Check Example

The first page of output is a copy of the XEDIT input data file. The format is described under "INPUT DATA FORMAT (XEDIT)".

Input data – Output Pages 1 to 5

These pages contain the input data as described above under DESIGN.

Factored Loads for Column Design Check – Output Page 6

These pages contain the information as described above under DESIGN. In the "CHECK" mode the column is checked for the area of steel input (i.e. no design). If the "RATIO" (Mu/M) is greater than or equal to 1.00 an "OK" is printed next to the load case. If the "RATIO" (Mu/M) is less than 1.00 an "NG**" is printed next to the load case.

Moment Magnification and Buckling Calculations – Output Page 7

This table contains the same information as described under DESIGN.

Column Service Loads – Output Page 8

For each group loading at the service level, the program calculates the maximum concrete stress in compression, the maximum steel stress in tension and the maximum steel stress in compression. These stresses are calculated using working stress theory which assumes that the concrete stress varies linerally from zero at the neutral axis to a maximum at the extreme compression fiber. The modular ratio, n = ES/EC; where EC = 57000 × Sqrt(FC). The applied moments are not magnified for slenderness effects and the critical buckling loads are not calculated.

Service and Factored Loads for Footing Design – Output Page 9

This page contains the loads for the footing design at the service (SER) and the factored (FAC) level. The live loads have been reduced by the PERCENT IMPACT. These loads will be written to the FOOT file if that option is selected.

Probable Moment (1.3 × Nominal Moment) – Output Pages 10 & 11

These pages contain the Probable Plastic Moments. The Probable Plastic Moment is 1.3 times the Nominal Yield Moment for axial loads below P-Balance. P-Balance is the balance point. For axial loads greater than P-Balance the column will fail in compression. For axial loads smaller than P-Balance the column will fail in tension. The angle of the resultant moment varies from 90 degrees (Transverse) to 0 degrees (Longitudinal) in 15 degree increments. A plot of these values is available.

Determination of Column Spiral Reinforcement – Output Pages 12 to 16

Section 3.21.7 of the Code and *Memo to Designers* 15-10 (pp 33-35) define the forces resulting from plastic hinging (a column reaching its yield moment capacity) in the columns. The column axial forces are the unfactored dead load axial force plus or minus the axial forces developed as a result of an analysis of the distribution of the plastic hinging forces on the bent.

Output page 11 contains a summary of the plastic hinging design assumptions and formulas used to determine the spiral reinforcement required for Confinement (Case A), Applied Shear (Case B), and Minimum Shear (Case C). This procedure is described in *Bridge Design Practice* section 5 (substructures) pages 5-78 to 5-86.

Output pages 12 and 15 are a summary of the plastic hinging analysis in the transverse and longitudinal directions.

