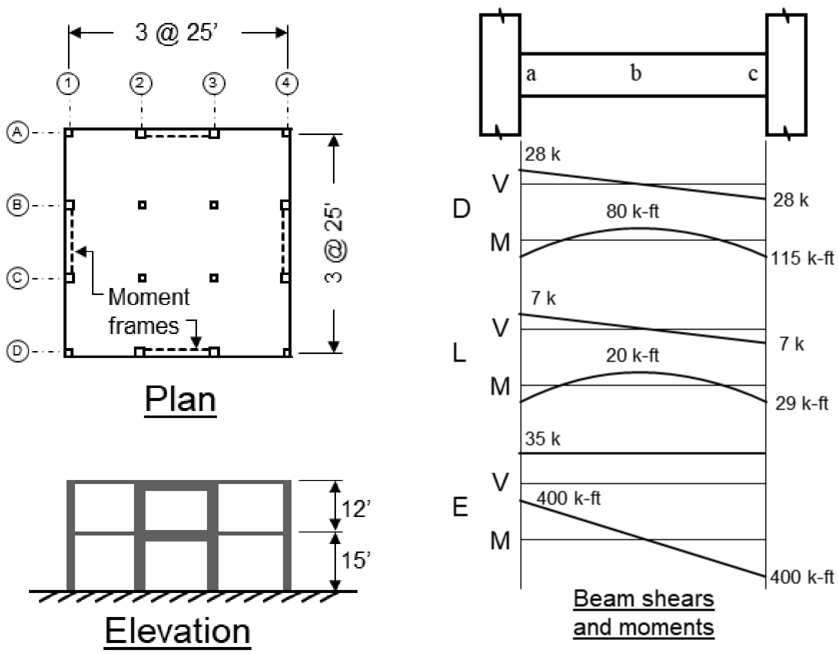
University of California, Berkeley
Fall Semester 2018

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.

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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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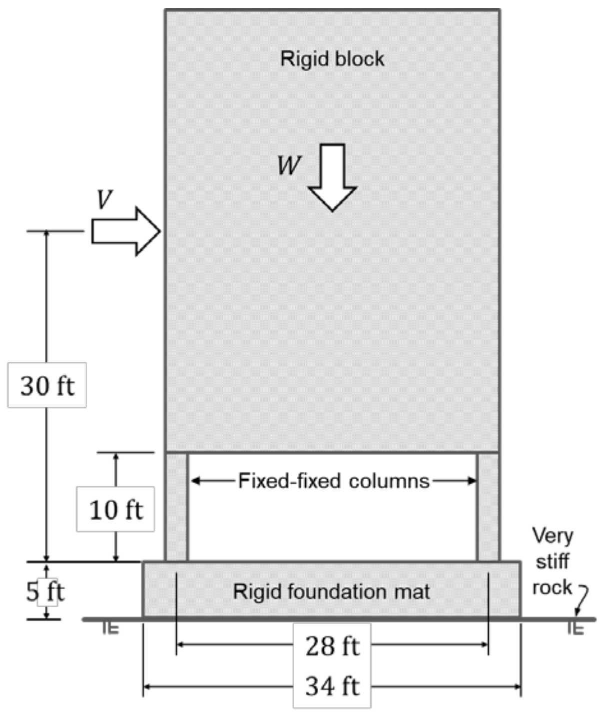
University of California, Berkeley
Spring Semester 2018

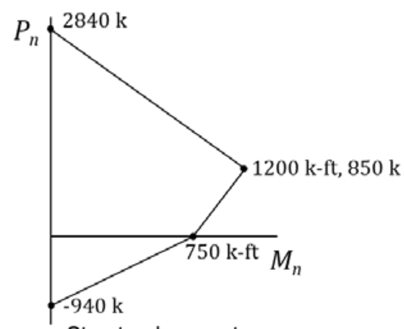
Civil and Environmental Engineering
Structural Engineering, Mechanics, and Materials

NAME:________________________________

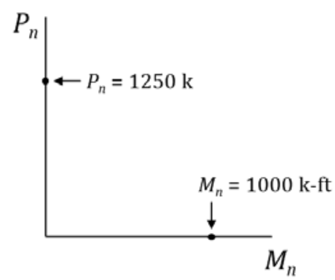
Preliminary Exam - Structural Design

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.





