Yonsei Univ.
School of Civil and Enviromental Engineering

Prof. Jang-Ho Jay Kim

Final Exam

Advanced Structural Behavior of Concrete

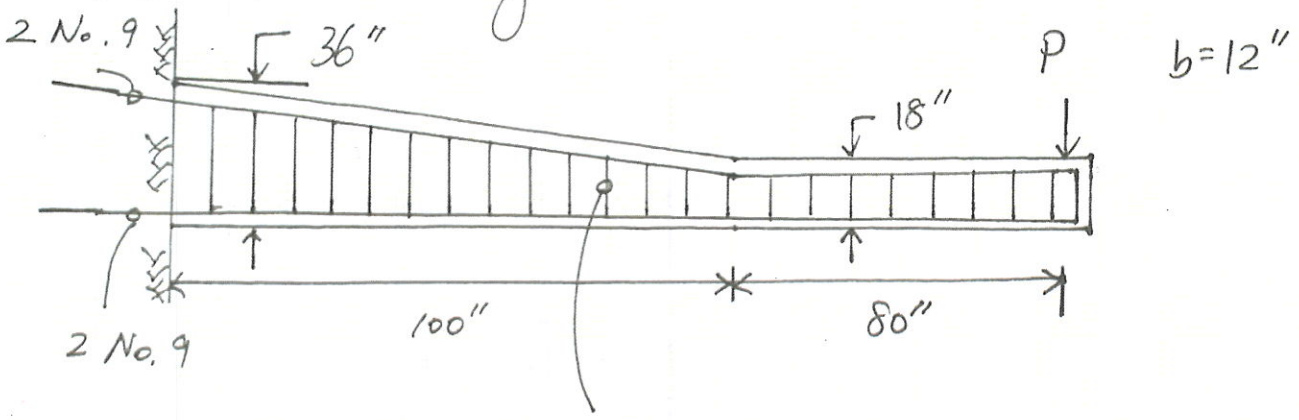
- Please solve all 4 problems
- Total points of the exam is 100 points
- Show all work. State all assumptions used.
- Due Dec. 17, 2017 @ 6 PM
- Send the solution file to jjhkim@yonsei.ac.kr

Problem 1. (25 points)

A cantilever beam 8 ft. long and 18 in. wide supports its own dead load plus a concentrated load located 6 in. from the end of the beam and 4.5 in. away from the vertical axis of the beam. The concentrated load is 15 kips dead load and 20 kips live load. Design reinforcement for flexure, shear, and torsion. Use $f'_c = 3{,}750$ psi and $f_y = 60{,}000$ psi for all steel.

Problem 2 (25 points)

A haunched beam has been constructed upside down as shown below. You have been hired to determine the theoretical load at failure (P). Assume the beam to be weightless.

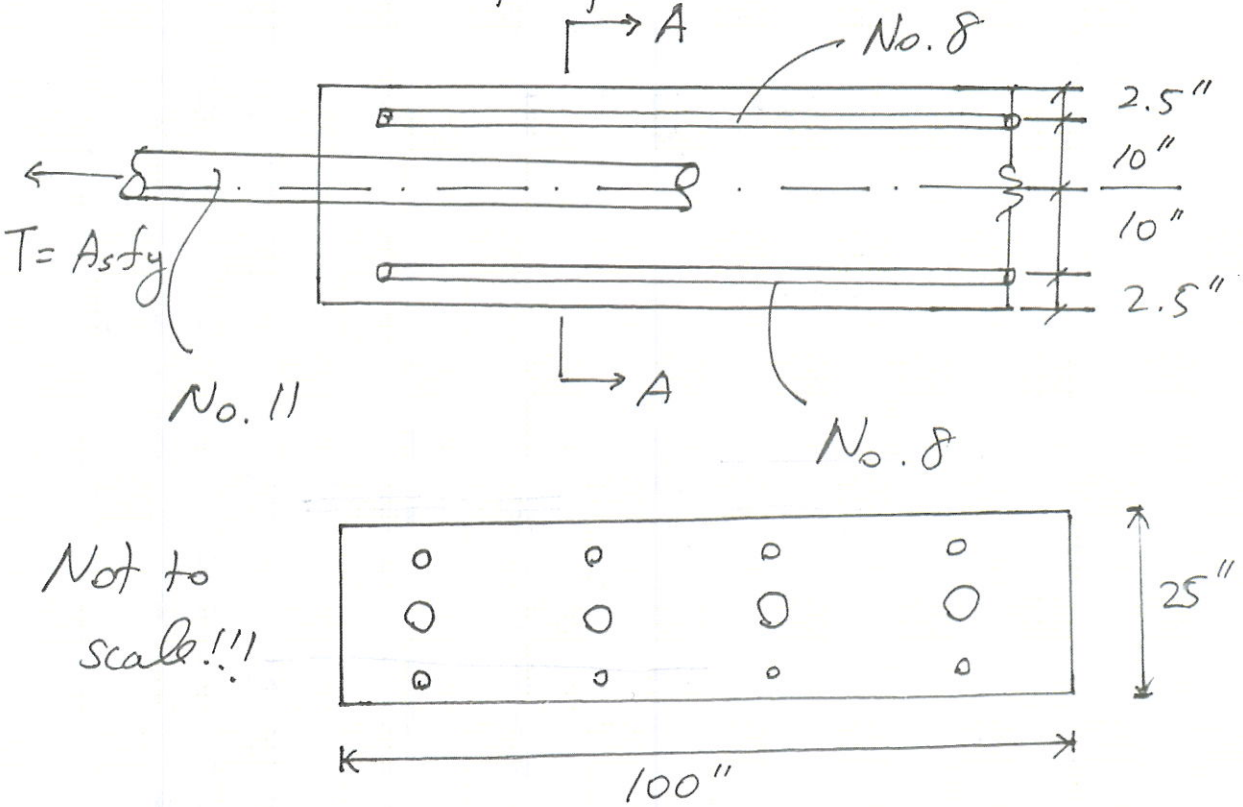


Adequate Anchorage Needed

No. 3 ⊓ @ 8"

