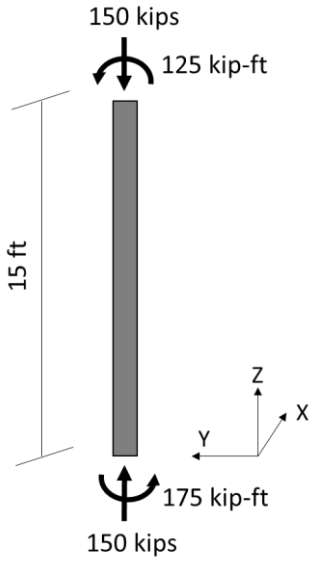
A 15’ column is in an upper story of a frame that is sideway inhibited in both directions. The controlling factored load combination is shown below with seismic causing bending about the X-axis. There is no moment about the Y-axis.

1) You should do this problem with *either* steel *or* concrete. Do not do both! Circle the material you will use here.

2) List the design checks that are necessary for this column.

3) Concrete: Design a cross section for this column including longitudinal and transverse rebar. Use $f'_c = 4$ ksi for the concrete and $F_y = 60$ ksi for the rebar. Show work.
   Steel: Select an appropriate W cross section with A992 steel. Show work.

4) The column must be spliced in this story, but you intend to use the same column section above and below the splice. (a) Show where on the elevation of the column you will locate the splice and describe why you would locate it there. (b) Draw a comprehensive sketch of the splice, labeling important details. No calculations are necessary.



UC Berkeley | Preliminary Exam
Civil and Environmental Engineering | **Structural Design** | Fall 2019
SEMM

A two-story building is to be constructed. In the N-S direction, the lateral load resisting system consists of concrete shear walls (R = 6). In the E-W direction, the lateral load resisting system consists of concentrically braced frames (R = 6). Assume the lateral systems are **fixed** at the base. The loads (including the structural frame) are:
2nd floor: Dead load of 65 psf; Live load of 50 psf
Roof: Dead load of 60 psf; Live load 30 psf
Cladding: 20 psf (Dead)

The earthquake design response spectrum parameters for the location, already including site amplification factors, are: S_{DS} = 1.5 g, S_{D1} = 0.6 g. You can estimate period with $T = 0.02\ h^{0.75}$

(a) You are responsible for the design of *either* the concrete shear walls *or* steel braced frames. Underline the system you will design. Note: you are *not* expected to design any component of the gravity frame.

(b) For the system of your choice, what are the deformation-controlled action(s) and force-controlled action(s)?

(c) Outline all the steps and checks you would make in designing your system in the order in which you would complete them.

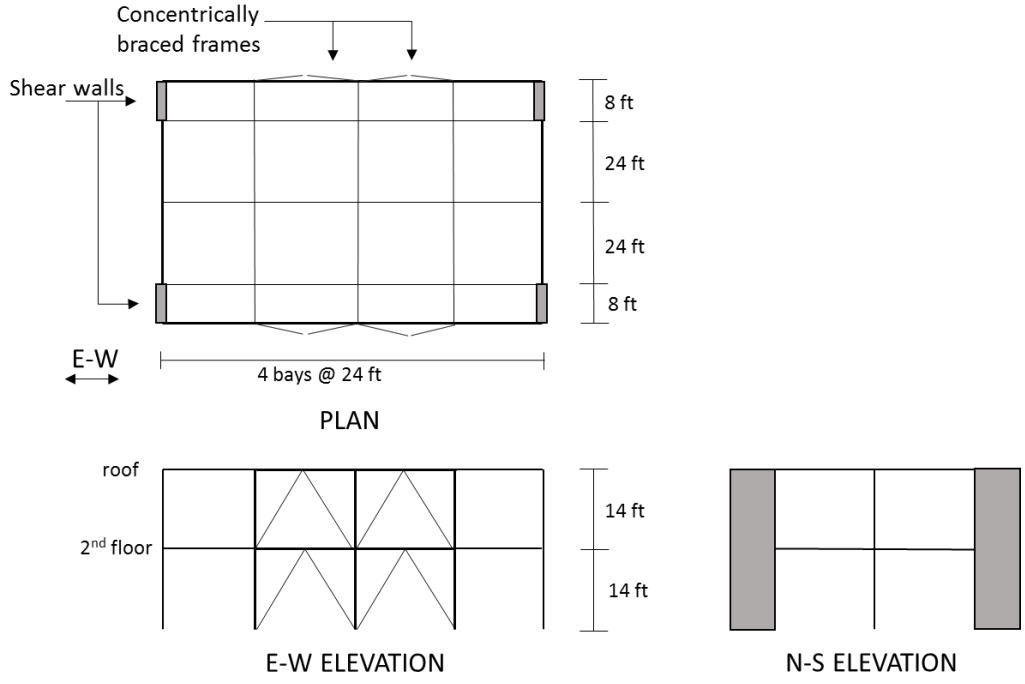
(d) Determine the external forces on your lateral system.