Structural concrete



Structural steel

(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.

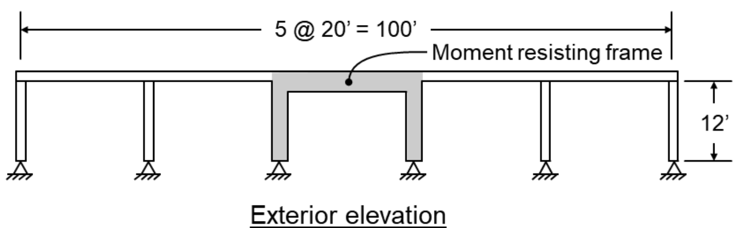
University of California, Berkeley
Fall Semester 2017

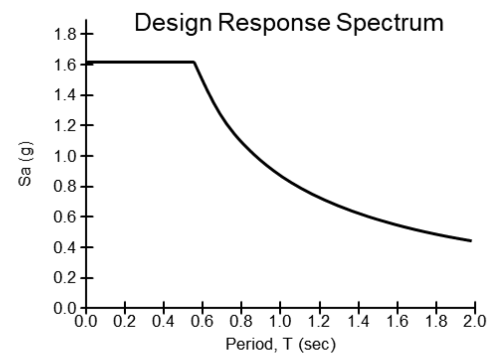
Civil and Environmental Engineering
Structural Engineering, Mechanics, and Materials

NAME:________________________________

Preliminary Exam - Structural Design

A small office building with square floor plan is braced by single-bay moment frames located around the building perimeter, with one moment frame per side. A typical elevation is shown. The remainder of the framing is of reinforced concrete flat-plate framing supported on columns, and can be classified as gravity framing not designated as part of the seismic-force-resisting system. Service loads comprise self-weight, which can be taken as 100 psf acting on the floor area, plus 50 psf live load. The building is located in a region of high seismicity. The design earthquake response spectrum is shown. Note that the design earthquake response spectrum represents elastic response of a single-degree-of-freedom oscillator with 5% of critical damping subjected to ground shaking with approximately 475-year return period.





(a) Determine the design base shear for the building along one of its principal axes.

(b) Determine the design moment for a moment frame beam at the face of the column.

(c) Size the beam for required moment strength using an accepted design method, with either reinforced concrete or structural steel.

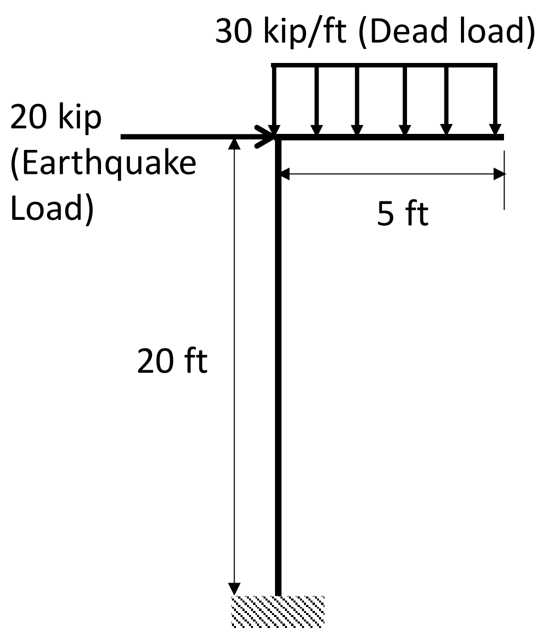
(d) Given the selected beam size, estimate the maximum axial tension that might reasonably occur at one of the pin supports supporting the moment resisting frame.

