JOB: MSRY Shear Wall - ASP

SHEET NO.: 1 OF

CALCULATED BY: DATE:

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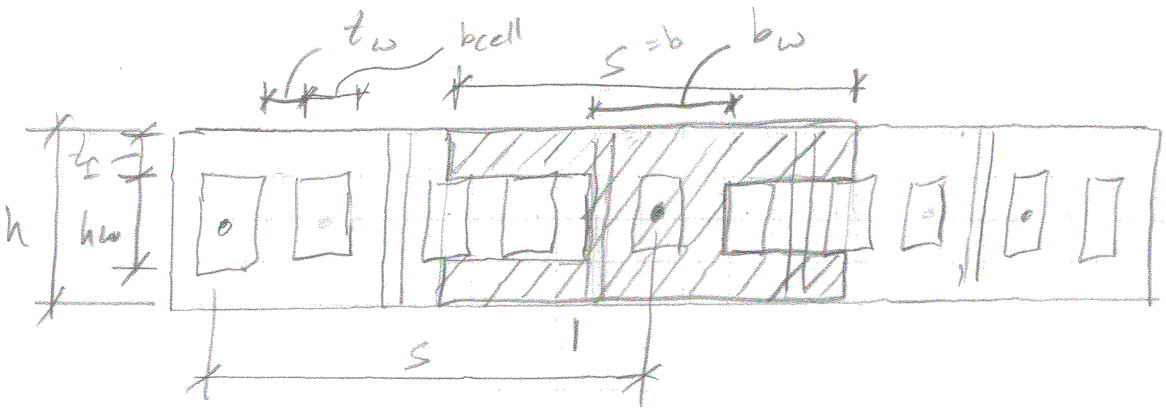
SCALE: Properties

– use weak axis or out of Plane properties b/c I & r will be use to check axial strength/stability.



$$S = \min \begin{cases} \text{bar space} \\ 6 \times h \\ 72'' \end{cases}$$

$b_{unit} = b_{unit} + b_{grout}$ ⇒ $b_{cell} = b_{unit} - 3t_w$

$b_w = b_{cell} + 2t_w$ $h_w = h - 2t_f$

$$\text{Area} = A_{ft} = (2 \times b \times t_f + h_w \times b_w) \times \frac{1}{S} = \text{Area/ft of wall}$$

(S = b)

$$I_{ft} = \left[\frac{S h^3}{12} - \left[\frac{\frac{(S - b_w)}{2} \times h_w^3}{12} \times 2 \right] \right] \times \frac{1}{S} = I/\text{ft of wall}$$

$A_{TOT} = A_{ft} \times L$

$I_{TOT} = I_{ft} \times L$

$$r = \sqrt{\frac{I_{TOT}}{A_{TOT}}}$$

(S' & L' may Also be used for a more conservative result.) See rebar layout on following pages.

JOB: MSRY SW ASP

SHEET NO.: 2 OF

CALCULATED BY: DATE:

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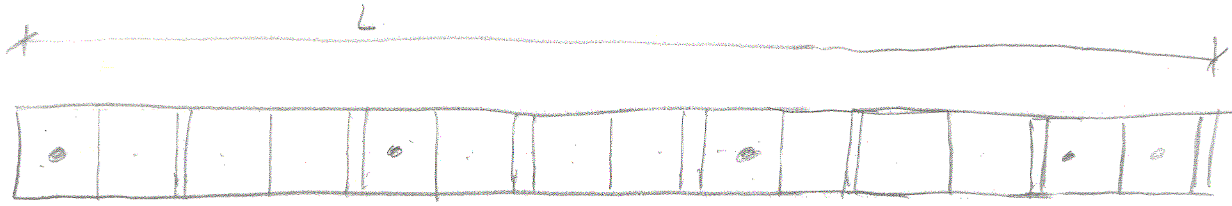
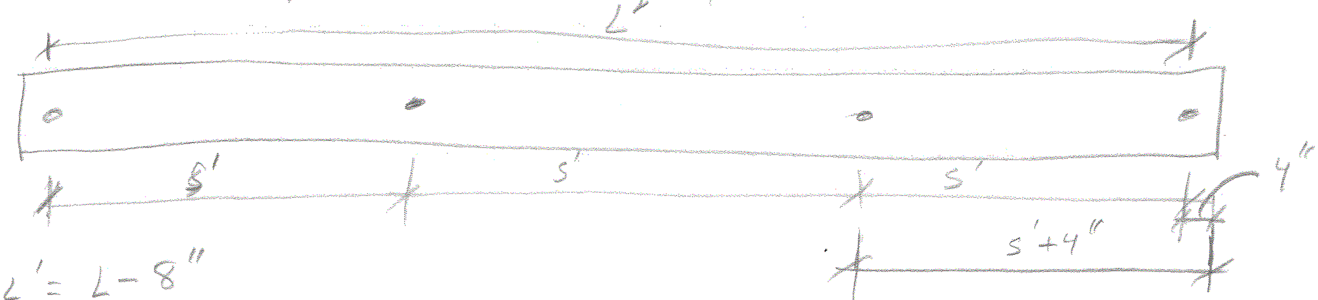
SCALE: Bar Layout