The last page in this section is a plot of the probable moments.

```
HP-UX A.09.03       Tue Jul 25 09:52:24 PDT 1995

DIRECTORY: /user/tsbtl/projects/test
INPUT FILE: adelinec.yield

0...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8

4' X 8' RECTANGULAR WITH FILLETS   CHECK     VERSION  1    12.09.83
         3
         2
         3        30
         4
         2       1.0       6.0         1     44.00      3.50        .00
      3250  29000000     .0030     60000
     96.00     48.00      9.00      9.00
     20.49     24.00                          1.56
LOAD 1 AT BOTTOM                       YES     PILE
 2.10 1.04                20.00     22.00    0    0      6.00 0111
      0       0   3087    800   1963   2565   398     0     0   374
    302       0    -34    417    -46     34    28     0     0  3497
   2083       0    272    150    367   -118     0     0     0     0
                  7140   4177   7140                          0
                   -88    587    -88                          0
                   505    279    505                          0
     19350     19500       300         0       651          0
       528      6084       300         0       651          0
        75        70       300         0       390          0

0...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8
```

```
TITLE 4' X 8' RECTANGULAR WITH FILLETS   CHECK  7/25/1995  09:52:19 PAGE  1


    ***********************************************************************
    *                YIELD PROGRAM - VERSION 1.01    10.11.90             *
    ***********************************************************************


    COLUMN TYPE                     =  3  (RECTANGULAR W/FILLETS)
    CONCRETE LOOPS                  =  1
    TOTAL NO. OF CONCRETE COORD.    =  8
    STEEL REBAR PATTERN             =  2  (INTERSECTING LOOPS)
    NUMBER OF STEEL REBAR LOOPS     =  3
    TOTAL NO. OF STEEL REBARS       = 30
    PLOT TYPE                       =  4  (MNY VS. MNX)
    DESIGN TYPE                     =  2  (CHECK)
    PERCENT STEEL LIMITS            =     (1.00 % MIN.  6.00 % MAX.)


    ************
    * BENT DATA *
    ***********************************************************************

    NUMBER OF COLUMNS IN BENT                    =     1
    OUT TO OUT DISTANCE (DIAMETER) OF SPIRAL     = 44.00 (INCHES)
    DISTANCE FROM TOP COLUMN PLASTIC HINGE TO
    CENTER OF GRAVITY OF THE SUPERSTRUCTURE      =  3.50 (FEET)
    CENTER TO CENTER SPACING OF COLUMNS          =   .00 (FEET)


    **********************
    * MATERIAL PROPERTIES *
    ***********************************************************************

    ULTIMATE CONCRETE COMPRESSIVE STRESS - FC =     3250. (PSI)
    YOUNG'S MODULUS FOR CONCRETE         - EC =  3249500. (PSI)
    YOUNG'S MODULUS FOR STEEL BARS       - ES = 29000000. (PSI)
    ULTIMATE CONCRETE COMPRESSIVE STRAIN - EO =      .003 (IN PER IN)
    YIELDING STRESS FOR STEEL BARS       - FY =    60000. (PSI)
```

```
TITLE 4' X 8' RECTANGULAR WITH FILLETS   CHECK  7/25/1995  09:52:19 PAGE  2


   RECTANGULAR CROSS-SECTION  (WITH FILLETS)

          HX         HY         FX         FY
        96.00      48.00       9.00       9.00


   CONCRETE COORDINATES  (INCHES)

   COORD        X          Y

     1        48.00      15.00
     2        39.00      24.00
     3       -39.00      24.00
     4       -48.00      15.00
     5       -48.00     -15.00
     6       -39.00     -24.00
     7        39.00     -24.00
     8        48.00     -15.00
```

```
TITLE 4' X 8' RECTANGULAR WITH FILLETS   CHECK  7/25/1995  09:52:19 PAGE  3


   INTERSECTING LOOP PATTERN

      RADIUS    SPACING       AREA
       20.49      24.00       1.56


   STEEL REBAR COORDINATES  (INCHES)

   COORD        X          Y

     1       -12.00      16.61
     2        12.00     -16.61
     3       -18.74      19.80
     4        18.74     -19.80
     5       -26.18      20.37
     6        26.18     -20.37
     7       -33.33      18.24
     8        33.33     -18.24
     9       -39.24      13.70
    10        39.24     -13.70
    11       -43.13       7.33
    12        43.13      -7.33
    13       -44.49        .00
    14        44.49        .00
    15       -43.13      -7.33
    16        43.13       7.33
    17       -39.24     -13.70
    18        39.24      13.70
    19       -33.33     -18.24
    20        33.33      18.24
    21       -26.18     -20.37
    22        26.18      20.37
    23       -18.74     -19.80
    24        18.74      19.80
    25        12.00      16.61
    26       -12.00     -16.61
    27         4.24      20.05
    28        -4.24     -20.05
    29        -4.24      20.05
    30         4.24     -20.05


   THE MAIN LONGITUDINAL STEEL IS ASSUMED TO BE # 11 BARS.
```

```
TITLE 4' X 8' RECTANGULAR WITH FILLETS   CHECK  7/25/1995  09:52:19 PAGE  4


    ************************
    * INITIAL REFERENCE DATA *
    ************************************************************************

    TOTAL AREA OF THE SECTION                 AG =     30.88 FT**2
    NOMINAL AXIAL LOAD STRENGTH               PO =  14960.79 KIPS
    TOTAL REINFORCEMENT AREA                 AST =     46.80 IN**2
    PERCENT STEEL                              %      1.05 %

    GROSS MOMENT OF INERTIA ABOUT Y-AXIS  IYC =    154.81 FT**4
    GROSS MOMENT OF INERTIA ABOUT X-AXIS  IXC =     39.19 FT**4

    STEEL MOMENT OF INERTIA ABOUT Y-AXIS  IYS =    2.0159 FT**4
    STEEL MOMENT OF INERTIA ABOUT X-AXIS  IXS =     .6197 FT**4
```

TITLE 4' X 8' RECTANGULAR WITH FILLETS CHECK 7/25/1995 09:52:19 PAGE 5

```
*************************
* COLUMN LOAD DATA (K-FT) *
*************************************************************************
```

LOAD NAME: LOAD 1 AT BOTTOM
FOOTING DATA FILE: YES
TYPE FOOTING: PILE

COLUMN EFFECTIVE LENGTH FACTORS KY (TRAN)	KX (LONG)	PERCENT IMPACT	COLUMN LENGTH (FEET)	STEEL 1=TIE 0=SPIRAL	LOCATION 1=TOP 0=BOTTOM	DUCTILITY FACTOR (Z)
2.10	1.04	20.00	22.00	0	0	6.00

COLUMN END CONDITIONS (TOPY TOPX BOTY BOTX) (1=FIX 0=PIN) 0111

COLUMN GROUP LOADS - SERVICE (K-FT)

	DEAD LOAD	PRE STRESS	:— LL+IMPACT —: CASE 1 TRANS MY-MAX	CASE 2 LONG MX-MAX	CASE 3 AXIAL N-MAX	WIND	WL	LF	CF-MY	TEMP
MY	0	0	3087	800	1963	2565	398	0	0	374
MX	302	0	-34	417	-46	34	28	0	0	3497
P	2083	0	272	150	367	-118	0	0	0	0
PMY			7140	4177	7140				0	
PMX			-88	587	-88				0	
P			505	279	505				0	

COLUMN SEISMIC AND ARBITRARY LOADS (K-FT)

