BASE DESIGN
TRANSVERSE DIRECTION

COMPUTATION SHEET

PROJECT	PAGE 1 OF 12	COMPUTED BY MZ	DATE 8/96
SUBJECT		CHECKED BY	

EFFECTIVE FLANGE

ACI 8.10 $b_{effective}$ is lesser of:

- $\frac{l_n}{4}$ where l_n = Lock Wall − Lock Wall = 110'

$\frac{110}{4} = 27.5'$

- $t_w + 2(8 \times \text{slab thick})$ (OVERHANG) $= 33.5'$

$= t_w + 2(6.25) = 14'$ ←

ACI 10.6.6 USABLE FLANGE WIDTH FOR FLEXURAL REINFORCEMENT

Reference Letter from S. Moustafa (WJE, INC) dated 20 Sept 96

Recommends using full 14' for flexural rebar distribution

ACI 10.6.7 Web Horiz Steel

$A_{sk}/_{FOOT} \geq 0.012(d - 30)$ $d = 144'' - 4\frac{1}{2}'' = 139.5$

$A_{sk} = 1.31''^2/12''$

USE # 11 @ 12'' $A_{sk} = 1.56''^2/LF$

ACI 8.10.5 The base design, w/ WEBS SPANNING both directions, is similar to joist construction and therefore not applicable. However, the spacing of bars in the opposite direction shall not exceed the requirements of 8.10.5.2. The perpendicular A_s shall be designed to resist the greater of the moment acting on the I-BEAM and the moment acting on the Flange as a continuous slab spanning supports @ 14' O.C.

COMPUTATION SHEET

PROJECT	SHEET 2 OF 12	COMPUTED BY gma	DATE 8/96
SUBJECT		CHECKED BY	DATE

ACI 10.5.1

$$\rho_{min} = \frac{200}{f_y} = 0.0033$$

$$\rho_{ACT} = \frac{A_s}{b \cdot d}$$

conservatively include only rebar above I-Beam C.G

TRANSVERSE DIRECTION

$$d = \frac{(2 \times 24 \times 1.56 \times 138) + (2 \times 24 \times 1.56 \times 125) + (2 \times 1.56 \times 114) + (2 \times 1.56 \times 102) + (2 \times 1.56 \times 90) + (2 \times 1.56 \times 78)}{162.24}$$

$$= \frac{20,892}{162.24} = 128.77''$$

$$b = b_w = 18''$$

$$\rho = \frac{162.24''^2}{18 \times 128.8} = 0.070 > 0.0033$$

FLEXURAL DESIGN

- Normal & Max Operation - Neglect Axial load
- USE #11 BARS, AS RECOMMENDED BY MOUSTAFA, TO Reduce cracks.

w/ 4 Rows of #11 @ 8" in Flange
#11 @ 12" HORIZ BARS IN WEB

	Applied M	Moment Mu	fs	ϕMN	
WSD NORMAL OPER	24,050 1-K	—	16.44 KSI	—	$< F_s = 17$ KSI Table 4.1 ACI 357
WSD MAX OPER	30,050 1-K	—	20.54 KSI	—	$< F_s = 23$ KSI Table 4.1 ACI 357
USD NORMAL	—	53,150 1-K	—	94,000	
USD MAXIMUM	—	66,410 1-K	—	94,000	

Wiss, Janney, Elstner Associates, Inc.

Mr. Mark Gonski
U.S. Army Corps of Engineers
New Orleans District

September 20, 1996
Page 2

4. ACI 357, Para. 4.4.2: Since you are designing for zero tension in the concrete, Δps will essentially equal zero according to the definition given in the ACI. For the sake of satisfying this section of 357, I agree with your interpretation of using the allowable value in Table 4.1.

5. The use of lightweight concrete: The type of aggregate and mix design have a great deal of influence on the durability and performance of lightweight concrete. The specified concrete mix should have substantial documentation of its performance to assure that is meets the project service life requirements.