Bar Spacing



→ In the field Bars will Be Placed @ Ends
- we will conservatively Drop one Interior bar and then space the Bars evenly.



$L' = L - 8''$

$N' = \text{Number of Bars} = \frac{L}{s} + 1$ (round Down)

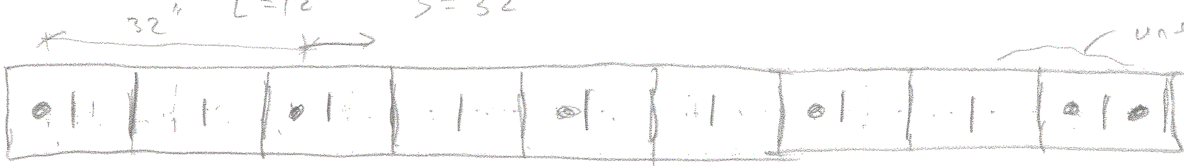
$s' = \frac{L'}{(N'-1)}$

- Although the reinforcement differs in field we Have (1) Less Bar in the analysis

Example

32" L = 12' S = 32"

In Field →



uneven placement may be placed Anywhere In field

$\#$ of Bars in field $= \frac{144}{32} = 4.5 + 1$ round up $= 6$ Bars

Calculation/design use $\frac{L}{s} + 1$ round down $= 5$ Bars

$s' = \frac{L'}{(N'-1)} = \frac{136}{4} = 34''$

