UC Berkeley
CE 123N – Fall 2015
Instructor: Alan Kren

Name:_____

CE 123N - Reinforced Concrete
Mid-Term Examination No. 1

Instructions:

- Read these instructions. Do not begin the exam until instructed to do so.
- Work all problems. Pace yourself so that you have time to work on each problem. Reasonable assumptions and approximations should be made where necessary.
- Show all relevant work. Credit will not be given for key elements of the solution that are not apparent.
- Partial credit will be given if procedures are outlined clearly.
- Work the solutions for each of the problems on separate sheets, working on one side of each sheet of paper. One problem solution may span more than one sheet. However, do not show the work for more than one problem on any given sheet. Staple the solution sheets to this cover sheet, problem 1 first, then problem 2, etc.
- If you have any questions, or need any paper or other materials, walk to the front of the classroom and ask the exam proctor. Do not raise your hand to get the proctor's attention, and do not call out questions from your seat.
- Neatness is expected and counts 10% of your grade. Therefore, write neatly and organize your solutions to make checking as easy as possible.
- Unless otherwise stated, all problems use the ACI 318-2014 strength design method, and all concrete is normal weight.
- When instructed, read the entire exam. Do not begin working out the solutions, rather, think about the problems and how you will solve them. You will have 5 minutes to think about the problems and to organize your thoughts.
- When instructed, begin working the problems.

| | Possible Points | Score |
|---|---|---|
| Problem 1 | 60 | _____ |
| Problem 2 | 40 | ____ |
| TOTAL | 100 | _____ |

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MIDTERM #1

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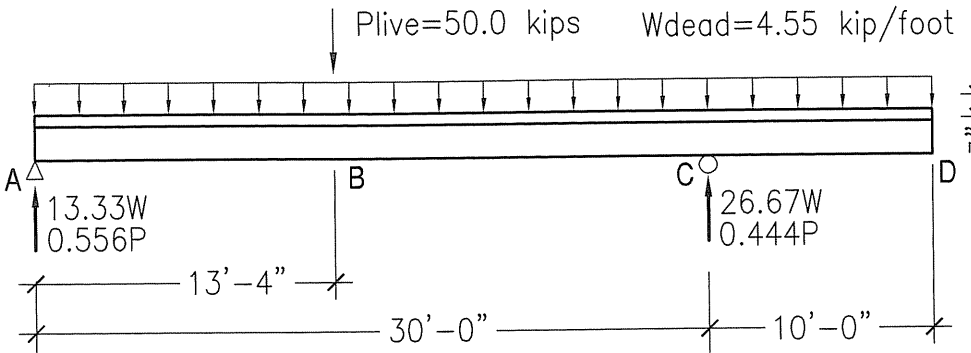


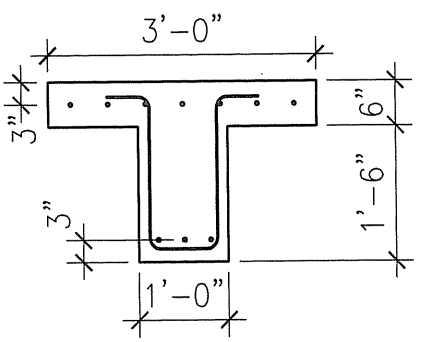


f'c=5.0 ksi
Fy=60 ksi
(7) #6 top bars
(3) #8 bot. bars
#4 stirrups

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Problem 1.

A T-beam is shown on the following page in elevation and in section. *Applied service* dead load and *service* live load magnitudes and extents of loading to the beam are illustrated. Service dead load does not include self-weight. Location and extent of live load is set; it does not change. Reactions in terms of "w" and "P" are shown.

Assume the following:

- $f'_c$ = 5.0 ksi
- $F_y$ = 60 ksi
- Dimension from top of beam to centerline top reinforcement = 3"
- Dimension from bottom of beam to centerline bottom reinforcement = 3"
- Normal weight concrete
- Stirrup size is #4

For the noted loading:

a. What are the applicable load combinations(s) and load factors?
b. Draw the shear diagram for applicable load combinations directly below the beam. Align support points, and points of applied point loads. Indicate maximum magnitudes of shear for all load combinations. Use a straight edge to align support points, and draw the diagrams neatly and to approximate scale.

For segment A-B

a. What is its shear strength $V_c$?
b. What is its maximum shear capacity $V_n$ permitted by ACI 318?
c. What maximum $V_u$ should be used to design for the shear demand in this segment? Assume the reaction point corresponds to the face of support.
d. What shear strength $V_s$ is required to design for the maximum shear demand?
e. What stirrup spacing is required to provide adequate shear capacity for the maximum shear demand? Assume a stirrup with two vertical legs and bar size as show in cross section.
f. What is the maximum permitted stirrup spacing that corresponds to the shear at point B assuming $V_n \geq V_u/\phi$?
g. At what magnitude of $V_u$ could the stirrup spacing be reduced to the maximum permitted spacing?

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Problem 2
Using the same beam as in Problem 1 and given the following:
Reinforcing for top of beam in tension = seven #6 bars
Reinforcing for bottom of beam in tension = three #8 bars
Ignore the effects of compression reinforcement when determining nominal moment capacity $M_n$.

a. What is $B_1$?
b. What is the area of steel $A_s$- for negative bending?
c. What is the area of steel $A_{s+}$ for positive bending?
d. What nominal moment capacity $M_n$- does the beam have for top in tension (negative bending)?
e. What nominal moment capacity $M_{n+}$ does the beam have for bottom in tension (positive bending)?
f. What minimum area of steel $A_s$- for top in tension (negative moment) is required by ACI 318, irrespective of the applied moment? Does the beam satisfy this requirement?
g. What maximum area of steel is $A_s$- for top in tension (negative moment) permitted by ACI 318, irrespective of the applied moment? Does the beam satisfy this requirement.
h. What is the strain in the top reinforcement assuming the beam is loaded to its nominal moment capacity $M_n$-?
i. What phi factor ($\phi$) should be used for this strain?
j. What area of top steel is required to support just the dead load of the beam at point C? Use the moment at point C for the demand.