I hope this answers your questions. If you require additional explanation or have additional questions, please do not hesitate to call.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Saad E. Moustafa, Ph.D., P.E.
Consultant

SEM:mjv.2204

WJE **Wiss, Janney, Elstner Associates, Inc.**
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R.A. WALTHER
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B. WONNENBERGER
PAST PRESIDENT
J.M. HANSON

September 20, 1996

Sent by Fax and U.S. Mail

Mr. Mark Gonski
U.S. Army Corps of Engineers
New Orleans District
Foot of Prytania Street
New Orleans, LA 70118

Re: IHNC Lock Replacement
WJE No. 960888

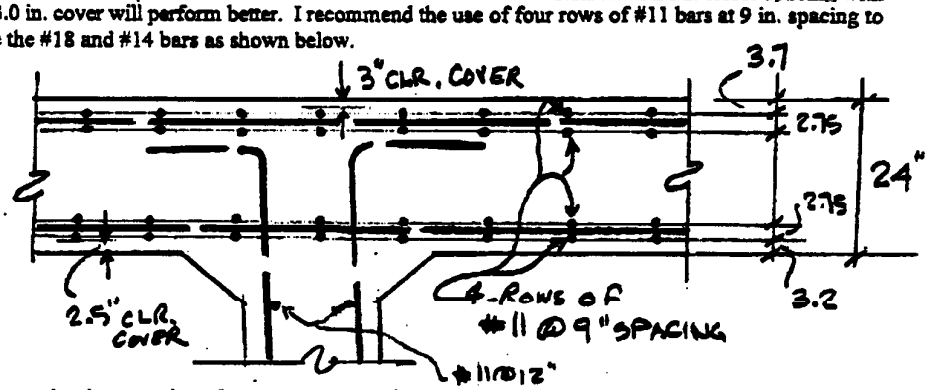
Dear Mark:

The following is in response to your letter of September 17, 1996.

1. ACI Para. 10.6.6: I recommend using the entire 14 ft distance as effective flange width. Note the span is somewhere between 110 ft and 180 ft and the assumption of 140 ft is reasonable.

2. ACI Para. 10.6.7: I recommend using #11 bars at 12 in. spacing each face of the web. This will help control web cracking due to flexural stresses and will also assist in the shear resistance.

3. Crack Criteria: Cracks are undesirable in structures subject to marine environment. Small hairline cracks (width < 0.01 in.) may be tolerated. Cracks of widths less than or equal to 0.005 in. apparently seal themselves and do not cause corrosion problems. Unfortunately, there is no reliable analytical method for predicting crack width especially for #18 bars. ACI crack width equation is limited to #11 bars or smaller. The value of β for this cross section is about 1.16. Smaller diameter bars at closer spacing with 2.0 to 3.0 in. cover will perform better. I recommend the use of four rows of #11 bars at 9 in. spacing to replace the #18 and #14 bars as shown below.



I agree with you that in general steel stresses are a good measure of crack width. Furthermore, at this phase of design I do not think you should be concerned with crack width control. However, I would recommend prestressing in both horizontal directions. Prestressing assures a structure that is essentially crack-free, and that has high quality of performance and long service life.

