |
|L134+ 24.7                                                                      |
|L135+ 23.3                                                                      |
|L136+.                                                                  22.3    |
|    |.20.4                                                             +       |
|L132+.19.3                                                             | 20.3   |
|L126+ 18.5                                                            .+        |
|L137+ 17.4                                                           ./|        |
|L138+\\..                                                              | 15.6   |
|    |\14.4                                                           ./ + 14.0  |
|L127+ 13.3  12.6                                                     / /+ 13.5  |
|L128+\ \\.+                                                          .  /+ 11.7 |
|    |\\ \ | 9.99                                                     ./ //+ 11.1 |
|    | \\\\+\9.13                                                     /9.76+      |
|    |   \\+\8.22                                                    + 7.47|      |
|    |    \+\6.76                                                   /+ /// |     |
|    |     +\\\                                                    //|/5.90| 5.84 |
|    |     |\\\\                                                   / +/3.92+ 4.41 |
|    |     | \\\                                                  ///+/2.98+ 2.92 |
|    | 1.77|.799\ .779                                  .850  .765/+ 1.72+        |
|L131+-----+.222\+ 741E-4     .545  .320  .426 +-498E+4----+ 702E-4               |
|    +======+======+======+======+======+======+======+======+======+              |
|                .\.. | 2.97+-----+     |     |    /+/2.28                        |
|                 \.\ + 3.96|     |     |     |   /.+/3.76                        |
|                  \.\+ 5.69| 5.75|     |     | /./.+/5.39                        |
|                   \\+ 6.14+ 7.7 |     |     |/6.85+                             |
|                    \+ 7.32+ 7.45| 7.21| 7.35+/7.85                             |
|                     +.. . + 9.31+-8.67+ 9.60+/9.5                                |
|                      .... + 10.2+-10.7+ 9.89+ /                                  |
|                        .. + 11.4+-11.8+ 11.9|/11.1                              |
|                         . + 12.4+ 12.4+ 12.3+                                   |
|                           +  .  + 13.8+ 14.1                                    |
|                                 +-----+                                         |
|                                                                                |
|                                                                                |
|                                                                                |
```

MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 2. ALL UNITS ARE - KIP FEET

LENGTH= 11.0 MAX(ABSOLUTE)= 26.2 AT 0.0 FROM START.FOR LOAD 134.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

26.20	12.58	1.73	-0.41	-0.54	-0.32
0.15	0.85	1.80	9.76	22.74	

CORRESPONDING LOAD NUMBERS

134.	134.	134.	121.	131.	131.
131.	131.	131.	132.	133.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

0.96	0.22	-0.50	-7.77	-12.39	-14.30
-14.06	-11.11	-5.39	-0.07	2.92	

CORRESPONDING LOAD NUMBERS

131.	131.	132.	133.	135.	135.
134.	134.	134.	127.	121.	

188. MSDR ENVELOPE FY MZ LIST 3

```
|                                                                                |
|                                                                                |
|                                                                   11.7         |
|                                                                  +             |
|                                                              10.1|             |
|                                                             +    | 9.22       |
|                                                            /|    +             |
|                                                           / |   . |            |
|                                                             | 7.62| 7.76       |
|                                                          /  + 6.70+            |
|                                                         /  .+     |            |
|                                                        /5.26|     | 5.23       |
|                                                      + 4.78| 4.35+ 4.42        |
|                                                 3.66+ /   +-4.16+              |
|                                               + 3.18|/3.49+ 2.94| 2.98         |
|                                             . + 2.42+ 2.43+------+             |
|                                          2.6 + 1.86+ /  .|     |               |
|                                        + 1.36+ 1.0 |/1.7 |.812 | 1.3           |
|                                       /+.658-+.704-+.749 +------+              |
|                              .553  .380 + 148E+4----+     |     |               |
|    +======+======+======+======+======+======+======+======+======+              |
|L121+ 1.45+ 1.98+ 1.91+------+-1.45+/1.46                                       |
|L128+ 2.4 +------+     | 2.51+ 2.6 +                                            |
|L131+     |     | 3.13+ 3.12+ 3.6                                               |
|    |     | 3.88+ 3.61+ 3.96+                                                     |
|    | 4.62+ 4.68+ 4.61+ 4.66                                                     |
|L138+ 5.24+     +   . +                                                         |
|L134+ 5.74| 5.68| 5.81                                                           |
|L126+ 6.74+     + 6.90                                                          |
|L124+     | 7.41+                                                                 |
|    |     +   .                                                                 |
|    | 9.0 | 8.50                                                                   |
|L136+     +                                                                     |
|    | 10.1                                                                       |
|L133+                                                                           |
|                                                                                |
|                                                                                |
|                                                                                |
```

FY SHEAR FORCE ENVELOPE

MEMBER 3. ALL UNITS ARE - KIP FEET

LENGTH= 11.3 MAX(ABSOLUTE)= 11.7 AT 11.3 FROM START.FOR LOAD 132.

UPPER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

-1.33	-1.24	-1.02	-0.76	-0.55	-0.34
2.06	3.66	5.26	10.07	11.67	

CORRESPONDING LOAD NUMBERS

121.	128.	128.	121.	128.	128.
132.	132.	132.	132.	132.	

LOWER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

-10.13	-8.53	-6.93	-4.69	-3.09	-1.49
-0.01	0.20	0.42	0.81	1.03	

CORRESPONDING LOAD NUMBERS

133.	133.	133.	133.	133.	133.
127.	127.	127.	127.	127.	

