

Midterm Examination

Duration one hour and fifteen minutes (75 minutes)

Open Book, Notes & Other stuff.

No Neighborly Participation

“The fine print”: Notes on the whole examination:

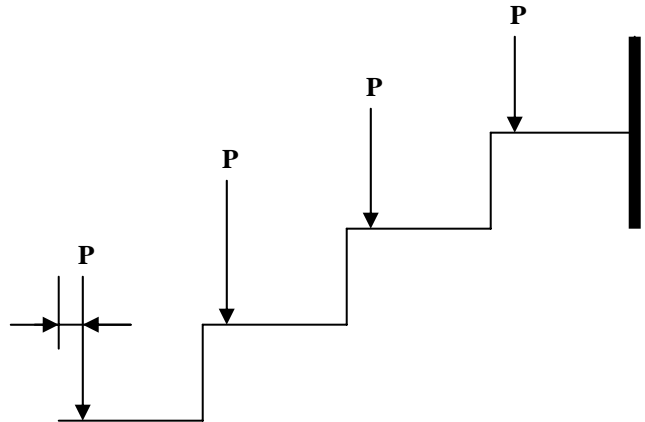
- 1) The total points on the exam are 120. You are given an extra 20 points to account for computational and inadvertent errors. However your grade will not exceed 100 even if your score is more than 100. If you score 93, you will get a 93. If you score 110 your score will be 100.
- 2) **PLEASE BUDGET YOUR TIME. YOU MAY WANT TO ANSWER THE SHORT ANSWER QUESTIONS FIRST.**

Problem #1: (30 points)

For the stair beam shown in the sketch determine:

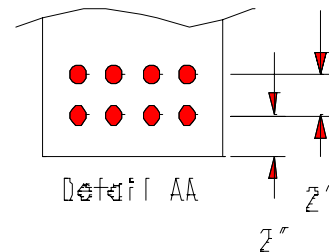
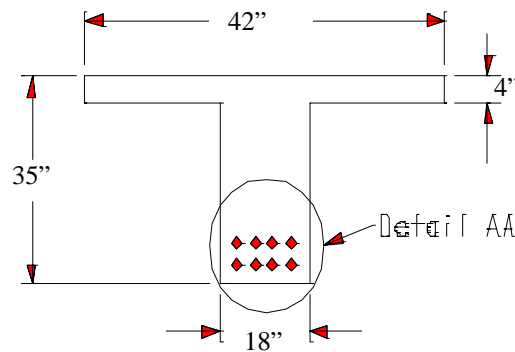
- a) The deflected shape (7)
- b) The moment diagram (7)
- c) The shear diagram (7)
- d) What would be the most appropriate cross section to support optimally the loading shown
 Show the reinforcement suggested (9)

Notes: Show the answer graphically. Indicate the critical points. Indicate moments on the tension side and indicate the shear force pair (sign) for orientation.



Problem #2: (40 points)

- 1) Determine the moment capacity M_{cap} of the T section shown in the figure on the right, if the compression in concrete extends for 6.0” from the top. (10)
- 2) Determine the corresponding reinforcement, to be arranged in two layers as shown in Detail AA, if the moment demand is equal to the (design) moment capacity M_{cap} (5)
- 3) Determine the reinforcement of the section for an acting (demand) moment equal to 1.3 times the size of the moment capacity calculated in (1) above (i.e. $M = 1.3 M_{cap}$), without increasing the area of compressed concrete. You may extend the overall height to accommodate the reinforcement (10)
- 4) Show the final arrangement of reinforcement to fit within the forms required to build the beam. (5)
- 5) If the section is loaded by a design shear force of (V_d) of 250 Kips, what should be the required shear reinforcement. Show complete calculation and explain your decision. (10)



Parameters: $f'_c = 4 \text{ ksi}$, $f_y = 70 \text{ ksi}$, $\rho_{min} = 200/f_y$ [psi]

Problem #4 (50 points)

Overall: Design a floor for a structure using approximations and determine the load cases for the typical floor slab

Detailed requirements:

- 1) Label (with numbers) all columns (horizontally) starting from the upper left corner. (6)
- 2) Choose a layout of beams between the columns and label them (either horizontal or vertical – but not both) (6)
- 3) Layout one way slab supported by the beams, which you chose in (2) and show in the sketch. with proper labels and arrows. (6)
- 4) Determine the thickness of the slab (unique for whole floor) using approximations ($h \sim L_{eq} / m$ or ACI recommendations) (6)
- 5) Determine the dimensions of all beams using also approximations with the “width” approximately half of the height but not less than 8”. Make all beams same dimensions. (8)
- 6) Determine the thickness of the slab if it was made a one-way flat plate. (8)
- 7) Determine and show the required load cases, for each of type the slab strips required to design the floor. Calculate the factored loading and show it in each of the load cases. Show the minimum number of load cases (10) [2 points will be deducted for each unnecessary load case shown, or for each of the necessary load cases missing]

