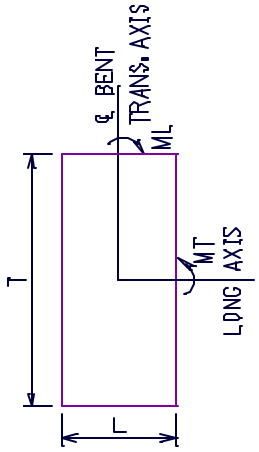
INTERACTION DIAGRAMS FOR SQUARE AND RECTANGULAR COLUMNS

Strength of rebar (ksi) = $fy := 60$

Strength of concrete (ksi) = $f'c := 3.5$

Beta Factor

$\beta 1 := if[\, f'c \le 4, 0.85, if[\, f'c \ge 8, 0.65, 0.85 - (f'c - 4)\cdot 0.05\,]\,]$ $\beta 1 = 0.85$



Longitudinal column dimension = $L := 48$

Transverse column dimension = $T := 48$

SIZE OF BAR; AREA OF ONE BAR; AND NUMBER OF EACH REQUIRED FOR 1% STEEL $EA := 0, 1 .. 5$

$$BART := \begin{pmatrix} 7 \\ 8 \\ 9 \\ 10 \\ 11 \\ 14 \end{pmatrix} \qquad AS\_EACH := \begin{pmatrix} 0.60 \\ 0.79 \\ 1 \\ 1.27 \\ 1.56 \\ 2.25 \end{pmatrix}$$

$$N\_REQUIRED_{EA} := floor\left(\frac{L\cdot T\cdot 0.01}{AS\_EACH_{EA}} + 1\right) \qquad N\_REQUIRED = \begin{pmatrix} 39 \\ 30 \\ 24 \\ 19 \\ 15 \\ 11 \end{pmatrix}$$

Note: Program will assume that the bars are spaced evenly and determine the number of bars in each face. If you have a different configuration you may change the configuration manually. This change should be made on page 3.

$$\begin{pmatrix} dia \\ cover \\ Asone \\ dia2 \\ cover2 \\ Asone2 \\ dia3 \\ cover3 \\ Asone3 \\ nbars \\ nbars2 \\ nbars3 \\ sbars \\ sbars2 \\ sbars3 \\ Ast\_total \end{pmatrix} :=$$

	ROW ONE	ROW TWO	ROW THREE
number of bars	28	0	0
size of bars	11	0	0
diameter	1.41	0	0
cover	3.205	0	0
Area of one bar	1.56	0	0
Total Area	43.68		

Input only the values that are in RED

Area of steel (total in the section) = $Ast\_total = 43.68$

Minimum reinforcement LRFD 5.7.4.2

Gross concrete area = $Ag := L \cdot T$ $Ag = 2304$

$$minr_{EA} := \frac{Ast\_total \cdot fy}{Ag \cdot f'c} \qquad minr = \begin{pmatrix} 0.325 \\ 0.325 \\ 0.325 \\ 0.325 \\ 0.325 \\ 0.325 \end{pmatrix}$$

$$check_{EA} := \begin{cases} \text{"NG"} & \text{if } minr_{EA} < 0.135 \\ \text{"OK"} & \text{otherwise} \end{cases} \qquad check = \begin{pmatrix} \text{"OK"} \\ \text{"OK"} \\ \text{"OK"} \\ \text{"OK"} \\ \text{"OK"} \\ \text{"OK"} \end{pmatrix}$$

Percent steel = $\%steel := \frac{Ast\_total}{T \cdot L} \cdot 100$ $\%steel = 1.896$

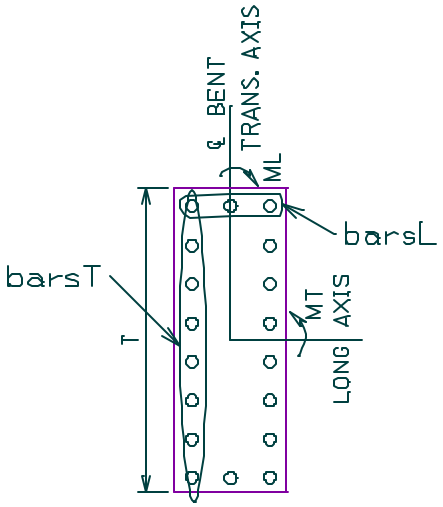
ROW ONE

The user may manually change the number of bars in each face here.