Calc Spacing ⇒

JOB: MSRY SW ASD

SHEET NO.: 3 OF

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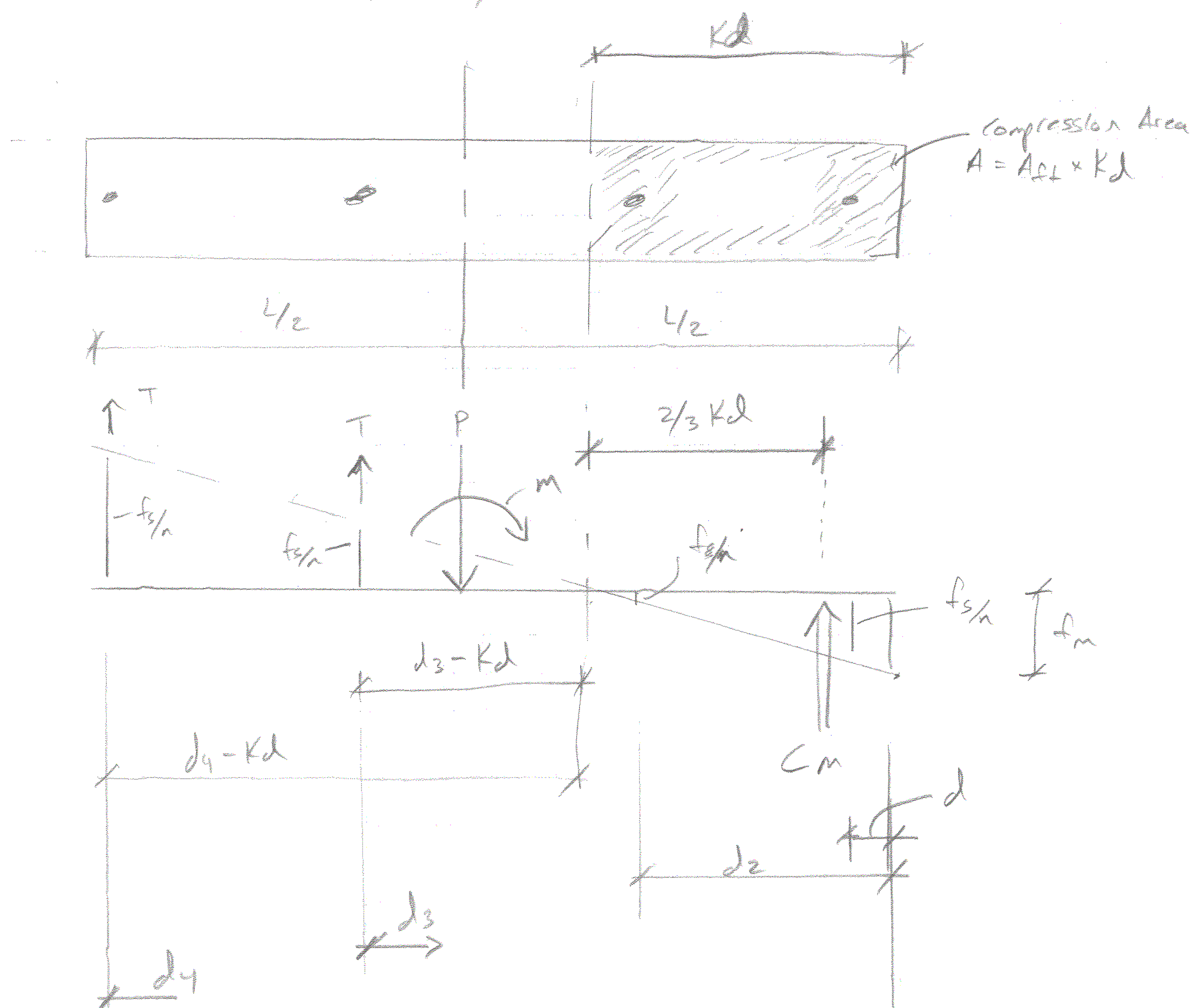
SCALE: Section Analysis

- Elastic Stress Distribution
- use Area section property calc'd on a per foot basis



$d_1 = 4''$

$d_2 = S' + \text{Edge dist} = 4''$

$d_i = (i-1)S' + \text{Edge dist}$

Stress in Rebar ⇒ use similar Triangles

$$\frac{f_m}{Kd} = \frac{f_s/n}{d_i - Kd}$$

$$f_s = n(d_i - Kd) \times \frac{f_m}{Kd} < F_s$$

if result is Neg Bar is in Compression. This calc does not Consider Bars Effective in compression - Bars must Be Tied to be effective.