```
                                  10.3
                                +       9.24
                            7.71|     +
                          + 7.38| 7.33| 6.60
                         /+ 5.56+-6.17+ 5.51  6.0
                        /.+ 4.45+-----+ 5.25+
                       /. .+ 4.12| 4.19+ 3.58|\3.36
                      /3.33+ 2.28+-2.60+ 3.5 + 3.14
                     + 1.51+-1.82+-----+ 2.15+.1.38  1.31
                    /+.981 +.975 |     +-----+.783\+.559
                 154E+4..  +     |.776 |.614 +.720 + 942E-5
     +=====+=====+=====+=====+=====+=====+=====+=====+.958=+=====+
     | 2.92+ 2.13|/2.74+ 2.3 +                      +\----+     | 2.82
|L121+     +     +-3.13+                             .\.  |\.   +
     | 4.41| 4.31+ 4.83                               .\ | 4.80| 5.2
|L131+ 5.84+  .//+                                    .\+ 5.90+
|L128+ .    | 6.84                                    \ +\   \| 6.93
     |     + 8.11                                     \|\7.94+
     |    /+/8.57                                      + \ \ |
     |   //+ /                                          \\\\| 10.2
     | / //|/11.0                                       . \\\+ 10.5
     |/11.7+/11.7                                       \ \\+ 11.7
|L138+ // /+                                            .   +
     |/14.0                                             \ \| 14.1
|L126+/15.6                                             .\ +
|L134+/16.1                                                |
|L124+                                                   .\| 17.3
     | /.                                                  +
     |/                                                   .|
     | 20.3                                                | 20.3
|L136+.                                                   +
     | 22.3
|L133+
```

MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 3. ALL UNITS ARE - KIP FEET

LENGTH= 11.3 MAX(ABSOLUTE)= 22.7 AT 0.0 FROM START.FOR LOAD 133.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

-2.92	-1.44	0.07	3.33	7.71	10.27
9.24	6.00	1.31	-1.66	-2.82	

CORRESPONDING LOAD NUMBERS

121.	121.	131.	132.	132.	132.
132.	132.	131.	121.	127.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

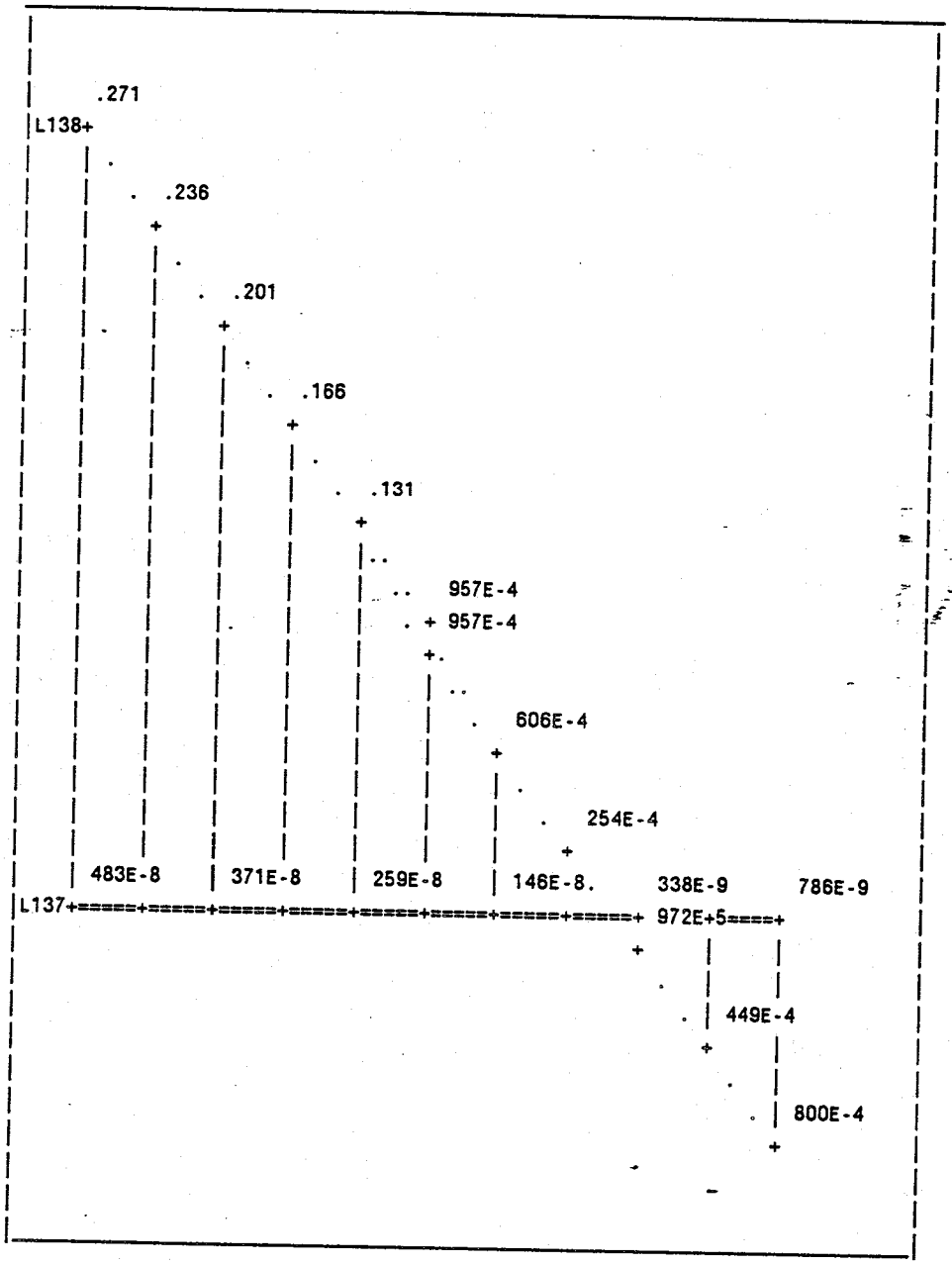
-22.74	-12.17	-4.83	-2.08	-1.33	-0.82
-0.66	-0.77	-1.52	-8.09	-20.37	

CORRESPONDING LOAD NUMBERS

133.	133.	134.	128.	128.	128.
128.	128.	134.	133.	133.	

189. MSDR ENVELOPE FY MZ LIST 4

MEMBER 4. HAS ZERO FY



MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 4. ALL UNITS ARE - KIP FEET

LENGTH= 11.3 MAX(ABSOLUTE)= 0.3 AT 0.0 FROM START.FOR LOAD 128.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

0.27	0.24	0.20	0.17	0.13	0.10
0.06	0.03	0.00	0.00	0.00	

CORRESPONDING LOAD NUMBERS

128.	128.	128.	128.	128.	128.
128.	128.	127.	127.	125.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	-0.01	-0.04	-0.08	

CORRESPONDING LOAD NUMBERS

133.	133.	133.	133.	133.	133.
133.	132.	124.	138.	138.	

190. MSDR ENVELOPE FY MZ LIST 5