Problem 3 (25 points)

Four No. 11 bars are to be anchored as shown to develop the yield stress in reinforced concrete member. The member is reinforced longitudinally with No. 8 bars as shown. Determine an appropriate design for the anchorage. None of the longitudinal bars may be bent. Note that the spacing between the No. 8 and No. 11 bars exceeds that allowed by ACI for lap spliced bars.



Section A-A

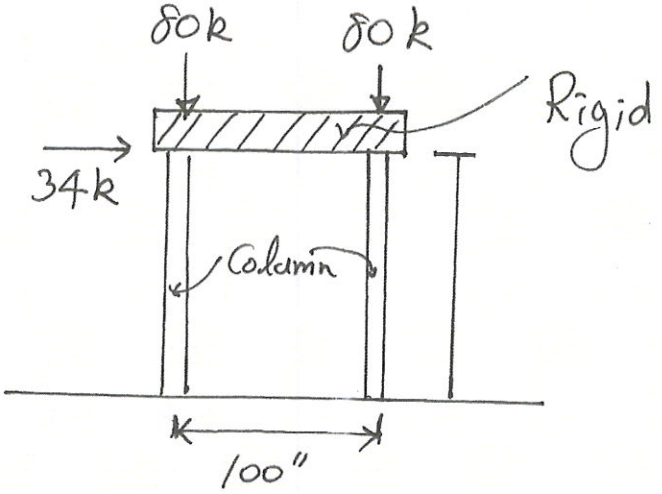
Problem 4 (25 points)

Two reinforced concrete columns are fixed at the base and fixed at the top to a rigid beam. Vertical and lateral loads are applied as shown. Assume to be factored design loads.

(a) Select a column cross section (to be used for both columns) from the three sections shown. Your selection should be economical and safe.

(b) Based on your selection, determine minimum transverse steel requirements to ensure that some minimal ductility will be available.

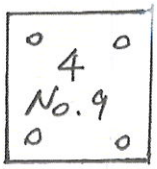
(c) Describe in words how your selection of transverse steel would change if the applied axial loads were 250 kips. No calculations are necessary.


80k
80k
Rigid
34k
Column
100"

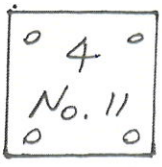
Column A

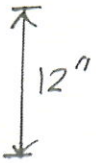

4
No. 6

B

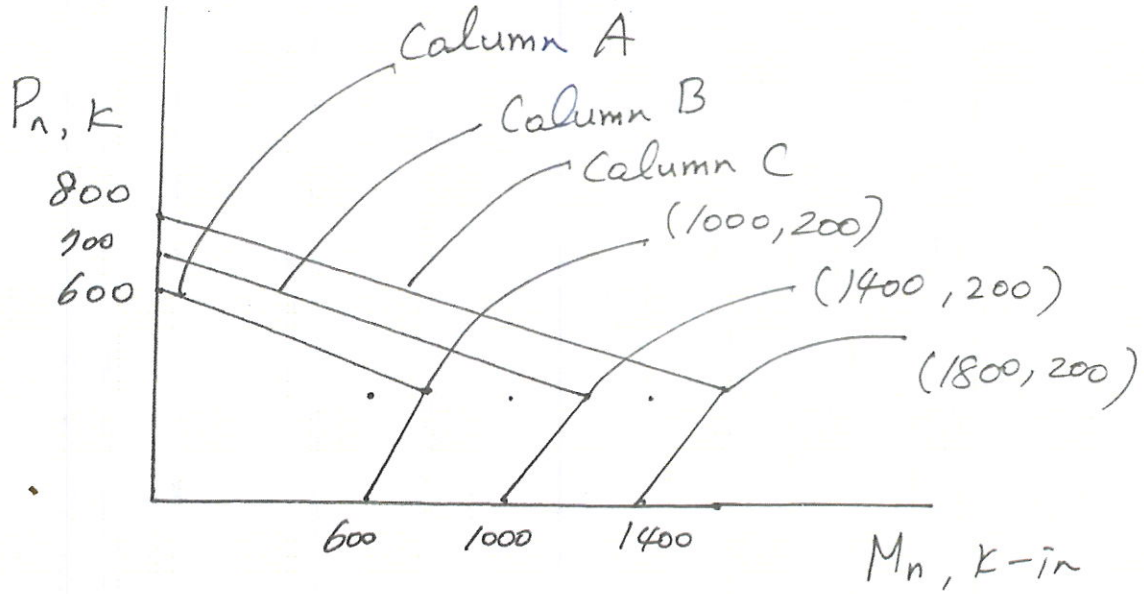

4
No. 9

C


4
No. 11


12"


12"


Column A
Column B
Column C
P_n, K
800
700
600
(1000, 200)
(1400, 200)
(1800, 200)
600
1000
1400
M_n, K-in