UNIVERSITY OF CALIFORNIA, BERKELEY — Dept. of Civil and Environmental Engineering
Spring Semester 2017 — Structural Engineering, Mechanics and Materials

Ph.D. Preliminary Examination: Design

Consider the frame shown below subjected to dead load and earthquake loading. Ignore the self-weight and select your material (steel or reinforced concrete) as you prefer making use of the information given below. All loads are unfactored. Use factored load combinations in your design. According to your chosen material, design the column either as a R/C column or a steel column. For the concrete case use a reinforced concrete square section. For the steel case, use a box section. The beam design is not part of this problem. You do not need to consider buckling in the column design. Justify any assumptions you may make.

After designing the column, compute the horizontal deflection at the column under the given unfactored (service) forces assume *linear elastic response* in your calculation. The horizontal deflection should be limited to 1/1000 of the column height because of the presence of important drift-sensitive nonstructural components. If the calculated deflection is larger than this limit, comment (without calculations) on how the deflection can be reduced.



STEEL	CONCRETE
Steel: Fy=36 ksi, Fu=58 ksi	Steel rebars: Fy=60 ksi; Concrete: f'c=4,000 psi

Student's Name (Please Print) ___________________________________

University of California at Berkeley
Department of Civil and Environmental Engineering

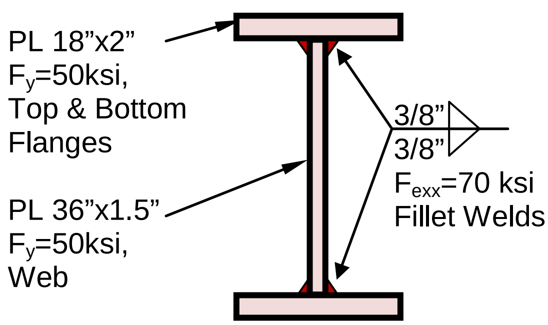
FALL 2016
SEMM

Doctoral Preliminary Examination: Design

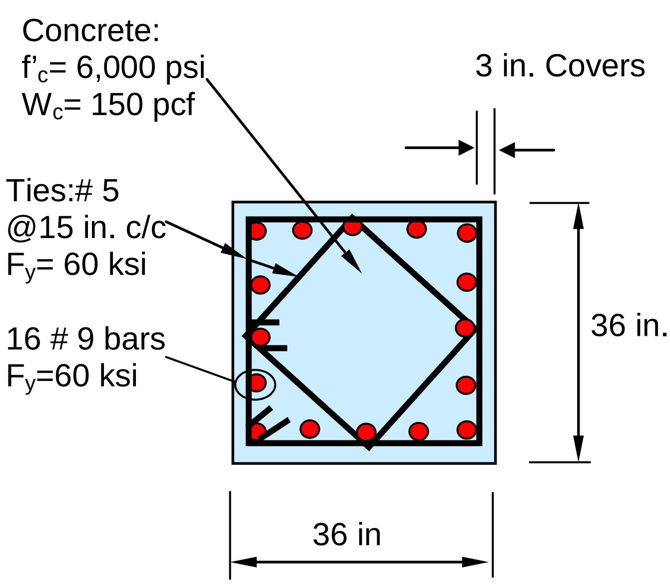
Important Note: All the information you need to do the problem below is provided. If you need any information that is not provided, you need to use a value and explain your reason for using the value. No questions can be asked during the exam.

a. Consider all failure modes of the R/C column and steel girder and calculate the maximum factored load P_u for the structure shown.