barsL = 8 bspaceT = 5.941

CHECK

barsT = 8 bspaceL = 5.941



ROW TWO

The user may manually change the number of bars in each face here.

barsL2 = bspaceT2 =

CHECK

barsT2 = bspaceL2 =

ROW THREE

The user may manually change the number of bars in each face here.

barsL3 = bspaceT3 =

CHECK

barsT3 = bspaceL3 =

Capacity reduction factor for concrete = (usually 0.85) $\phi concrete := 0.85$

Capacity reduction factor for steel = (usually 0.90) $\phi steel := 0.90$

Number of iteration points $ip := 100$ $q := 1.. ip$

Modulus for steel $Es := 29000$

Capacity Reduction Factor = see 8.16.1.2.2 $\phi max := 0.90$ $\phi min := 0.70$

Max strain is steel $\varepsilon max := \frac{fy}{Es}$ $\varepsilon max = 0.002$

Theoretical max strain in concrete (ACI suggests 0.003) = $\varepsilon maxconc := 0.003$

Z := READPRN("col_rect.prn")

APPLIED LOADS

Pu (k) MuT (k*ft) MuL (k*ft)

Count the number of data points

G := for j3 ∈ 0.. 100
  F ← 0 on error | B ← j3 if $Z_{j3,0} > 0$
  | break otherwise
B

G = 4

n := 0.. G

Z =

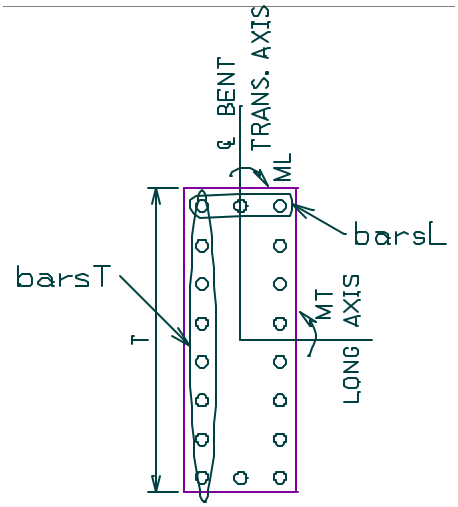
	0	1	2
0	1415	1189	4023
1	1300	951.9	3103
2	910.6	1612	548.9
3	1043	164.4	0
4	1300	1737	3400
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0

PL := $Z^{\langle 0 \rangle}$ MT := $Z^{\langle 1 \rangle}$ ML := $Z^{\langle 2 \rangle}$ PT := $Z^{\langle 0 \rangle}$