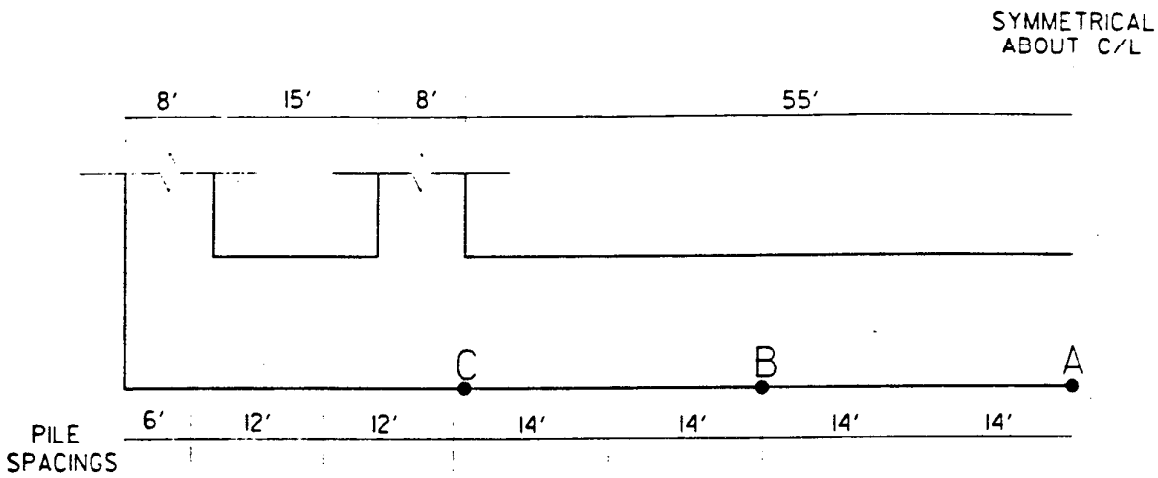
1200 x 110 x 36

Chamber Section

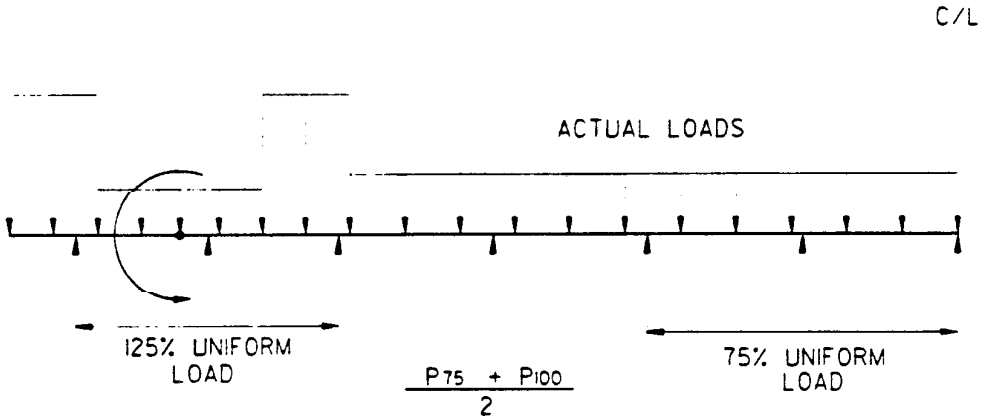
Load Case	U	Reach I V (kips)	Reach I Vu (kips)	Reach I M (ft - kips)	Reach I Mu (ft - kips)	Reach II V (kips)	Reach II Vu (kips)	Reach II M (ft - kips)	Reach II Mu (ft - kips)
1 - Normal Operation	2.21	338	747	22430	49570	694	1534	20600	45526
	2.21	543	1200	24050	53151	1057	**2336**	18100	40001
2A - Maximum Operation	2.21	308	681	24400	53924	563	1244	23690	52355
	2.21	550	**1216**	30050	**66411**	986	2179	23940	**52907**
2B - Maximum Operation	2.21	427	944	25300	55913	908	2007	18610	41128
	2.21	440	972	15460	34167	922	2038	22170	48996
3 - Dewatering	1.7	388	660	16500	28050	1444	2455	28400	48280
	1.7	493	838	6903	11735	1270	2159	30390	51663
Design Values		***Vu =***	***1216***	***Mu =***	***66411***	***Vu =***	***2336***	***Mu =***	***52907***

* For Load Case 3, Reach II, a reduction "d" from the face is allowed; therefore, this case does not govern for shear.

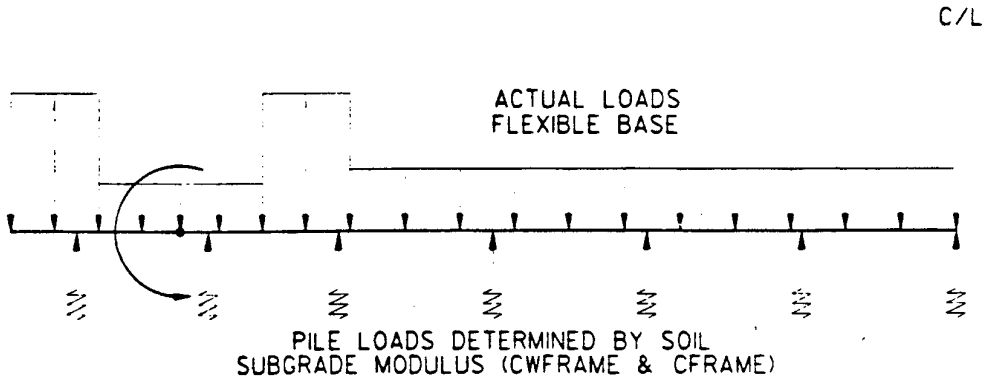
NOTE: EACH LOAD CASE HAS TWO V & M SHOWN, THE UPPER ROW IS FOR ANALYSIS ASSUMPTIONS 1, 2 & 3; THE LOWER ROW IS FOR ASSUMPTIONS 4 & 5



