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PROJECT :
CLIENT :
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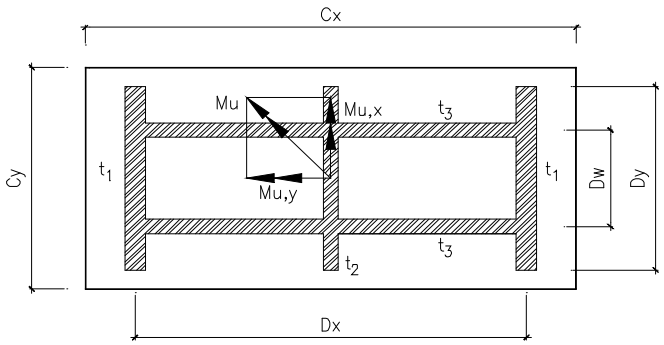
PAGE :
DESIGN BY :
REVIEW BY :

Super Composite Column Design Based on AISC 360-05 & ACI 318-08

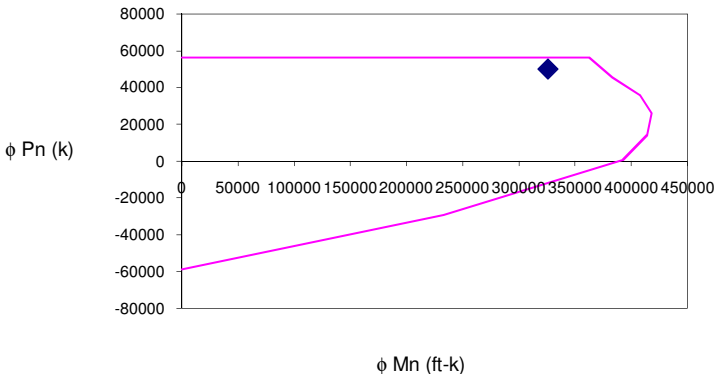
INPUT DATA & DESIGN SUMMARY

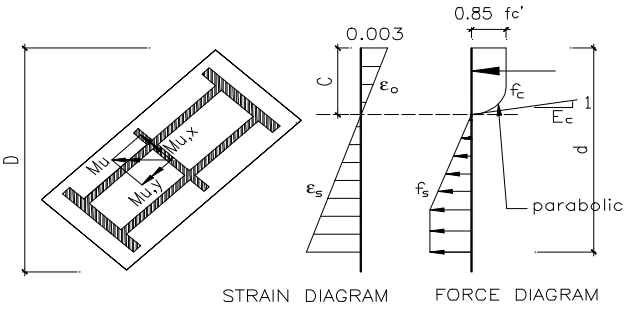
CONCRETE STRENGTH	f_c'	=	5	ksi
STEEL YIELD STRESS	f_y	=	50	ksi
COLUMN EFFECTIVE LENGTH	KL	=	240	ft
CONCRETE SECTION SIZE	C_x	=	240	in
	C_y	=	125	in
STEEL SECTION SIZE	D_x	=	192	in
	D_y	=	100	in
	t_1	=	2	in
	t_2	=	1.5	in
	t_3	=	2	in
	D_w	=	75	in
FACTORED AXIAL LOAD	P_u	=	50000	k
FACTORED MOMENT	$M_{u,x}$	=	310000	ft-k
	$M_{u,y}$	=	100000	ft-k
FACTORED SHEAR LOAD	$V_{u,x}$	=	1800	k
	$V_{u,y}$	=	3200	k



THE COLUMN DESIGN IS ADEQUATE.

ANALYSIS





Capacity Drawings	ϕ	ϕ Pn (k)	ϕ Mn (ft-k)
AT AXIAL LOAD ONLY	0.75	56495	0
AT MAXIMUM LOAD	0.75	56495	362678
AT AXIAL LOAD 45615 k	0.75	45615	383081
AT AXIAL LOAD 35923 k	0.78	35923	407207
AT AXIAL LOAD 26276 k	0.82	26276	417700
AT AXIAL LOAD 14501 k	0.86	14501	413791
AT STEEL STRAIN 0.005	0.9	715	392128
AT AXIAL LOAD -28982 k	0.9	-28982	232902
AT PURE TENSION	0.9	-58680	0