(ARS)	UNREDUCED SEISMIC CASE 1 MAX TRAN	CASE 2 MAX LONG	ARBITRARY LOADS SERVICE AL1	SERVICE AL2	ARBITRARY LOADS FACTORED AL1	FACTORED AL2
MY TRAN	19350.	19500.	300.	0.	651.	0.
MX LONG	528.	6084.	300.	0.	651.	0.
P AXIAL	75.	70.	300.	0.	390.	0.

```
TITLE 4' X 8' RECTANGULAR WITH FILLETS   CHECK  7/25/1995  09:52:19 PAGE  6


*****************************************************
* FACTORED LOADS FOR COLUMN DESIGN CHECK  (KIP-FT) *
*****************************************************************************

APPLIED FACTORED MOMENTS ARE MAGNIFIED FOR SLENDERNESS IN ACCORDANCE WITH
CALTRANS BRIDGE DESIGN SPECIFICATIONS. (ART 8.16.5)

LENGTH =  22.00 FT     FC  =   3.25 KSI      FY  = 60.00 KSI
STEEL  =   1.05 %      AST =   46.80 SQ IN

              :—— APPLIED FACTORED ——: CAPACITY
GROUP CASE  TRANS      LONG      COMB     AXIAL (PHI*MN)  PHI RATIO
              MY        MX        M         P       MU        MU/M

  IH    1    6688.     445.     6703.    2620.   11777.  .75 1.76 OK
  IH    2    1733.    1198.     2107.    2356.    8159.  .75 3.87 OK
  IH    3    4253.     596.     4295.    3503.   11981.  .75 2.79 OK
  IP    1    9282.     457.     9293.    2687.   11908.  .75 1.28 OK
  IP    2    5430.    1058.     5532.    2394.   10847.  .75 1.96 OK
  IP    3    9282.     572.     9300.    3364.   12365.  .75 1.33 OK
  II         3335.     339.     3352.    1878.   10731.  .75 3.20 OK
  III   1    5531.     398.     5545.    2339.   11451.  .75 2.07 OK
  III   2    2558.     886.     2707.    2180.    9651.  .75 3.57 OK
  III   3    4070.     534.     4104.    3139.   11856.  .75 2.89 OK
  IV    1    4499.    4796.     6576.    2385.    7306.  .75 1.11 OK
  IV    2    1526.    5383.     5595.    2226.    6203.  .75 1.11 OK
  IV    3    3038.    4879.     5747.    3185.    7171.  .75 1.25 OK
  V          3674.    4697.     5963.    1805.    6551.  .75 1.10 OK
  VI    1    5786.    4660.     7429.    2249.    7741.  .75 1.04 OK
  VI    2    2927.    5223.     5988.    2096.    6435.  .75 1.07 OK
  VI    3    4381.    4739.     6454.    3018.    7619.  .75 1.18 OK
  VII   1    3225.     390.     3248.    2158.   13672. 1.00 4.21 OK
  VII   2    3250.    1316.     3506.    2153.   11598. 1.00 3.31 OK


*****************************************************
* ARBITRARY LOADS FOR COLUMN DESIGN CHECK  (KIP-FT) *
*****************************************************************************

ARBITRARY APPLIED FACTORED MOMENTS ARE NOT MAGNIFIED FOR SLENDERNESS.

              :— APPLIED FACTORED ——:CAPACITY
GROUP CASE  TRANS      LONG      COMB     AXIAL (PHI*MN)  PHI RATIO
              MY        MX        M         P       MU        MU/M

  AL1          651.      651.      921.     390.    6646. 1.00 7.22 OK

NOTE: THE AXIAL (ARS) UNREDUCED SEISMIC LOADS (P) ARE NOT DIVIDED
BY THE DUCTILITY FACTOR Z
```

```
TITLE 4' X 8' RECTANGULAR WITH FILLETS   CHECK  7/25/1995  09:52:19 PAGE  7

   ***********************************************
   * MOMENT MAGNIFICATION AND BUCKLING CALCULATIONS *
   ***********************************************************************

   REFERENCE: "CALTRANS BRIDGE DESIGN SPECIFICATIONS" (ART 8.16.5)
              (COLUMN ASSUMED TO BE UNBRACED AGAINST SIDESWAY.)

   MAGY   = MOMENT MAGNIFACTION FACTOR ABOUT Y-AXIS
   MAGX   = MOMENT MAGNIFACTION FACTOR ABOUT X-AXIS

   PCY    = CRITICAL BUCKLING LOAD ABOUT Y-AXIS
   PCX    = CRITICAL BUCKLING LOAD ABOUT X-AXIS

   KY     = EFFECTIVE LENGTH FACTOR ABOUT Y-AXIS =  2.10
   KX     = EFFECTIVE LENGTH FACTOR ABOUT X-AXIS =  1.04

   KY*L/R = SLENDERNESS RATIO ABOUT Y-AXIS       = 21.
   KX*L/R = SLENDERNESS RATIO ABOUT X-AXIS       = 20.

   IYS    = STEEL MOMENT OF INERTIA ABOUT Y-AXIS =  2.0159 FT**4
   IXS    = STEEL MOMENT OF INERTIA ABOUT X-AXIS =   .6197 FT**4
```