JOB: MSRY S.W. ASP

SHEET NO.: 4 OF

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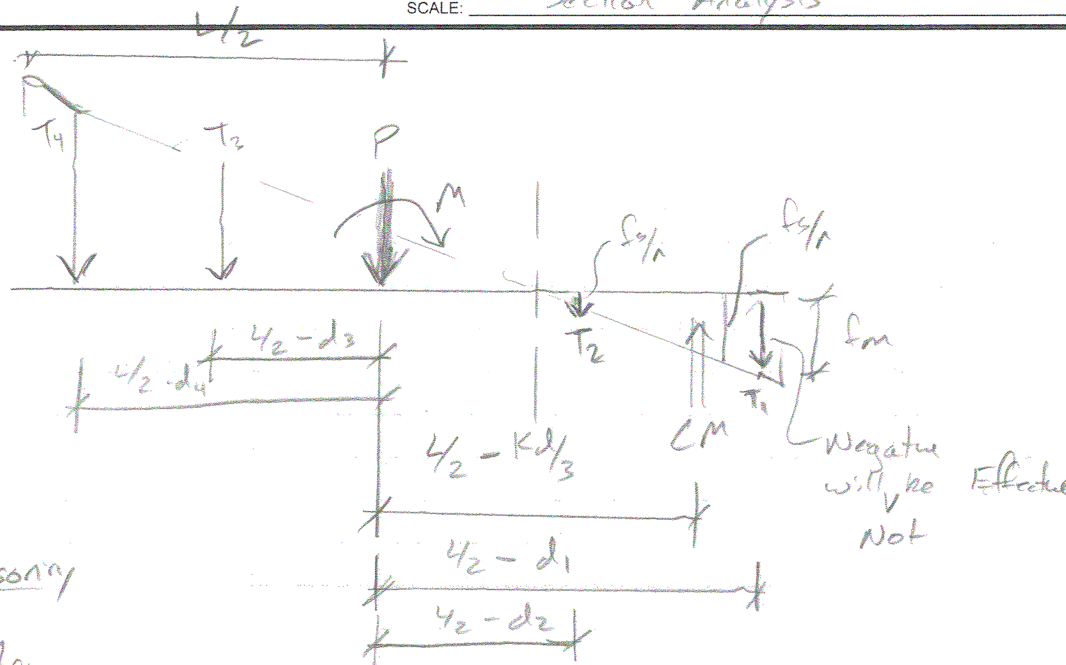
SCALE: Section Analysis



Compression in Masonry

$C_m = \frac{1}{2} f_m \times Kd\, A_{ft}$

Tension in steel

$T = \max(0, f_{si} \times A_{si})$

Moment Arms – Sum moments about Center of wall

$X_m = L/2 - Kd/3$

$X_{si} = d_i - \frac{L}{2}$

$\Sigma F_{vertical} = -P - \Sigma T + C_m = 0 \qquad P_n = C_m - T$

$\Sigma M_{L/2} = -M + C_m X_m + \Sigma T_i X_{si} \qquad M_n = C_m X_m + \Sigma T_i X_{si}$

JOB: MSRY SW ASD

SHEET NO.: 5 OF

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SCALE:

- Process

① Given Load P, M & Geometry of section

② Find $e_{r'd} = \frac{M}{P}$ From Load

③ Assume Kd, $f_m = F_m$ $F_m = \frac{f'_m}{3} \times 4/3$ ← wind & EQ.

④ Perform iteration until $e_{design} = \frac{M_{nominal}}{P_{nominal}} = e_{req'd}$ from step 1

Checks

Apply Reduction Factor to Allowable Axial stress / Force

Axial

$F_a = 0.25 f'_m R$ =>

$f_a = P_r / A_{TOT}$

$$R \begin{cases} h/r \le 99 & R = 1 - \left(\frac{h}{140r}\right)^2 \\ h/r > 99 & R = \left(\frac{70r}{h}\right)^2 \end{cases}$$

$F_a > f_a$?

$P_c = P_n \times R$

$P_c > P_r$?

Moment

$M_n = M_c > M_r$?

Shear $d = L'$

Reinforced

$\frac{M}{Vd} < 1$ $F_v^* = \min \begin{cases} \frac{1}{2}\left(4 - \frac{M}{Vd}\right)\sqrt{f'_m} \\ 120 - 45 \frac{M}{Vd} \end{cases}$

$\frac{M}{Vd} \ge 1$ $F_v^* = \min \begin{cases} 1.5\sqrt{f'_m} \\ 75 \text{ psi} \end{cases}$

Shear Reinf.

Horiz = $A_{VH} = \frac{VS}{F_s d}$

Min Vert = $A_{VV} = 1/3\, A_{VH}$ (min)

* Multiply by 4/3 for wind & seismic. (ASCE 7-05, 2.4.1)

Unreinforced

$\frac{M}{Vd} < 1$ $F_v = \min \begin{cases} \frac{1}{3}\left(4 - \frac{M}{Vd}\right)\sqrt{f'_m} \\ 120 - 45 \frac{M}{Vd} \end{cases}$

$\frac{M}{Vd} \ge 1$ $F_v = \min \begin{cases} \sqrt{f'_m} \\ 35 \text{ psi} \end{cases}$