UC Berkeley
CE 123 – Fall 2017
Instructor: Alan Kren Name:_____

CE 123 - Reinforced Concrete

Midterm Examination No. 2

Instructions:

- Read these instructions. Do not turn the exam over 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 318-2011 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	33.3	_____
Problem 2	33.3	_____
Problem 3	33.3	_____
TOTAL	100	_____

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Problem 1

Refer to the attached building plan and load table (note loads are already summed).

a. What is the tributary width to the beam.
a. What is w_{dead} to a typical interior beam?
b. What is w_{live} to a typical interior beam?
c. What load factors are used for combined dead plus live load?
d. What is the factored dead load, w_{udead}, to a typical interior beam?
e. What is the factored live load, w_{ulive}, to a typical interior beam?
f. What is the nominal length, l_n, of a typical interior beam?
g. Can moment and shear coefficients be used to design a typical interior beam? Why or why not?

For the following parts of problem 1, assumed w_{udead} = 3.5 kip/foot and w_{ulive} = 2.5 kip/foot.

h. Assuming moment and shear coefficients can be used, draw the moment envelope for the first three bays (one span between girders is a bay) for the first beam east of Line B. Note the moment coefficients on the moment diagram. (Note that the beam frames into a spandrel (same as a edge girder or edge beam), not a column.)
i. On a second moment diagram, note the moment values to the corresponding locations on the diagram.
j. Again, assuming moment and shear coefficients can be used, draw the shear envelope for the first three spans. Note the shear coefficients on the diagram. For the first span, assume that just plotting the shear diagram from the values using the shear coefficients will result in the correct shear envelope. For the interior spans, consider the effects of partial live load on the span.
k. On a second shear diagram, note the shears values to their corresponding locations on the diagram.

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Problem 1 Load Table

DEAD LOAD - psf						
	Member					
Load	Slab	Beam	Girder	Column	Seismic	Remark
Tile on grout	15	15	15	15	15	
Wood Ceilings	10	10	10	10	10	
Lights	1	1	1	1	1	
MEP	10	10	10	9	7	Reduced for col & seismic
Miscellaneous	4	4	4	3	2	Reduced for col & seismic
Tile on grout	15	15	15	15	15	
Slab	75	75	75	75	75	
Beam		20	20	20	20	
Girder			12	12	12	
Column				10	10	
SUM	130	150	162	170	167	
Live load - psf						
Live	50	50	50	50	na	none
Partition	20	20	20	20	na	Incl in seismic
SUM	70	70	70	70	0	
Seismic load						
Partition					10	
SUM					177	

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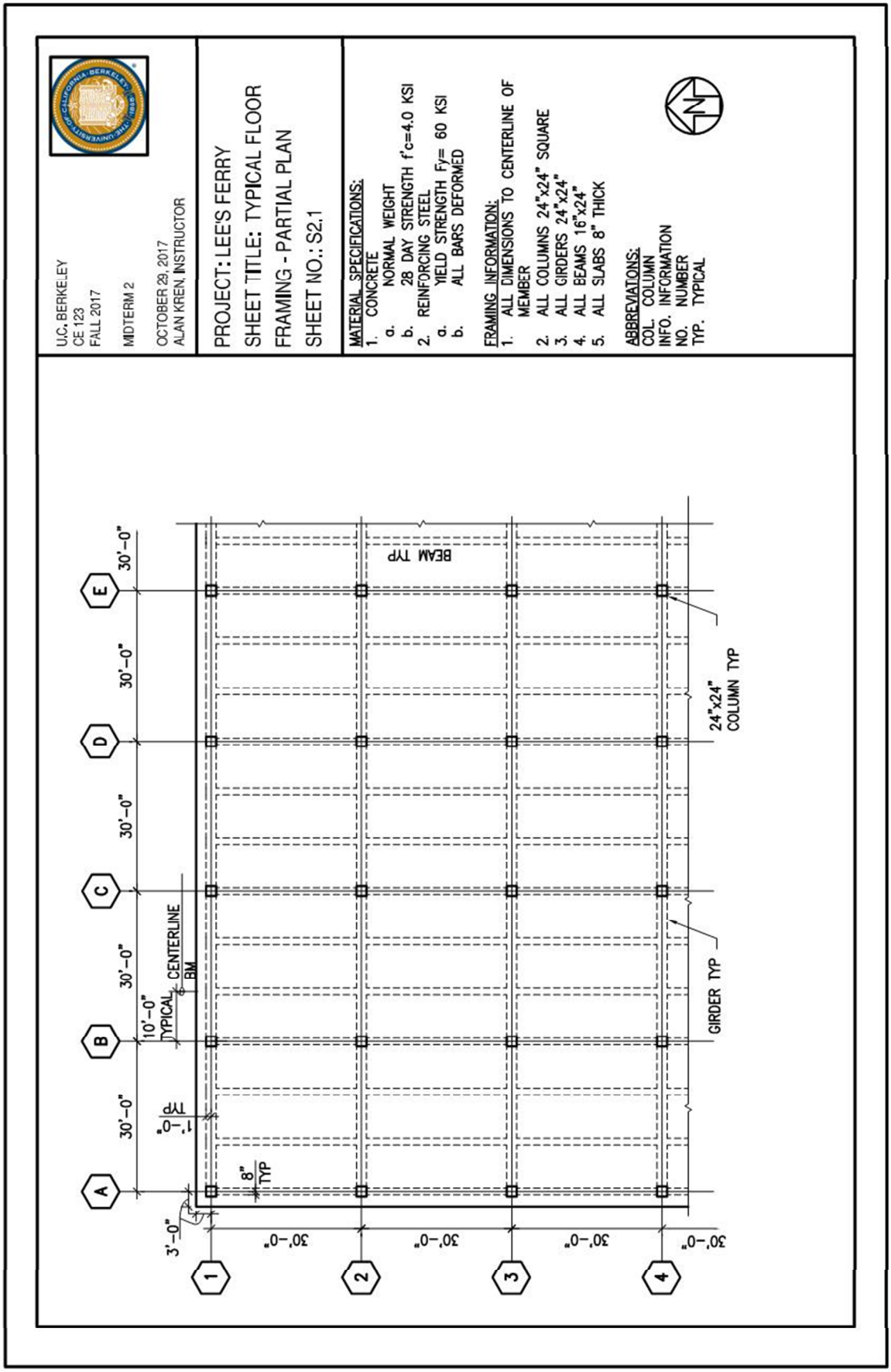