Capacity reduction factors $\phi min = 0.7$ $\phi max = 0.9$

Max tension force = $Pt := -Pten \cdot \phi max$ $Pt = -2122.848$

Max compression force = $Pc := Pcomp \cdot \phi min$ $Pc = 6358.22$

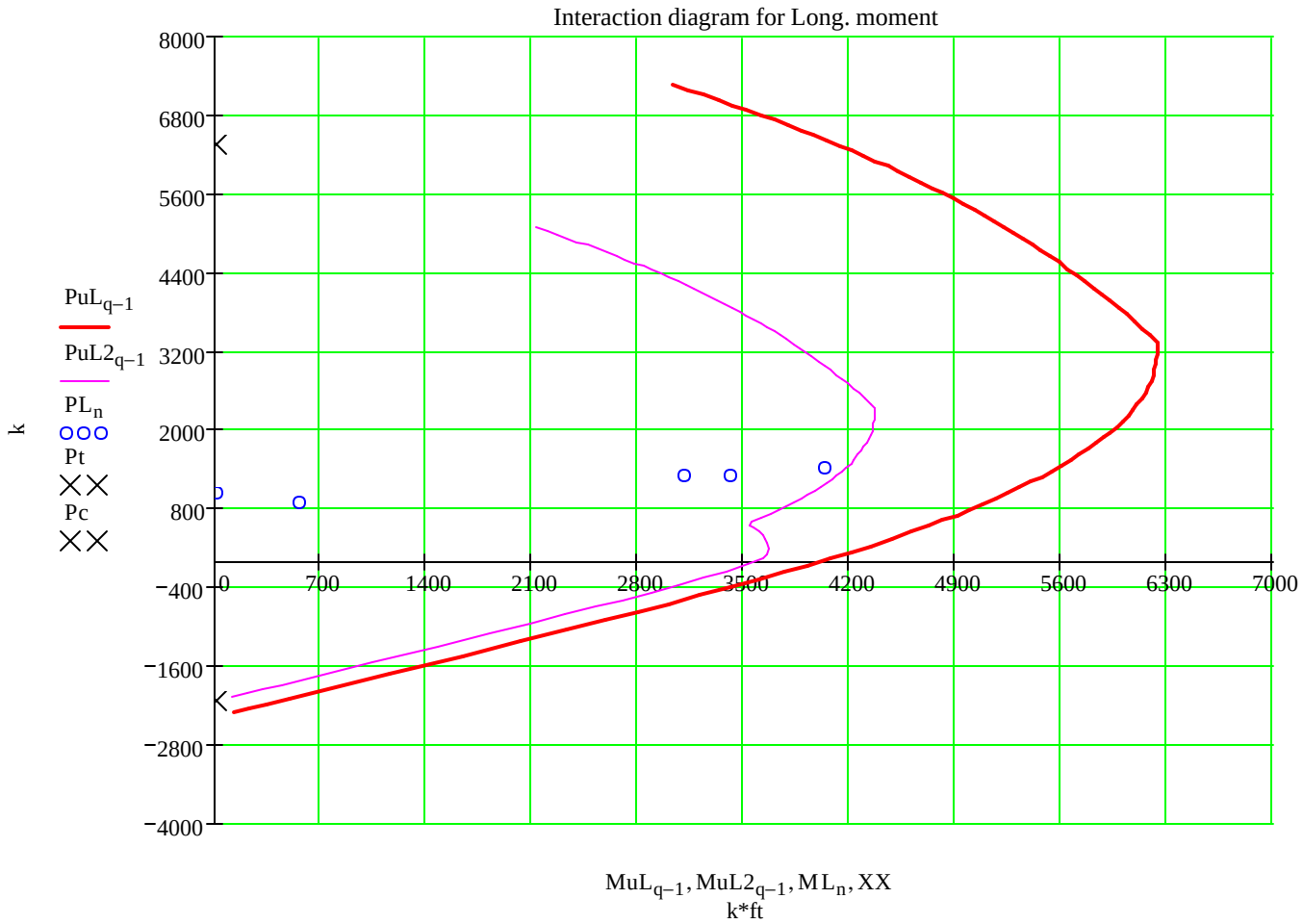


	ROW ONE	ROW TWO	ROW THREE
COVER	cover = 3.205	cover2 = 0	cover3 = 0
BARS L	barsL = 8	barsL2 = ▮	barsL3 = ▮
BARS T	barsT = 8	barsT2 = ▮	barsT3 = ▮
BAR SIZE	sbars = 11	sbars2 = 0	sbars3 = 0
NUMBER BARS	nbars = 28	nbars2 = 0	nbars3 = 0

L = 48 f'c = 3.5 Ast = 43.68

T = 48 fy = 60 Ag = 2304

Percent steel = $\%steel := 100 \cdot \frac{Ast}{Ag}$ $\%steel = 1.896$



SAFETY FACTOR

$\min(SF) = 1.035$

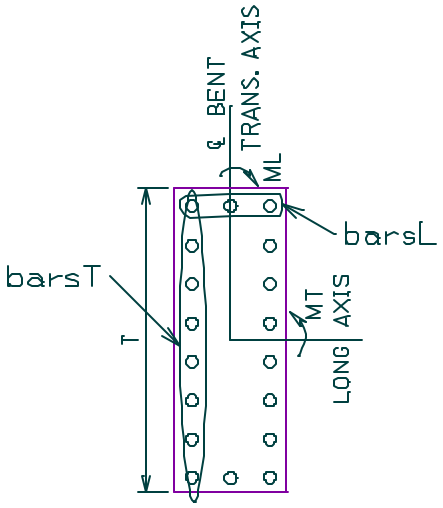
$$\min\left(\begin{pmatrix} SF1_n \\ SF2_n \end{pmatrix}\right) =$$

1.035
1.32
6.975
6.096
1.205

Capacity reduction factors $\phi min = 0.7$ $\phi max = 0.9$

Max tension force = $Pt := -Pten \cdot \phi max$ $Pt = -2122.848$

Max compression force = $Pc := Pcomp \cdot \phi min$ $Pc = 6358.22$



	ROW ONE	ROW TWO	ROW THREE
COVER	cover = 3.205	cover2 = 0	cover3 = 0
BARS L	barsL = 8	barsL2 = ∎	barsL3 = ∎
BARS T	barsT = 8	barsT2 = ∎	barsT3 = ∎
BAR SIZE	sbars = 11	sbars2 = 0	sbars3 = 0
NUMBER BARS	nbars = 28	nbars2 = 0	nbars3 = 0