GR	CA	MOMENT MAGNIFICATION TRAN MAGY	LONG MAGX	COMB MAG	CRACKED TRANSFORMED SECTION E*IY	E*IX	CRITICAL BUCKLING TRAN PCY	LONG PCX	AXIAL LOAD P
IH	1	1.000	1.000	1.000	43384307.	5923456.	200608.	111677.	2521.
IH	2	1.000	1.000	1.000	43384307.	9509520.	200608.	179286.	2257.
IH	3	1.000	1.000	1.000	43384307.	5923456.	200608.	111677.	3371.
IP	1	1.000	1.000	1.000	43384307.	5923456.	200608.	111677.	2588.
IP	2	1.000	1.000	1.000	43384307.	9266791.	200608.	174710.	2294.
IP	3	1.000	1.000	1.000	43384307.	5923456.	200608.	111677.	3232.
II		1.000	1.000	1.000	43384307.	6337003.	200608.	119474.	1778.
III	1	1.000	1.000	1.000	43384307.	5977871.	200608.	112703.	2239.
III	2	1.000	1.000	1.000	43384307.	8892358.	200608.	167650.	2081.
III	3	1.000	1.000	1.000	43384307.	5923456.	200608.	111677.	3007.
IV	1	1.000	1.000	1.000	43384307.	11161690.	200608.	210435.	2285.
IV	2	1.000	1.000	1.000	43384307.	11232456.	200608.	211769.	2127.
IV	3	1.000	1.000	1.000	43384307.	10964601.	200608.	206719.	3053.
V		1.000	1.000	1.000	43384307.	11148034.	200608.	210177.	1706.
VI	1	1.000	1.000	1.000	43384307.	11142779.	200608.	210078.	2149.
VI	2	1.000	1.000	1.000	43384307.	11214720.	200608.	211435.	1997.
VI	3	1.000	1.000	1.000	43384307.	10940547.	200608.	206266.	2886.
VII	1	1.000	1.000	1.000	43384307.	5923456.	200608.	111677.	2026.
VII	2	1.000	1.000	1.000	43384307.	9124743.	200608.	172032.	2021.

TITLE 4' X 8' RECTANGULAR WITH FILLETS CHECK 7/25/1995 09:52:19 PAGE 8

COLUMN SERVICE LOADS (K-FT) AND MAXIMUM WORKING STRESSES (PSI)

YOUNG S MODULUS FOR CONCRETE - EC = 3249500. PSI
MODULAR RATIO (ES/EC) - N = 8.9

		:— SERVICE LOADS (K-FT) —:— MAX STRESS (PSI) —:						
		TRANS	LONG	COMB	AXIAL	CONC	STEEL	STEEL
GP	CASE	MY	MX	M	P	COMP	TEN	COMP
IH	1	3087.	268.	3099.	2355.	1045.	0.	8628.
IH	2	800.	719.	1076.	2233.	796.	0.	6485.
IH	3	1963.	256.	1980.	2450.	878.	0.	7320.
II		2052.	269.	2070.	1572.	715.	20.	5833.
III	1	3404.	245.	3412.	1856.	1029.	1867.	8376.
III	2	1574.	606.	1687.	1758.	764.	0.	6140.
III	3	2504.	235.	2515.	1932.	856.	0.	7054.
IV	1	2769.	3012.	4091.	1884.	2368.	17628.	16806.
IV	2	939.	3373.	3501.	1786.	2167.	19221.	15772.
IV	3	1870.	3002.	3537.	1960.	2100.	14065.	15325.
V		2099.	2738.	3450.	1404.	2142.	19703.	14950.
VI	1	3306.	2717.	4279.	1657.	2384.	19305.	16573.
VI	2	1673.	3039.	3469.	1570.	2187.	19851.	15531.
VI	3	2503.	2708.	3688.	1725.	2123.	15447.	15098.
AL1		300.	300.	424.	300.	220.	725.	1655.
DL		0.	302.	302.	2083.	528.	0.	4580.

TITLE 4' X 8' RECTANGULAR WITH FILLETS CHECK 7/25/1995 09:52:19 PAGE 9

```
*************************************************
* SERVICE LOADS FOR FOOTING DESIGN (UNITS KIP-FT) *
*************************************************************************
```

GROUP	CASE	TRANS MY	LONG MX	COMB M	AXIAL P
IH	1	2573.	274.	2587.	2310.
IH	2	667.	650.	931.	2209.
IH	3	1636.	264.	1657.	2389.
II		2052.	269.	2070.	1572.
III	1	2992.	249.	3002.	1819.
III	2	1467.	550.	1567.	1738.
III	3	2243.	241.	2256.	1883.
IV	1	2357.	3017.	3828.	1848.
IV	2	833.	3317.	3420.	1766.
IV	3	1608.	3009.	3411.	1911.
V		2099.	2738.	3450.	1404.
VI	1	2939.	2721.	4005.	1624.
VI	2	1577.	2989.	3380.	1552.
VI	3	2270.	2713.	3537.	1681.
AL1		300.	300.	424.	300.

```
*************************************************
* FACTORED LOADS FOR FOOTING DESIGN (UNITS KIP-FT) *
*************************************************************************
```