$$\varepsilon_o = \frac{2\left(0.85 f_c'\right)}{E_c} \quad , \quad E_c = 57\sqrt{f_c'} \quad , \quad E_s = 29000 ksi$$

$$f_c = \begin{cases} 0.85 f_c' \left[2\left(\frac{\varepsilon_c}{\varepsilon_o}\right) - \left(\frac{\varepsilon_c}{\varepsilon_o}\right)^2 \right] & , \ for \ \ 0 < \varepsilon_c < \varepsilon_o \\ 0.85 f_c' & , \ for \ \ \varepsilon_c \geq \varepsilon_o \end{cases}$$

$$f_s = \begin{cases} \varepsilon_s E_s & , \ for \ \ \varepsilon_s \leq \varepsilon_t \\ f_y & , \ for \ \ \varepsilon_s > \varepsilon_t \end{cases}$$

CHECK FLEXURAL & AXIAL CAPACITY

$\phi P_{max} = \phi_c P_n$ = 56495 kips, (AISC 360-05 I2-2 & I2-3)

> P_u **[Satisfactory]**

where ϕ_c = 0.75 (AISC 360-05 I2.1b & ACI 318-08 9.3.2.2)

A_c	=	28696	in^2	I_c	=	37543603	in^4
A_s	=	1304	in^2	I_s	=	1518897	in^4

(cont'd)

C_1 = 0.187 , (AISC 360-05 I2-7) $E I_{eff}$ = 72334735452 ksi-in^4, (AISC 360-05 I2-6)

P_e = 86072 kips, (AISC 360-05 I2-5) P_o = 187158 kips, (AISC 360-05 I2-4)

Balanced : ϕ = 0.75 (AISC 360-05 I2.1b & ACI 318-08 Fig. R9.3.2)

$C_b = d\,\varepsilon_c / (\varepsilon_c + \varepsilon_s)$ = 151.5 in ε_t = 0.0017 ε_c = 0.003

d = 238.6 in, (ACI 7.7.1) D = 266.8 in

Critical Points	**ϕ**	**ϕ Pn (k)**	**ϕ Mn (ft-k)**
AT AXIAL LOAD ONLY	0.75	56495	0
AT MAXIMUM LOAD	0.75	56495	362678
AT 0 % TENSION	0.75	95998	240093
AT 25 % TENSION	0.75	81038	298887
AT 50 % TENSION	0.75	67975	336762
AT STEEL STRAIN 0.002	0.75	39686	390588
AT BALANCED CONDITION	0.75	45661	383006
AT STEEL STRAIN 0.005	0.9	715	392128
AT FLEXURE ONLY	0.75	0	387404

ϕM_n = 374858 ft-kips @ P_u = 50000 kips **>** M_u = 325730 ft-kips **[Satisfactory]**

ρ_{max} = 0.08 (ACI 318-08 10.9) ρ_{provd} = 0.043

ρ_{min} = 0.01 (AISC 360-05 I2.1a & ACI 318-08 10.9) **[Satisfactory]**

CHECK SHEAR CAPACITY (AISC I2.1d & ACI 318-08 11.1 & 11.2)

$\phi V_{nx} = \phi (V_{cx})$ **>** V_{ux} (ACI 318-08 11.1.1)

$\phi_v V_{ny} = \phi_v (V_{ny})$ **>** V_{uy} (AISC 360-05 G2.1) **[Satisfactory]**

where ϕ = 0.75 (ACI 318-08 9.3.2.3)

ϕ_v = 1.00 (AISC 360-05 G2.1)

	d	A_0	A_w	$V_c = 2 (f_c')^{0.5} A_0$	$V_n = 0.6 f_y A_w C_v$	ϕV_n
x	216	27000		3818.4		2864
y	100		550		16500.0	16500

Note:

1. The minimum Stud Shear Connectors (not shown on this spreadsheet) are 3/4" ϕ @ 12" O.C. in both directions of vertical and horizontal around built-up structural steel shape. (AISC 360-05 I2.1g)
2. The column shall be reinforced, not shown on this spreadsheet, with continuous longitudinal bars (ρ_{sr} = 0.004 min.), and lateral ties or spirals at least 0.009 in^2 per in. (AISC 360-05 I2.1a)