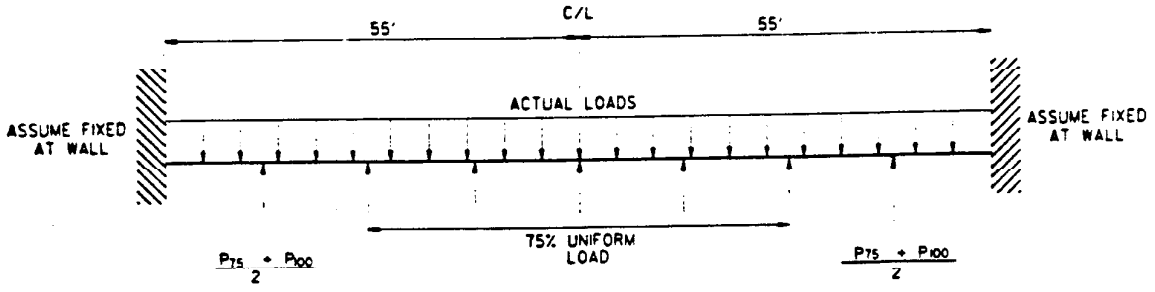
ANALYSIS 1



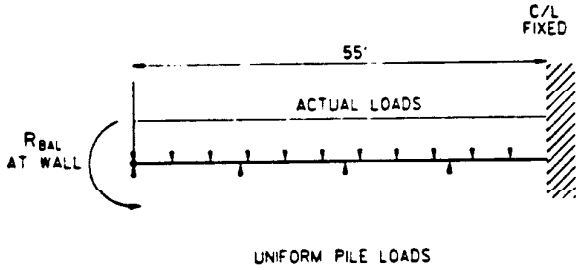
ANALYSIS 2



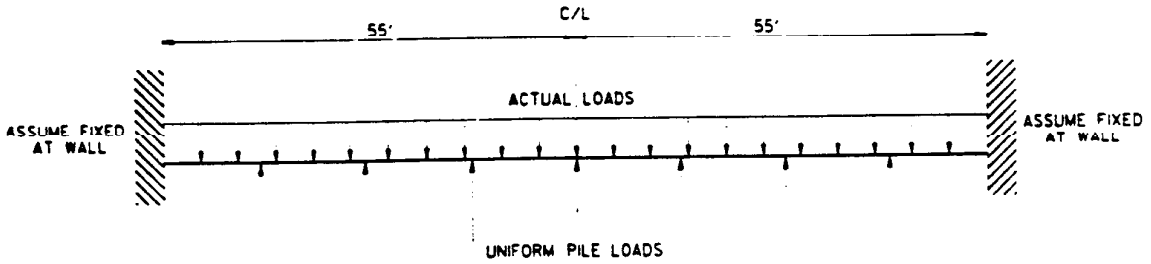
ANALYSIS 3



ANALYSIS 4



ANALYSIS 5



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010 SHIP LOCK CHAMBER TRANS IBEAM ANALYSIS(WSD) NORMAL OPER. LOAD
070 13 16 1
120 1 -84 72 84 72 84 48
040 1 9 48 9 -48 84 -48
070 1 84 -72 -84 -72 -84 -48
    1 -9 -48 -9 48 -84 48
    1 -84 72
080 2 1.56 -81 67.4 24 81 67.4
081 2 1.56 -81 64.5 24 81 64.5
082 2 1.56 -81 54.5 24 81 54.5
083 2 1.56 -81 51.75 24 81 51.75
100 2 1.56 -4.5 42 2 4.5 42
110 2 1.56 -4.5 30 2 4.5 30
120 2 1.56 -4.5 18 2 4.5 18
130 2 1.56 -4.5 6 2 4.5 6
140 2 1.56 -4.5 -6 2 4.5 -6
150 2 1.56 -4.5 -18 2 4.5 -18
160 2 1.56 -4.5 -30 2 4.5 -30
170 2 1.56 -4.5 -42 2 4.5 -42
200 2 1.56 -81 -51.75 24 81 -51.75
201 2 1.56 -81 -54.5 24 81 -54.5
202 2 1.56 -81 -64.5 24 81 -64.5
203 2 1.56 -81 -67.4 24 81 -67.4
230 3 0 0 -288600 6.6 0.15 0.01
240
250 0 0 0
```

WSD @ NORMAL OPER.
CHAMBER - SHIPLOCK
TRANSVERSE I-BEAM
FLGS - 4 ROWS #11 @ 8"

```
^P
Bad command or file name

C:\STRUC\CGFAG (Type HELP for menu!)>>x8008
*******************************
*  CORPS PROGRAM  #  X8008     *
*  MICRO VERSION  # 86/02/12   *
*******************************


ENTER 0 IF USING GRAPHICS TERMINAL.
   OR 1 IF NOT.
0

COMPUTER WILL PAUSE TO ALLOW OUTPUT COPYING.
THEN PRESS CARRIAGE RETURN TO CONTINUE.

