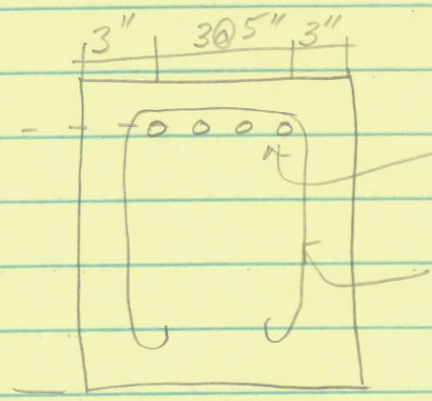
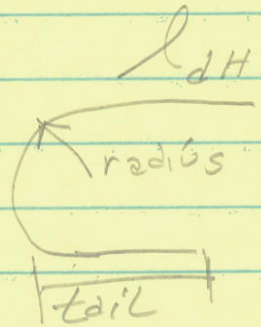


Exam 2
Next Wedn.
Covers
Shear/Stirrups
Developement
Lengths
Doubly Reinforced
hooks



Colums
Slenderness
Sway
Design
Gross Area
Details
Example
Eccentric Loads
Example

— Column Slenderness

A column is short if:

non-sway (braced) frame [10.10.1]

$$\frac{k\,l_u}{r} \leq 34 - 12\left(\frac{m_1}{m_2}\right) \leq 40$$

- assume k (unless specified)

l_u = unbraced

radius of gyration

$$r \equiv \sqrt{\frac{I_g}{A_g}} = \sqrt{\frac{\frac{1}{12}bh^3}{bh}} = \sqrt{\frac{1}{12}}\,h$$

$m_1 \equiv$ minimum moment

$m_2 \equiv$ maximum moment

$\left(\frac{m_1}{m_2}\right) = (+)$ single curvature D

$(-)$ double curvature S

— SWAY (unbraced) [10.10.1]

$$\frac{k\,l_u}{r} \leq 22$$

* The focus in this class is NON-sway Frames with short colums *

Short ≡ Non-Slender

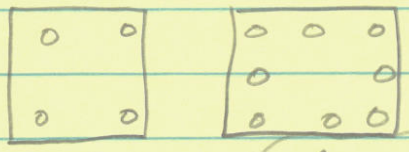
→ Column Design

- Structural Analysis
- Estimate column cross section [2-4]
- Analyze using interaction diagram [5-7]
- Iterate
- Detail Column [8-12]

* Focus on tied columns *

- Estimate Gross AREA
  - Assume column is square & has steel on all faces

symmetric



A_g & can vary

$$A_g \geq \frac{P_u}{0.45(f'_c + f_y \rho_{TRIAL})}$$

(ρ = reinforcement ratio)

ρ_g = reinforcement ratio

$$\rho_g = \frac{A_s}{A_g} = \frac{A_s}{bh}$$

0.01 - 0.03 typically

$0.01 \leq \rho_g \leq 0.08$ [10.9.1]

- Column Details

  TIES [7.10.5]

  longitudinal bars $\leq$ #10, #3
  " " #11, 14, 18, #4

Maximum spacing of ties.

min { 16 d_b of longitud. bars
48 d_b of ties
min b, h

See [7.10.5.4] if near slab

- Shear [11.2.1.2]
  ties act as shear stirrups

- Example Design a rectangular column (tied) with long side equal to two times the short side.

$P_D = 650^k$ $\quad P_L = 400^k$

$f'_c = 3\ ksi$ $\quad f_y = 60\ ksi$

initially assure $\rho_{gross} = 0.02$

$A_{steel} = \rho A_g$

Select column size

$P_u = 1.2(650^k) + 1.6(400^k) = 1420^k$

$\phi P_n = 0.80\phi[0.85 f'_c (A_g - A_{st}) + f_y A_{st}]$

$1420 = 0.80(0.65)[0.85(3)(A_g - 0.02A_g) + 60(0.02A_g)]$

$A_g = 738.25\ in^2$

↳ use 20×40 column ($A_g = 800\ in^2$)

Select reinforcement bars

$1420 = 0.80(0.65)[0.85(3)(800 - A_{st}) + 60(A_{st})]$

$A_{st} = 12.02\ in^2$

use 8 #11 bars ($12.50\ in^2$)

Design Ties

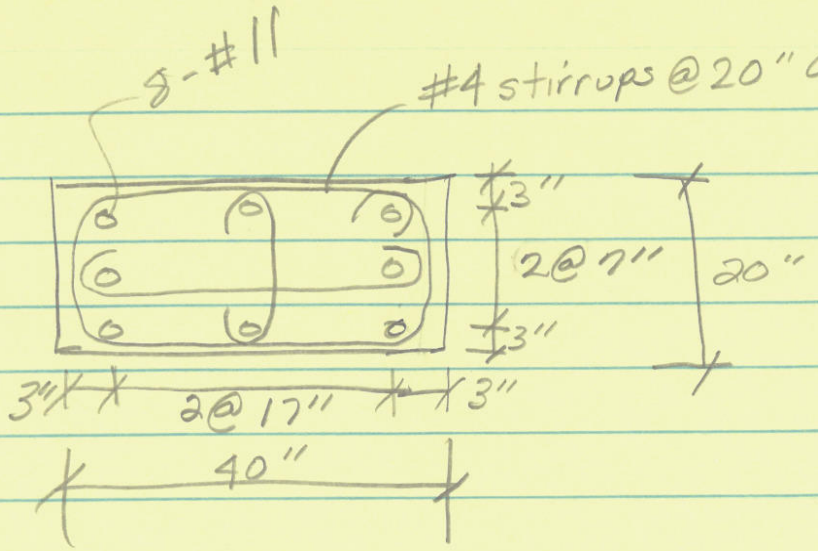
Max spacing = min

$16 d_b$ ← Longitudinal bars $= 16(1.41) = 22.56''$

$48 d_b = 48(0.5) = 24''$

least column dim $= 20''$ ←

use #4 ties @ 20" o.c.



Check code 7.10.5 for maximum spacing of vertical bars