GROUP	CASE	TRANS MY	LONG MX	COMB M	AXIAL P
IH	1	5574.	331.	5584.	3199.
IH	2	1444.	1146.	1844.	2979.
IH	3	3544.	310.	3558.	3371.
IP	1	7735.	297.	7741.	3255.
IP	2	4525.	1029.	4640.	3010.
IP	3	7735.	297.	7741.	3255.
II		3335.	437.	3363.	2555.
III	1	4862.	405.	4879.	2957.
III	2	2384.	894.	2547.	2824.
III	3	3644.	392.	3665.	3059.
IV	1	3830.	4902.	6221.	3003.
IV	2	1353.	5390.	5558.	2870.
IV	3	2613.	4889.	5543.	3105.
V		3674.	4791.	6038.	2456.
VI	1	5143.	4761.	7008.	2843.
VI	2	2760.	5231.	5914.	2716.
VI	3	3972.	4749.	6191.	2942.
AL1		651.	651.	921.	390.

TITLE 4' X 8' RECTANGULAR WITH FILLETS CHECK 7/25/1995 09:52:19 PAGE 10

```
*************************************************************
* PROBABLE PLASTIC MOMENT (1.3 X NOMINAL MOMENT) (KIP-FT) *
*************************************************************
```

CODE (8.16.4.4) AND MEMO TO DESIGNERS 15-10

FC = 3.25 KSI FY = 60.00 KSI
EO = .0030 IN/IN AST = 46.80 SQ IN

ANGLE	TRANS MPY	LONG MPX	COMB MP	AXIAL P	P-BALANCE (APPROX)
90.0	19019.	0.	19019.	8976.	5534
	20969.	0.	20969.	7479.	
	22125.	0.	22125.	5984.	
	21794.	0.	21794.	4490.	
	19979.	0.	19979.	2993.	
	18178.	0.	18178.	2084.	
	16752.	0.	16752.	1497.	
	12152.	0.	12152.	1.	
	9330.	0.	9330.	-747.	
	6186.	0.	6186.	-1495.	
75.0	16331.	4368.	16905.	8975.	5459
	17798.	4755.	18422.	7479.	
	18612.	4936.	19255.	5986.	
	18430.	4929.	19078.	4490.	
	17145.	4588.	17748.	2994.	
	15781.	4224.	16336.	2084.	
	14698.	3934.	15216.	1498.	
	10934.	2927.	11319.	1.	
	8520.	2281.	8820.	-747.	
	5735.	1535.	5937.	-1495.	
60.0	12174.	7000.	14043.	8975.	5309
	13286.	7559.	15286.	7479.	
	13720.	7883.	15823.	5986.	
	13690.	7833.	15772.	4487.	
	12738.	7334.	14698.	2994.	
	11782.	6793.	13600.	2084.	
	10978.	6330.	12672.	1498.	
	8199.	4730.	9465.	1.	
	6458.	3726.	7455.	-747.	
	4400.	2539.	5080.	-1495.	

TITLE 4' X 8' RECTANGULAR WITH FILLETS CHECK 7/25/1995 09:52:19 PAGE 11

```
*****************************************************************
* PROBABLE PLASTIC MOMENT VALUES  (KIP-FT) AST =  46.80 SQ IN *
*****************************************************************
```

ANGLE	TRANS MPY	LONG MPX	COMB MP	AXIAL PN	P-BALANCE (APPROX)
45.0	8526.	8475.	12022.	8978.	5237
	9306.	9215.	13097.	7481.	
	9681.	9586.	13624.	5983.	
	9661.	9569.	13597.	4488.	
	9017.	8931.	12692.	2991.	
	8226.	8186.	11605.	2082.	
	7600.	7562.	10721.	1495.	
	5511.	5500.	7786.	1.	
	4246.	4236.	5998.	-747.	
	2852.	2846.	4029.	-1495.	
30.0	5426.	9334.	10797.	8978.	5160
	5988.	10199.	11827.	7482.	
	6275.	10685.	12391.	5983.	
	6280.	10695.	12403.	4488.	
	5785.	9850.	11424.	2991.	
	5192.	8931.	10331.	2082.	
	4763.	8197.	9481.	1495.	
	3391.	5840.	6753.	-1.	
	2585.	4449.	5146.	-749.	
	1736.	2957.	3429.	-1495.	
15.0	2660.	9820.	10174.	8978.	5236
	3007.	10831.	11240.	7480.	
	3178.	11449.	11882.	5984.	
	3179.	11439.	11872.	4488.	
	2879.	10362.	10754.	2991.	
	2594.	9334.	9687.	2083.	
	2310.	8526.	8833.	1495.	
	1627.	6010.	6226.	-1.	
	1264.	4550.	4723.	-747.	
	835.	3007.	3121.	-1496.	
.0	0.	10035.	10035.	8976.	5459
	0.	11166.	11166.	7479.	
	0.	11945.	11945.	5983.	
	0.	11778.	11778.	4490.	
	0.	10622.	10622.	2993.	
	0.	9554.	9554.	2084.	
	0.	8692.	8692.	1497.	
	0.	6078.	6078.	1.	
	0.	4600.	4600.	-747.	
	0.	3027.	3027.	-1495.	