ENTER 1 TO GET DETAILED STRESS TABLES,
   OR 0 TO GET MAXIMUM VALUES ONLY.
1

INPUT COMPLETE FILENAME OF DATA FILE
OR
PRESS RETURN TO USE INTERACTIVE INPUT

?ibeam106.wsd



PROGRAM CORPS/X8008   CONCRETE GENERAL FLEXURE ANALYSIS  REV 86
SHIP LOCK CHAMBER TRANS IBEAM ANALYSIS(WSD) NORMAL OPER. LOAD
**  I N P U T   L O A D I N G   A N D   P A R A M E T E R S  **

LD. CASE      P    Y-AXIS MOM. X-AXIS MOM.    N     R    ACCURACY
     3       .00          .00  -288600.00   6.60   .15     .010

 S T R E S S   E Q U A T I O N   A N D   N E U T R A L   A X I S:

   UNIT STRESS =      .00000 X  +     -.02420 Y  +     -.86014

  AT Y = 0, NEUTRAL AXIS CROSSES X-AXIS AT X =   -.10357420E+13
  AT X = 0, NEUTRAL AXIS CROSSES Y-AXIS AT Y =   -35.543720


         MAXIMUM CONCRETE STRESS =      .88 AT POINT 8
         MAXIMUM STEEL STRESS    =    16.44 T
                                 =      .76 C
```

COMPRESSIVE STRESS IS SHOWN PLUS, TENSION MINUS (CONC. & STEEL)

C O N C R E T E S T R E S S E S F O R O U T L I N E 1:

T	X-COORD	Y-COORD	COMPRESSIVE STRESS	POINT	X-COORD	Y-COORD	COMP. STRESS
1	-84.00	72.00		2	84.00	72.00	
3	84.00	48.00		4	9.00	48.00	
5	9.00	-48.00	.301	6	84.00	-48.00	.301
7	84.00	-72.00	.882	8	-84.00	-72.00	.882
9	-84.00	-48.00	.301	10	-9.00	-48.00	.301
11	-9.00	48.00		12	-84.00	48.00	
13	-84.00	72.00					

S T E E L S T R E S S E S F O R P A T T E R N NO. 2:

EA OF ONE BAR	QUAN. OF BARS/ROW	ROW END	X COORDINATE	Y COORDINATE	STRESS IN BAR
1.560	24	1	-81.000	67.400	-16.442
		2	81.000	67.400	-16.442
1.560	24	1	-81.000	64.500	-15.979
		2	81.000	64.500	-15.979
1.560	24	1	-81.000	54.500	-14.381
		2	81.000	54.500	-14.381
1.560	24	1	-81.000	51.750	-13.942
		2	81.000	51.750	-13.942
1.560	2	1	-4.500	42.000	-12.385
		2	4.500	42.000	-12.385
1.560	2	1	-4.500	30.000	-10.468
		2	4.500	30.000	-10.468
1.560	2	1	-4.500	18.000	-8.552
		2	4.500	18.000	-8.552
1.560	2	1	-4.500	6.000	-6.635
		2	4.500	6.000	-6.635
1.560	2	1	-4.500	-6.000	-4.719
		2	4.500	-6.000	-4.719
1.560	2	1	-4.500	-18.000	-2.802
		2	4.500	-18.000	-2.802
1.560	2	1	-4.500	-30.000	-.885
		2	4.500	-30.000	-.885
1.560	2	1	-4.500	-42.000	.155
		2	4.500	-42.000	.155
1.560	24	1	-81.000	-51.750	.388
		2	81.000	-51.750	.388
1.560	24	1	-81.000	-54.500	.454
		2	81.000	-54.500	.454
1.560	24	1	-81.000	-64.500	.694
		2	81.000	-64.500	.694
1.560	24	1	-81.000	-67.400	.763
		2	81.000	-67.400	.763