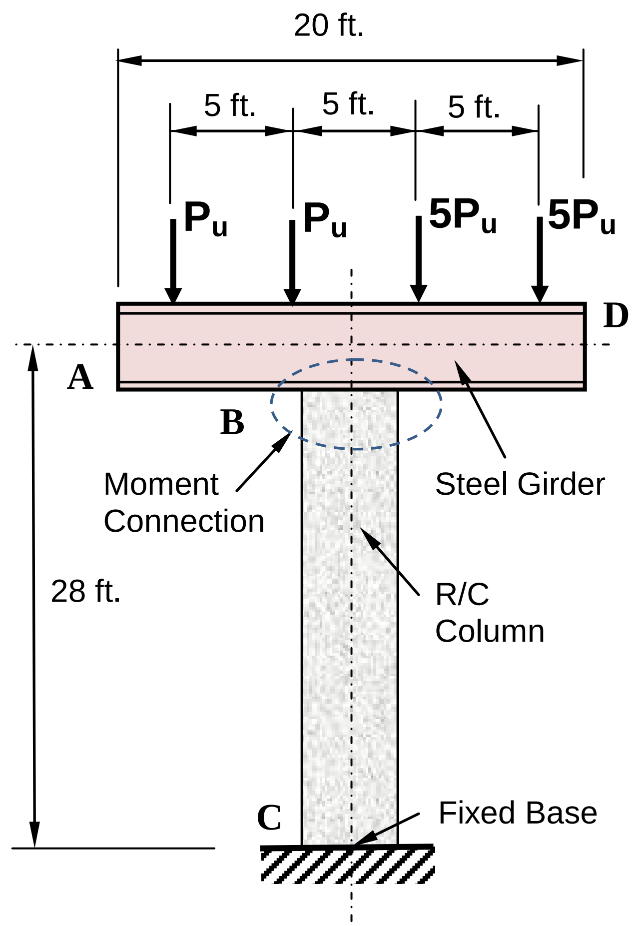
b. Using the value of the P_u calculated in part "a" design the moment connection at B between the steel girder and the R/C column. Show the calculations and detail of the connection on a neat sketch.



CROSS SECTION OF THE STEEL GIRDER



CROSS SECTION OF THE R/C COLUMN



THE STRUCTURE

University of California, Berkeley
Department of Civil and Environmental Engineering
Structural Engineering, Mechanics and Materials

PRELIMINARY EXAMINATIONS- FALL 2015

DESIGN Question

Consider the propped shear wall shown in the figure. The wall is subjected to earthquake lateral forces (E) as shown. The Dead Load (DL) and Live Load (LL) of each floor supported by the shear wall are also given. All loads given (i.e. E, DL and LL) are service loads (not factored).

You are required to do <u>only</u> the following:

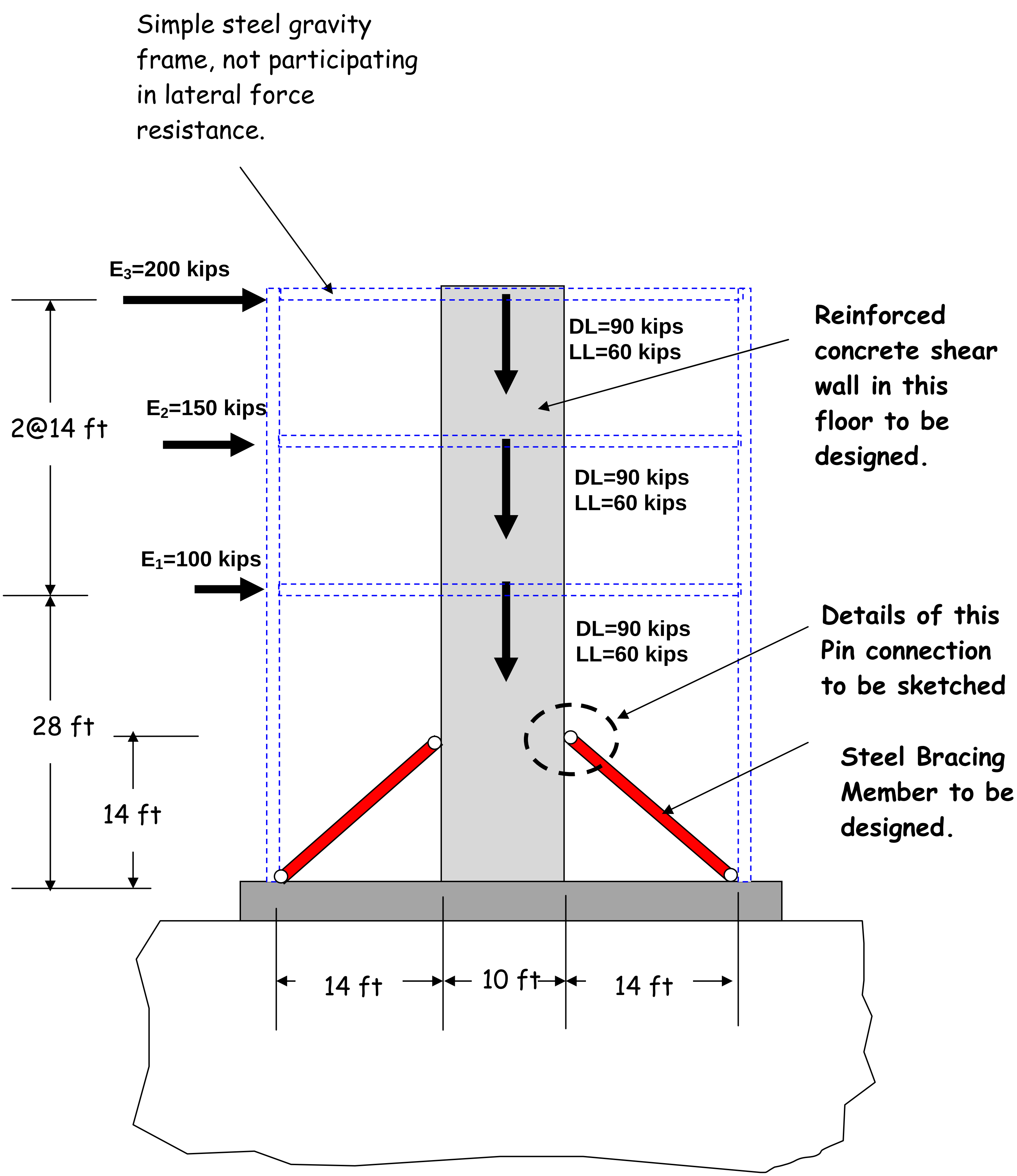
1. Design the necessary thickness of the reinforced concrete shear wall as well as all the necessary reinforcement for this wall to resist the applied loads. Make reasonable assumptions about all parameters of design, and material properties and explain all your assumptions and why you made those assumptions.