L = 48 f'c = 3.5 Ast = 43.68

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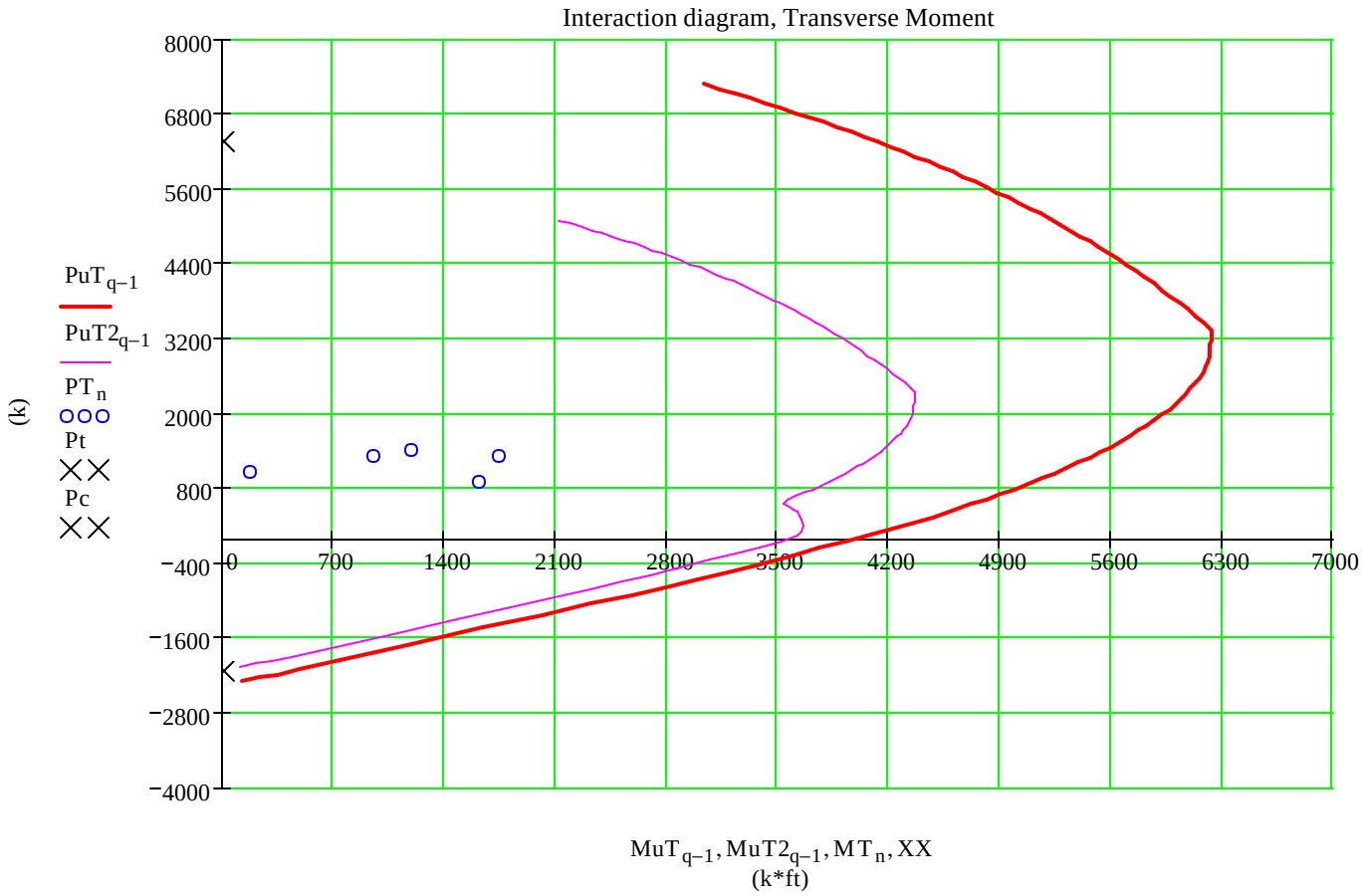

SAFETY FACTOR

$\min(SF) = 2.358$

$$\min\left(\begin{pmatrix} SF1_n \\ SF2_n \end{pmatrix}\right) =$$

3.501
4.304
2.375
6.096
2.358