```
010 SHIP LOCK CHAMBER TRANS IBEAM ANALYSIS(WSD) NORMAL OPER. LOAD
020 13 16 1
030 1 -84 72 84 72 84 48
040 1 9 48 9 -48 84 -48
050 1 84 -72 -84 -72 -84 -48
060 1 -9 -48 -9 48 -84 48
070 1 -84 72
080 2 1.56 -81 67.4 24 81 67.4
081 2 1.56 -81 64.5 24 81 64.5
082 2 1.56 -81 54.5 24 81 54.5
083 2 1.56 -81 51.75 24 81 51.75
100 2 1.56 -4.5 42 2 4.5 42
110 2 1.56 -4.5 30 2 4.5 30
120 2 1.56 -4.5 18 2 4.5 18
130 2 1.56 -4.5 6 2 4.5 6
140 2 1.56 -4.5 -6 2 4.5 -6
150 2 1.56 -4.5 -18 2 4.5 -18
160 2 1.56 -4.5 -30 2 4.5 -30
170 2 1.56 -4.5 -42 2 4.5 -42
200 2 1.56 -81 -51.75 24 81 -51.75
201 2 1.56 -81 -54.5 24 81 -54.5
202 2 1.56 -81 -64.5 24 81 -64.5
203 2 1.56 -81 -67.4 24 81 -67.4
230 3 0 0 -360600 6.6 0.15 0.01
240
250 0 0 0
```

WSD @ MAXIMUM OPER
CHAMBER - SHIPLOCK
TRANSVERSE I-BEAM
FIGS - FROM #11 @ 8"

```
^P
Bad command or file name

C:\STRUC\CGFAG (Type HELP for menu!)>>x8008
*****************************
*  CORPS PROGRAM  #  X8008      *
*  MICRO VERSION  # 86/02/12    *
*****************************


ENTER 0 IF USING GRAPHICS TERMINAL.
   OR 1 IF NOT.
0

COMPUTER WILL PAUSE TO ALLOW OUTPUT COPYING.
THEN PRESS CARRIAGE RETURN TO CONTINUE.

ENTER 1 TO GET DETAILED STRESS TABLES,
   OR 0 TO GET MAXIMUM VALUES ONLY.
1

INPUT COMPLETE FILENAME OF DATA FILE
OR
PRESS RETURN TO USE INTERACTIVE INPUT

?ibeam106.wsd
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```
 PROGRAM CORPS/X8008   CONCRETE GENERAL FLEXURE ANALYSIS  REV 86
 SHIP LOCK CHAMBER TRANS IBEAM ANALYSIS(WSD) NORMAL OPER. LOAD
 **  I N P U T   L O A D I N G   A N D   P A R A M E T E R S  **

LD. CASE      P     Y-AXIS MOM. X-AXIS MOM.    N      R     ACCURACY
     3        .00          .00  -360600.00   6.60   .15      .010

 S T R E S S   E Q U A T I O N   A N D   N E U T R A L   A X I S:

   UNIT STRESS =      .00000 X  +     -.03024 Y  +    -1.07472

  AT Y = 0, NEUTRAL AXIS CROSSES X-AXIS AT X =   -.10357420E+13
  AT X = 0, NEUTRAL AXIS CROSSES Y-AXIS AT Y =   -35.543720