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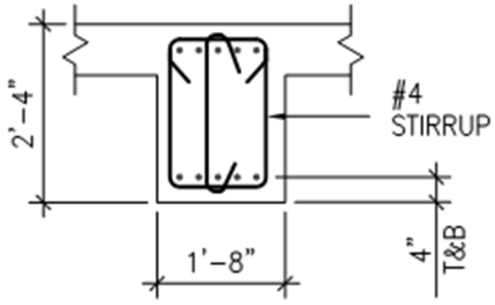
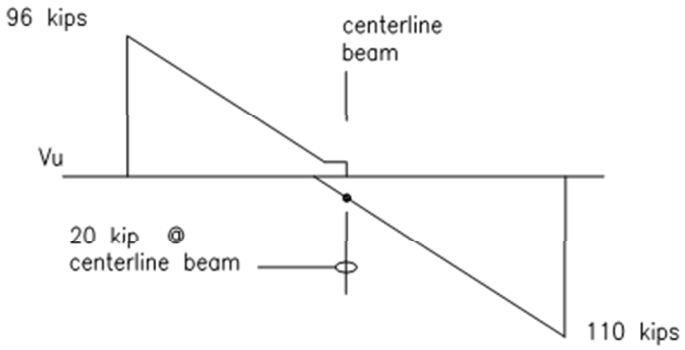
Problem 2

A beam section and a shear diagram are shown below. The beam span, l_n, is 32' The shear diagram is for the first interior bay of a multi-bay building, and values of shear were determined using shear coefficients. Consideration for live load on only ½ of the length of the beam span is also include in the shear diagram.

The factored dead and live load to the beam are the same as noted in Problem 1, i.e, w_{udead} = 3.5 k/f and w_{ulive} = 2.5 k/f.

f'_c = 4.0 ksi, fy = 60 ksi.





a. What is b_w?
b. What is d?
c. What is V_c of the section?
d. What is ϕ for shear?
e. Considering the shear diagram, what is the greatest value of shear, V_u, do you need to design for?
f. Indicate where the greatest value of shear, $V_{u,}$ occurs on the shear diagram and provide a dimension to it from and identifiable point on the diagram.
g. Assume that V_u = 155 kips, what V_s is required, if any?
h. How many legs does the stirrup have?
i. What is A_v?
j. Assume that $V_u/\phi - V_c = V_s$ = 100 kips, what maximum stirrup spacing is required for strength?
k. What stirrup spacing is required to meet maximum permitted spacing per ACI 318-14 §9.7.6.2.2?
l. What stirrup spacing is required to meet maximum permitted spacing per ACI 318-14 §9.6.3.3?
m. Considering the above, what is the maximum permitted stirrup spacing, round down to the nearest inch?
n. What is the magnitude of the shear due to live load on just ½ the length of the beam span.

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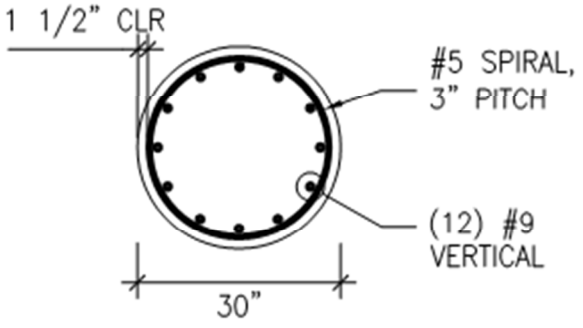
Problem 3

A 30" diameter circular column is reinforced with (12) #9 bars and has #5 spirals (5/8" diameter) at a 3" pitch (s=3")

f'_c = 4.0 ksi, fy verticals = 60 ksi, fy spiral = 60 ksi

a. What is the diameter of the core, d_c?
b. What is the equation for the volumetric ratio, p_s, of a spiral in a column?
c. What is the volumetric ratio of the column?
d. Does the spiral satisfy the requirements for p_s per ACI 318-14 §25.7.3.3?
e. What value α can be used to calculate the upper limit column's pure axial strength, $\alpha\varphi P_{0,}$ and why?
f. What is A_s of the column?
g. What is P_0 (i.e. pure compression)?
h. What is the value ϕ that corresponds to this value on the P_n-M_n interaction diagram?
i. What is the value α that corresponds to this value on the P_n-M_n interaction diagram?
j. What is T_0 (i.e. pure tension)?
k. What is the value ϕ that corresponds to this value on the P_n-M_n interaction diagram?
l. Assume at ϵ_{s1} = 0.0020, P_n = 1000 kips and M_n=1250 kip-feet. What is the value ϕ that corresponds to this value on the P_n-M_n interaction diagram?
m. Assume α = 0.85 (it may or may not, do not use this assumption in your answer to part e). Can the column support imposed loads of P_u = 1000 kips and M_u = 300 kip-feet? Construct a rough interaction diagram using the information asked above to demonstrate your answer.
n. If the spiral pitch (i.e. spacing, "s") were reduced to 6", what would the appropriate values of α φ be and why?



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