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   DESIGN ASSUMPTIONS:

   1. ALL COLUMNS ARE THE SAME I.E., PRISMATIC, EQUAL LENGTH, EQUAL SPACING.
   2. PLASTIC HINGES FORM AT THE TOP AND BOTTOM OF THE COLUMNS.
   3. THE DISTANCE BETWEEN THE PLASTIC HINGES IS TAKEN AS THE COLUMN LENGTH.
   4. THE OVER-TURNING FORCE ACTS THROUGH THE C.G. OF THE SUPERSTRUCTURE AT A
      DISTANCE 'CGS' ABOVE THE TOP OF THE COLUMN.
   5. THE COLUMNS ARE NUMBERED FROM LEFT TO RIGHT AND THE OVERTURNING FORCE
      ACTS TO THE RIGHT.

   DETERMINATION OF COLUMN LATERAL REINFORCEMENT

   NUMBER OF COLUMNS IN BENT                    =    1
   OUT TO OUT DISTANCE (DIAMETER) OF
   LATERAL REINFORCEMENT                        =  44.00 IN
   DISTANCE FROM TOP COLUMN PLASTIC HINGE
   TO CENTER OF GRAVITY OF SUPERSTURCTURE       =   3.50 FT
   CENTER TO CENTER SPACING OF COLUMNS          =    .00 FT
   COMPRESSIVE STRENGTH OF CONCRETE      - FC   =   3.25 KSI
   YIELD STRENGTH OF REINFORCEMENT       - FY   =  60.00 KSI
   CONCRETE GROSS AREA (2" COVER)        - AG   =  28.57 FT**2
   CONCRETE CORE AREA                    - AC   =  25.23 FT**2
   TRANSVERSE DIRECTION                  - BW   =  44.00 IN
   TRANSVERSE DIRECTION                  - D    =  73.60 IN
   LONGITUDINAL DIRECTION                - BW   =  92.00 IN
   LONGITUDINAL DIRECTION                - D    =  35.20 IN


   AMOUNT OF REINFORCEMENT CONFORMS TO THE FOLLOWING BRIDGE DESIGN
   SPECIFICATIONS:

   CASE A - CONFINEMENT REINFORCEMENT     -  (CODE 8.18.2.2)
            PS1 = .45 (AG/AC - 1) FC/FY (.5 + 1.25 P/(FC * AG))
            PS2 =            .12 FC/FY (.5 + 1.25 P/(FC * AG))
            PS3 = .45 (AG/AC - 1) FC/FY

   CASE B - APPLIED SHEAR REINFORCEMENT  -  (CODE 8.16.6)
            VU <= PHI * VN                 (8-46)
            VN  = VC + VS                  (8-47)
            VC  = 2 * SQRT(FC) * BW * D    (8-51)
            VS  = (AV * FY * D) / S        (8-53)

   CASE C - MINIMUM SHEAR REINFORCEMENT  -  (CODE 8.19.1.1)
            AV = (50 * BW * S)/FY          (8-63)
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**********************
* TRANSVERSE DIRECTION *
**********************************************************************

LOADS RESULTING FROM PLASTIC HINGING OF COLUMN NO. 1

TOP OF COLUMN     AXIAL FORCE              P =  1981. KIPS
                  PLASTIC MOMENT          MP =     0. K-FT
BOTTOM OF COLUMN  AXIAL FORCE              P =  2083. KIPS
                  PLASTIC MOMENT          MP = 18174. K-FT