```
 ______________________________________________________________________________
|                                                                              |
|                                                                              |
|     10.1                                                                     |
|L133+                                                                         |
|    | 9.0   8.50                                                              |
|L136+      +                                                                 |
|    |  .  | 7.41                                                             |
|    | 6.74+   .    6.90                                                       |
|L124+ 5.74| 5.68+ 5.81                                                        |
|L126+ 5.21+      + .                                                          |
|L134+ 4.62| 4.68| 4.61  4.66                                                  |
|L138+      + 3.88+ 3.61+ 3.96                                                 |
|    |      +      + 3.13+ 3.12  3.6                                          |
|    | 2.4 |      +  .  + 2.51+ 2.6                                            |
|L131+ 1.45| 1.98| 1.91+      + 1.45  1.46                                     |
|L128+ 1.33+-1.28+ 1.23|.762 +.716 +.671                                       |
|L121+-----+-----+-----+-----+.553-+.380   148E-4                              |
|    +=====+=====+=====+=====+=====+=====+=====+=====+=====+=====+             |
|                                   .. + 1.36+ 1.0-+ 1.7 |.812 | 1.3          |
|                                    .\+ 2.6-+-1.86+.    +-----+               |
|                                      +  .  + 2.42| 2.47|     |               |
|                                        ..  + 3.18+ 3.49| 2.94| 2.98         |
|                                          . + 3.66+ . \ + 4.16+               |
|                                            +  .  | 4.78+ 4.35| 4.42         |
|                                               .  + 5.26+--.--+ 5.23         |
|                                                  +.  \ |     +               |
|                                                   \ . \| 6.70|               |
|                                                    \ . + 7.62| 7.76         |
|                                                     \  +     +               |
|                                                        | .   |               |
|                                                      \ |   . | 9.22         |
|                                                       \| 10.1+               |
|                                                        +     |               |
|                                                            . | 11.7         |
|                                                              +               |
|                                                                              |
|______________________________________________________________________________|
```

FY S H E A R F O R C E E N V E L O P E

MEMBER 5. ALL UNITS ARE - KIP FEET

LENGTH= 11.3 MAX(ABSOLUTE)= 11.7 AT 11.3 FROM START.FOR LOAD 132.

UPPER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

10.13	8.53	6.93	4.69	3.09	1.49
0.01	-0.20	-0.42	-0.81	-1.03	

CORRESPONDING LOAD NUMBERS

133.	133.	133.	133.	133.	133.
127.	127.	127.	127.	127.	

LOWER ENVELOPE FY VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

1.33	1.21	0.99	0.74	0.52	0.31
-2.06	-3.66	-5.26	-10.07	-11.67	

CORRESPONDING LOAD NUMBERS

121.	128.	128.	128.	128.	128.
132.	132.	132.	132.	132.	