(e) Compete only one of the following:

For the concrete shear walls: for ONE wall, design the thickness of the wall and all necessary reinforcement. Show the design in a neat sketch. You do not need to design anchorage reinforcement.

For the steel concentrically braced frame: (i) Select square HSS braces for each floor. Use nominal dimensions for calculations and the Euler buckling load in lieu of the code formulae. (ii) What are the range of design forces on the columns of the braced frame?

Clearly label all steps and state all assumptions made.



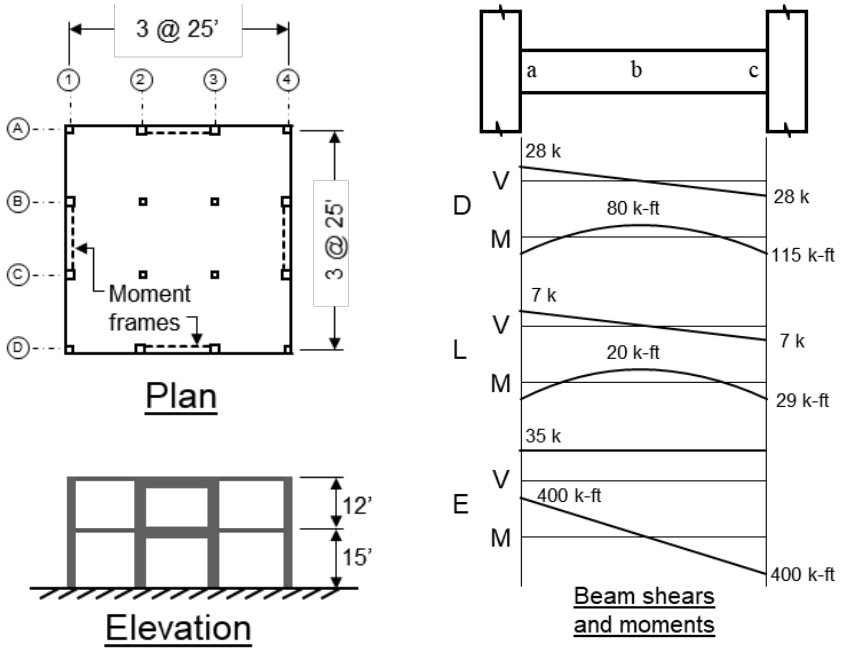
University of California, Berkeley
Fall Semester 2018

Civil and Environmental Engineering
Structural Engineering, Mechanics, and Materials

NAME:_____

Preliminary Exam - Structural Design

A small building is located in downtown Berkeley. The structural system, either structural steel or reinforced concrete, comprises gravity framing plus one-bay moment frames located around the perimeter of the building. The sketch to the right shows moments and shears for the first-story beams, calculated using linear elastic methods under code-specified loads D (dead), L (live), and E (earthquake). Load E has been reduced by coefficient R as permitted for seismic design.



(a) In this sentence, underline either *structural concrete* or *structural steel* to indicate the material you will use for your design.

NAME:_____

(b) Make a bullet list describing the steps you would follow to design the beams in the first elevated level above the base. Use as many bullets as needed. Be brief rather than wordy.

-
-

NAME:_____

(c) Design the beam from the face of the joint to one beam depth from the face. Whether a steel beam or a concrete beam, make sure the beam cross section is symmetric. Show beam size, important details, etc.