DESIGN SHEAR FORCE:                       VU =   713. KIPS
CONCRETE FACTORED SHEAR STRENGTH:  .85 * VC =   314. KIPS
STEEL    FACTORED SHEAR STRENGTH:  .85 * VS =   399. KIPS
```

MAXIMUM CENTER TO CENTER SPACING (PITCH) OF LATERAL REINFORCEMENT. (IN)

BAR SIZE	CASE A CONFINEMENT	CASE B APP SHEAR	CASE C MIN SHEAR	CONFINEMENT RATIO	CONFINEMENT EQUATION
4	2.834	3.764	10.909	.00452	2
5	4.385	5.835	16.909	.00452	2
6	6.208	8.281	24.000	.00452	2
7	8.452	11.293	32.727	.00452	2
8	11.109	14.869	43.091	.00452	2

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* TRANSVERSE DIRECTION *
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THE MAXIMUM SPACING OF LATERAL REINFORCEMENT SHALL NOT EXCEED ONE-FIFTH OF THE LEAST DIMENSION OF THE COLUMN, 6 TIMES THE NOMINAL DIAMETER OF THE LONGITUDINAL REINFORCEMENT, OR 8 INCHES. (8.21.1.1)

THE MINIMUM SPACING SHALL NOT BE LESS THAN 1.5 BAR DIAMETERS, 1.5 TIMES THE MAXIMUM SIZE COARSE AGGREGATE, OR 1.5 INCHES. (8.21.1)

FACTORED SHEAR STRENGTH ..85 * (VS + VC) BASED ON MAXIMUM AND MINIMUM CENTER TO CENTER SPACING (PITCH) OF LATERAL REINFORCEMENT:

BAR SIZE	MAX PITCH (IN)	SHEAR STRENGTH (KIPS)	1.0" AGG MIN PITCH (IN)	SHEAR STRENGTH (KIPS)
4	8.000	502.	2.000	1065.
5	8.000	605.	2.125	1409.
6	8.000	727.	2.250	1569.
7	8.000	877.	2.375	1569.
8	8.000	1055.	2.500	1569.

NOTE:

THE ABOVE FACTORED SHEAR STRENGTH VALUES ARE BASED ON A FACTORED CONCRETE SHEAR STRENGTH (.85 * VC) OF 314. KIPS.

IF THE APPLIED AXIAL LOAD IS LESS THAN 1181. KIPS, THEN THE FACTORED CONCRETE SHEAR STRENGTH DECREASES FROM 314. KIPS TO 0. KIPS AND THE VALUES IN THE ABOVE TABLE MUST BE APPROPRIATELY ADJUSTED.

IF THE DESIGNER SELECTS A LATERAL BAR SIZE DIFFERENT THAN THE ONE ASSUMED, HE SHOULD CONSIDER ADJUSTING THE RADIUS OF THE MAIN STEEL BAR LOOP AND RE-RUN THE PROBLEM.

MAXIMUM SHEAR CAPACITY OF THE SECTION:
VMAX = .85 * 10 * SQRT(FC) * B * D = 1569. KIPS

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 *************************
 * LONGITUDINAL DIRECTION *
 ***************************************************************************


 LOADS RESULTING FROM PLASTIC HINGING OF COLUMN NO. 1

 TOP OF COLUMN     AXIAL FORCE                 P =  1981. KIPS
                   PLASTIC MOMENT             MP =  9411. K-FT
 BOTTOM OF COLUMN  AXIAL FORCE                 P =  2083. KIPS
                   PLASTIC MOMENT             MP =  9552. K-FT

 DESIGN SHEAR FORCE:                         VU =   862. KIPS
 CONCRETE FACTORED SHEAR STRENGTH:   .85 * VC =   314. KIPS
 STEEL    FACTORED SHEAR STRENGTH:   .85 * VS =   548. KIPS

 MAXIMUM CENTER TO CENTER SPACING (PITCH) OF LATERAL REINFORCEMENT. (IN)