          MAXIMUM CONCRETE STRESS =     1.10 AT POINT 7
          MAXIMUM STEEL STRESS    =    20.54 T
                                  =      .95 C
```

COMPRESSIVE STRESS IS SHOWN PLUS, TENSION MINUS (CONC. & STEEL)

C O N C R E T E S T R E S S E S F O R O U T L I N E 1:

POINT	X-COORD	Y-COORD	COMPRESSIVE STRESS	POINT	X-COORD	Y-COORD	COMP. STRESS
1	-84.00	72.00		2	84.00	72.00	
3	84.00	48.00		4	9.00	48.00	
5	9.00	-48.00	.377	6	84.00	-48.00	.377
7	84.00	-72.00	1.102	8	-84.00	-72.00	1.102
9	-84.00	-48.00	.377	10	-9.00	-48.00	.377
11	-9.00	48.00		12	-84.00	48.00	
13	-84.00	72.00					

S T E E L S T R E S S E S F O R P A T T E R N NO. 2:

AREA OF ONE BAR	QUAN. OF BARS/ROW	ROW END	X COORDINATE	Y COORDINATE	STRESS IN BAR
1.560	24	1	-81.000	67.400	-20.544
		2	81.000	67.400	-20.544
1.560	24	1	-81.000	64.500	-19.965
		2	81.000	64.500	-19.965
1.560	24	1	-81.000	54.500	-17.969
		2	81.000	54.500	-17.969
1.560	24	1	-81.000	51.750	-17.421
		2	81.000	51.750	-17.421
.560	2	1	-4.500	42.000	-15.475
		2	4.500	42.000	-15.475
1.560	2	1	-4.500	30.000	-13.080
		2	4.500	30.000	-13.080
1.560	2	1	-4.500	18.000	-10.685
		2	4.500	18.000	-10.685
1.560	2	1	-4.500	6,000	-8.291
		2	4.500	6.000	-8.291
1.560	2	1	-4.500	-6.000	-5.896
		2	4.500	-6.000	-5.896
1.560	2	1	-4.500	-18.000	-3.501
		2	4.500	-18.000	-3.501
1.560	2	1	-4.500	-30.000	-1.106
		2	4.500	-30.000	-1.106
1.560	2	1	-4.500	-42.000	.193
		2	4.500	-42.000	.193
1.560	24	1	-81.000	-51.750	.485
		2	81.000	-51.750	.485
1.560	24	1	-81.000	-54.500	.567
		2	81.000	-54.500	.567
1.560	24	1	-81.000	-64.500	.867
		2	81.000	-64.500	.867
1.560	24	1	-81.000	-67.400	.954
		2	81.000	-67.400	.954