NAME:_____

(d) Make a bullet list describing in some detail the steps you would follow to design the beam-column joint in the first elevated level above the base. Use as many bullets as needed. As a final bullet, make a sketch of the joint. You need not calculate quantities, but show typical required details.

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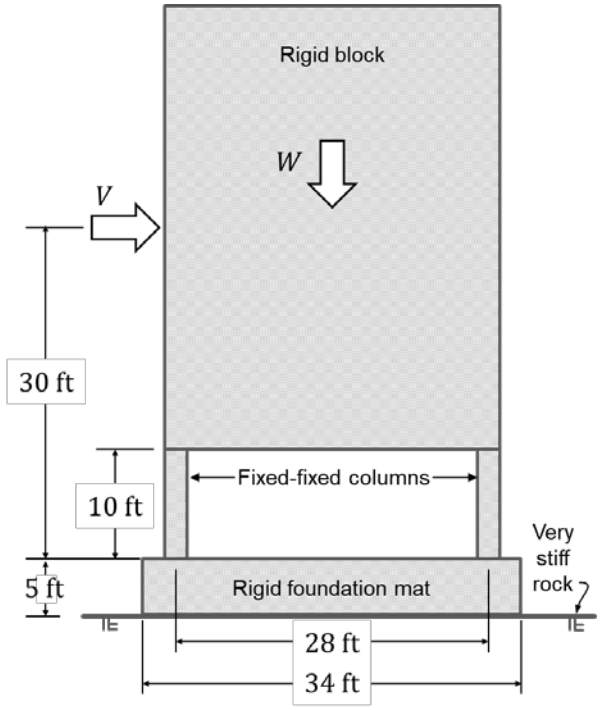
University of California, Berkeley
Spring Semester 2018

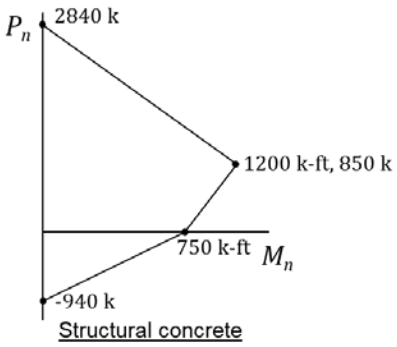
Civil and Environmental Engineering
Structural Engineering, Mechanics, and Materials

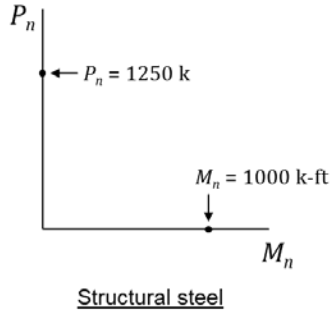
NAME:_____

Preliminary Exam - Structural Design

A rigid block is supported on four columns laid out on a 28 ft by 28 ft grid. The columns are supported on a rigid foundation on a very stiff rock. The columns are fixed against rotation at both ends. Weight W comprises 1400 kips service dead load and 400 kips service live load. You may otherwise ignore self-weight. Total design lateral load V is 400 kips, which was calculated from the design earthquake loading using ASCE 7 including permissible force reduction factor R/I_e. For this problem, assume the load V acts in one horizontal direction and ignore loading in the orthogonal horizontal direction and the vertical direction. The columns can be either structural concrete or structural steel. If concrete, use f_c' = 4000 psi and Grade 60 steel, and assume the column has square cross section. If steel, use A36 steel. An engineer has completed preliminary designs for both steel and concrete, with the resulting nominal strengths shown.







(a) In this sentence, underline either *structural concrete* or *structural steel* to indicate the material you will use for your design.

(b) Calculate the shear force, moment, and axial force in each column due to the lateral force V.

(c) Use the LRFD method to assess whether the column moment design is sufficient for the specified loads. You may ignore second-order effects.

(d) Describe how you would use engineering software to determine whether the structure was likely to uplift during a strong earthquake. Be specific about what load combinations and member properties you would use.

(e) Conduct an approximate hand analysis to estimate whether overturning is likely.