```
 ___________________________________________________________________________
|                                                                           |
|                                                                           |
|     22.3                                                                  |
|L133+                                                                      |
|    | 20.3                                                       20.3      |
|L135+ 19.8                                                     +           |
|L136+ .                                                        |           |
|    |\                                                        .| 17.3      |
|    |\16.1                                                    +           |
|L123+ 15.6                                                   ./|           |
|L124+ 14.0                                                     | 14.1      |
|L134+ 13.5                                                   ./ +          |
|L126+ 11.7  11.7                                             / /|          |
|L137+ 11.1+ 11.0                                             .  | 10.5     |
|L138+\\\\\+ 10.5                                           / / + 10.3     |
|    |.\ \\+\8.57                                           . / /+          |
|    |  .\\+\8.11                                           7.94|          |
|    |   .\+ 6.84                                         + / / | 6.93     |
|    | 5.84+.\\\                                          /|/5.90+          |
|L128+ 4.41|.4.31  4.33                                   / +/4.99| 5.2     |
|L131+  .  + 3.83+ 3.13                                   //+   / +         |
|    | 2.92+ 2.13+ 2.74  2.3                             ./.| / . | 2.82     |
|L121+     + 1.44+..---+ 1.62  1.28                     1.16|/1.66+         |
|    |      +  .  |.154E+4    +.906  .776  .614  .720 +/935E+5    |         |
|    +=====+=====+=====+.439=+=====+=====+=====+=====+=====+=====+          |
|                 ..\+ 1.51| 1.82|      | 2.15+ 1.38+ 1.31                 |
|                    \+ 3.33+ 2.28| 2.60+ 3.5-+ 3.14+                      |
|                     +.. . +-4.12+-3.66+ 3.35+ 3.36                       |
|                      \... + 4.45+-----+ 5.25+ /                          |
|                       \.. + 5.56| 6.17+ 5.50|/6.0                        |
|                         \ + 7.38+ 7.33+ 6.60+                            |
|                          \+ 7.71+ 7.67+   .                              |
|                           + .   +     | 9.24                             |
|                               .. | 10.3+                                 |
|                                  +                                       |
|                                                                           |
|                                                                           |
|___________________________________________________________________________|
```

MZ B E N D I N G M O M E N T E N V E L O P E

MEMBER 5. ALL UNITS ARE - KIP FEET

LENGTH= 11.3 MAX(ABSOLUTE)= 22.7 AT 0.0 FROM START.FOR LOAD 133.

UPPER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

22.74	12.17	4.33	2.03	1.28	0.78
0.61	0.72	1.24	8.09	20.37	

CORRESPONDING LOAD NUMBERS

133.	133.	134.	127.	127.	127.
127.	127.	134.	133.	133.	

LOWER ENVELOPE MZ VALUES AT CONSECUTIVE SECTIONS FROM START TO END:

2.92	1.44	-0.07	-3.33	-7.71	-10.27
-9.24	-6.00	-1.31	1.58	2.66	

CORRESPONDING LOAD NUMBERS

121.	121.	131.	132.	132.	132.
132.	132.	131.	128.	128.	

```
191.      PLOT DIS FIL
192.      FINISH


*************** END OF STAAD-III ***************

****** DATE= JUL 22,1994   TIME= 13:44:32 ******


*****************************************************************
*          FOR QUESTIONS ON STAAD-III/ISDS, CONTACT:            *
*          RESEARCH ENGINEERS, INC AT (609) 983-5050            *
*          TELEX:  4994385      FAX:  (609) 983-3825            *
*****************************************************************
```