2. Design the steel pipe bracing (both braces will have the same pipe section). Both ends of the braces are pin-connected to the concrete wall and concrete foundation. Again make all assumptions you need in your design and explain the basis for your assumptions.

3. Draw a clear sketch showing the details of the pin connection of the steel tube bracing to the reinforced concrete shear wall.

4. List failure modes of the pin-connection in Item 3 above that you would check if you had enough time to do the actual design of the pin connection.

All of the information you need for this problem are given. Still, if you feel you need a piece of information that is not given, make a reasonable assumption and continue the problem. No questions can be asked during the exam. You can use approximate equations if you do not remember the exact equations, but, you have to explain the approximation and how that approximation might affect your design. A portion of the grade will be assigned to how reasonable your assumptions were and how well you have explained the justification of your assumptions.


Simple steel gravity frame, not participating in lateral force resistance.
E3=200 kips
E2=150 kips
E1=100 kips
2@14 ft
28 ft
14 ft
DL=90 kips
LL=60 kips
DL=90 kips
LL=60 kips
DL=90 kips
LL=60 kips
Reinforced concrete shear wall in this floor to be designed.
Details of this Pin connection to be sketched
Steel Bracing Member to be designed.
14 ft
10 ft
14 ft

Student's Name (Please Print) (Last:) ______________________________(First:)__________________

Structural Engineering Mechanics and Materials
Department of Civil and Environmental Engineering, University of California at Berkeley
Spring Semester 2015

Preliminary Examination- Design Question

<u>Important Note:</u> All the information needed to do this problem are given below. If you still think there is an item that you need and is not given, or an equation that you need to use but do not remember, please make an assumption, explain your assumption and use your assumed value or equation and continue your solution. No questions can be asked or answered during this exam.

Problem:

Consider the gable frame shown below subjected to gravity, wind and crane loads. Ignore the self weight and select your material as you see fit and explain why you selected a particular steel or concrete material. All loads are unfactored loads. Use factored load combinations in your design.

Design the Column AB as a R/C column. Beam design is not part of this problem. For concrete case use a reinforced concrete square section. Then design the column as a steel box column. For steel case use a welded square steel box section made of four plates with the same thickness.