   BAR     CASE A        CASE B        CASE C          CONFINEMENT
   SIZE    CONFINEMENT   APP SHEAR     MIN SHEAR     RATIO  EQUATION
    4          2.834        3.930        15.652      .00452     2
    5          4.385        6.092        24.261      .00452     2
    6          6.208        8.647        34.435      .00452     2
    7          8.452       11.791        46.957      .00452     2
    8         11.109       15.525        61.826      .00452     2


 NOTE:

 THE UNREDUCED ELASTIC ARS + DEAD LOAD MOMENT (  6386. K-FT)
 IS LESS THAN THE PROBABLE PLASTIC MOMENT (  9552. K-FT)
 THEREFORE, PLASTIC HINGING DOES NOT CONTROL.
 (CODE 8.16.6.11.1)

 THE DESIGNER MUST CHECK THE SHEAR REINFORCEMENT (CASE B)
 FOR GROUP LOADS I TO VII
 (USE UNREDUCED ELASTIC ARS + DEAD LOAD SHEAR FOR GROUP VII)
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TITLE 4' X 8' RECTANGULAR WITH FILLETS CHECK 7/25/1995 09:52:19 PAGE 16

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* LONGITUDINAL DIRECTION *
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THE MAXIMUM SPACING OF LATERAL REINFORCEMENT SHALL NOT EXCEED ONE-FIFTH OF THE LEAST DIMENSION OF THE COLUMN, 6 TIMES THE NOMINAL DIAMETER OF THE LONGITUDINAL REINFORCEMENT, OR 8 INCHES. (8.21.1.1)

THE MINIMUM SPACING SHALL NOT BE LESS THAN 1.5 BAR DIAMETERS, 1.5 TIMES THE MAXIMUM SIZE COARSE AGGREGATE, OR 1.5 INCHES. (8.21.1)

FACTORED SHEAR STRENGTH .85 * (VS + VC) BASED ON MAXIMUM AND MINIMUM CENTER TO CENTER SPACING (PITCH) OF LATERAL REINFORCEMENT:

BAR SIZE	MAX PITCH (IN)	SHEAR STRENGTH (KIPS)	1.0* AGG MIN PITCH (IN)	SHEAR STRENGTH (KIPS)
4	8.000	583.	2.000	1391.
5	8.000	731.	2.125	1569.
6	8.000	906.	2.250	1569.
7	8.000	1122.	2.375	1569.
8	8.000	1378.	2.500	1569.

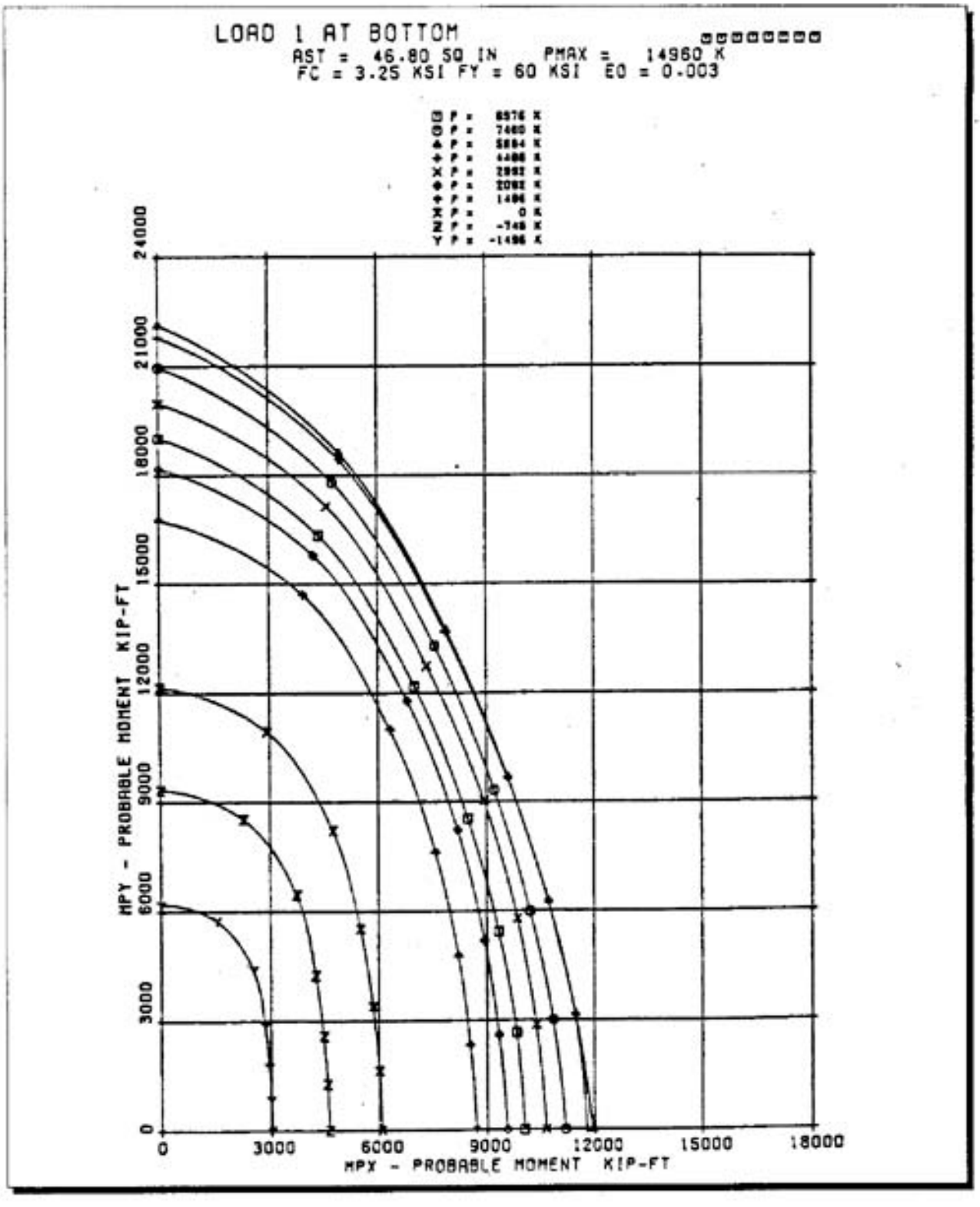
NOTE:

THE ABOVE FACTORED SHEAR STRENGTH VALUES ARE BASED ON A FACTORED CONCRETE SHEAR STRENGTH (.85 * VC) OF 314. KIPS.

IF THE APPLIED AXIAL LOAD IS LESS THAN 1181. KIPS, THEN THE FACTORED CONCRETE SHEAR STRENGTH DECREASES FROM 314. KIPS TO 0. KIPS AND THE VALUES IN THE ABOVE TABLE MUST BE APPROPRIATELY ADJUSTED.

IF THE DESIGNER SELECTS A LATERAL BAR SIZE DIFFERENT THAN THE ONE ASSUMED, HE SHOULD CONSIDER ADJUSTING THE RADIUS OF THE MAIN STEEL BAR LOOP AND RE-RUN THE PROBLEM.

MAXIMUM SHEAR CAPACITY OF THE SECTION:
VMAX = .85 * 10 * SQRT(FC) * B * D = 1569. KIPS


LOAD 1 AT BOTTOM
AST = 46.80 SQ IN PMAX = 14960 K
FC = 3.25 KSI FY = 60 KSI EO = 0.003
P = 8576 K
P = 7480 K
P = 5884 K
P = 4488 K
P = 2992 K
P = 2092 K
P = 1496 K
P = 0 K
P = -748 K
P = -1496 K
MPY - PROBABLE MOMENT KIP-FT
MPX - PROBABLE MOMENT KIP-FT
0
3000
6000
9000
12000
15000
18000
21000
24000