```
1000 GONSKI
1010 MEMBER, CHAMBASE
1020 SECTION, CENTER
1030 MATERIALS, 6000.0000, 60000.0000
 40 DIMENSION, IN
 050 POINTS, 13
1060 0.0000, 0.0000
1070 0.0000, 24.0000
1080 75.0000, 24.0000
1090 75.0000, 120.0000
1100 0.0000, 120.0000
1110 0.0000, 144.0000
1120 168.0000, 144.0000
1130 168.0000, 120.0000
1140 93.0000, 120.0000
1150 93.0000, 24.0000
1160 168.0000, 24.0000
1170 168.0000, 0.0000
1180 0.0000, 0.0000
1190 REINFORCE, 12
1195 24, 3.1200, 4.50000, 138.0000, 163.5000, 138.0000
1196 24, 3.12, 4.5, 125.1, 163.5, 125.1
1200 2, 1.56, 79.8, 114.0, 88.2, 114.00
1201 2, 1.56, 79.8, 102.0, 88.2, 102.00
1202 2, 1.56, 79.8, 90.0, 88.2, 90.00
1203 2, 1.56, 79.8, 78.0, 88.2, 78.00
1204 2, 1.56, 79.8, 66.0, 88.2, 66.00
1205 2, 1.56, 79.8, 54.0, 88.2, 54.00
1206 2, 1.56, 79.8, 42.0, 88.2, 42.00
1207 2, 1.56, 79.8, 30.0, 88.2, 30.00
 13 24, 3.12, 4.5, 18.90, 163.5, 18.90
 14 24, 3.12, 4.5, 6.1, 163.5, 6.1
1240 USE, 0.9000, 0.0030, 4410000.0000, 0.7500, 0.80
1250 LOAD, SHIPCNOR, 1
1260 -53150.0000, 0.0000, 00000.00, 84.0000, 72.0000
1270 EXIT
```

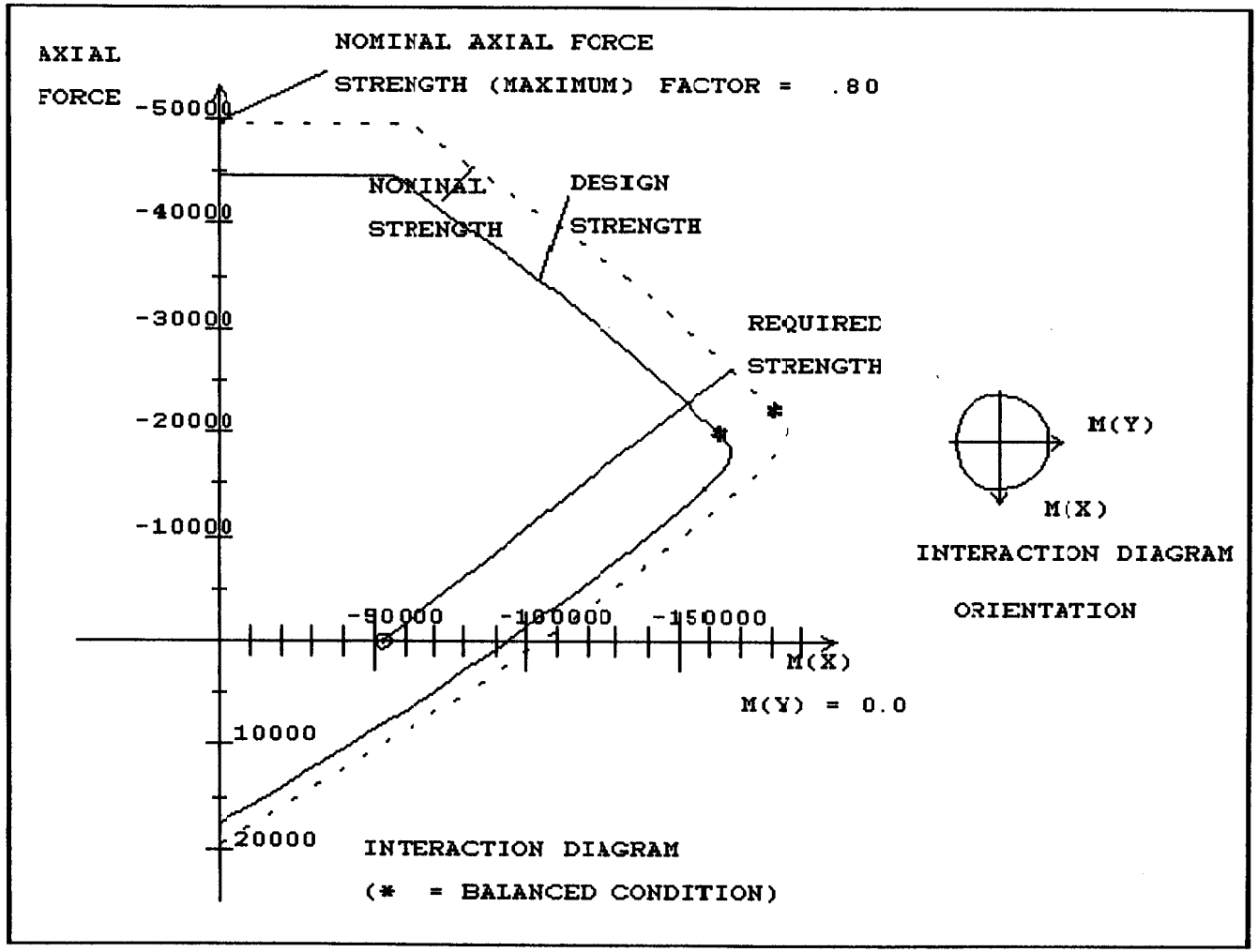
USO @ NORMAL OPER.

CHAMBER - SHALLOW

TRANSVERSE I-BEAM

FLGS - 4 ROWS #11 @ 8

(Due to Program limitation Flg steel shown as one row with A_s = 2 #11)


AXIAL
FORCE
NOMINAL AXIAL FORCE
STRENGTH (MAXIMUM) FACTOR = .80
-50000
-40000
-30000
-20000
-10000
10000
20000
NOMINAL
STRENGTH
DESIGN
STRENGTH
REQUIRED
STRENGTH
-50000
-100000
-150000
M(X)
M(Y) = 0.0
M(Y)
M(X)
INTERACTION DIAGRAM
ORIENTATION
INTERACTION DIAGRAM
(* = BALANCED CONDITION)

```
X0061 -- 713-F3-R0061 -- September 1983
        Concrete General Strength Investigation

Output - X0061 - Loads

Fig. 2.    1 .

Strain Analysis and Interaction
Diagram for Load  SHIPCNOR

Required Strength (U)
(Referenced to XC,YC)

  P(U) =                0.000 kips
  M(UX)=           -53150.000 kip-ft
  M(UY)=                0.000 kip-ft

  (XC,YC)=   84.000,  72.000

Percentage of Balanced Reinforcement =    26.83%

Press Up, Down, PgUp, and PgDn to Scroll, Enter to Continue.
```