CE243A - DESIGN AND RESPONSE OF RC STRUCTURAL SYSTEMS
Problem Set #5: Frame Design and Detailing
Due: 17 Nov. 2004

Analysis results for gravity and earthquake loading of an interior column and beam of a building frame are given below. Use f'_c = 4000 psi and f_y = 60 ksi.
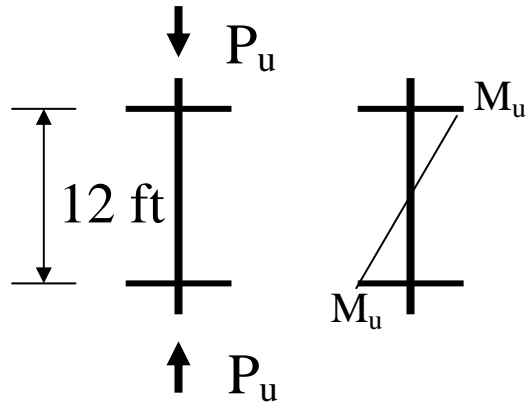
5.1 Determine the moment and shear envelops for the ACI 318-02 load combinations (S9.2). Assume all loads given below are unfactored. For gravity loads, use values from ACI 318 S8.3 for a typical interior span (e.g., see MacGregor, Appendix A or similar reference).

5.2 Design an economical beam section for the given loads. Assume a 10 inch thick slab and that #5 @ 9 in. on center are used for negative slab reinforcement within the column strip. Assume slab bottom reinforcement is not continuous at the beam ends. Check flexural and shear strength requirements.

5.3 Verify that development length requirements are satisfied for the beam using appropriate provisions in Chapter 12 and 21 (Chapter 21 of ACI 318-02, Sections 21.1 through 21.3). Indicate results with a sketch (with cross section and elevation views) of the beam with dimensions and notes. For anchorage, plot the $\phi M_n(x) > M_u$ to verify that your beam has sufficient moment strength to avoid yielding along the beam span. Do not terminate (cut) any flexural reinforcement within a tension region (extend all reinforcement beyond inflection points).

5.4 Design an economical column section for the given loading using ACI 318-02 requirements. Check flexure and shear requirements, as well as requirements for confinement (Chapter 21, Sections 21.1 through 21.4). Ensure that your column satisfies the strong-column, weak-beam requirements in ACI 318-02 Section 21.4.2.2. Indicate results on a sketch (with cross section and elevation views) of the column with dimensions and notes.

Beam Gravity Loads: w_{DL} = 2 k/ft   (unfactored)
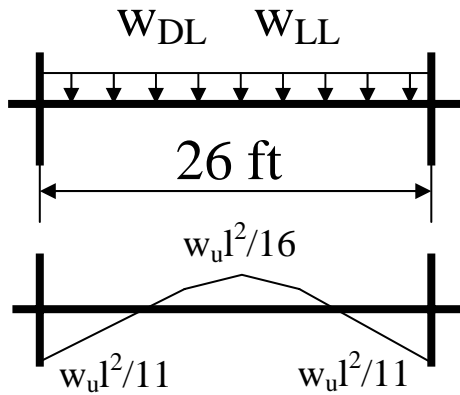**w_{LL} = 1 k/ft   (unfactored)**

Column Gravity Loads: P_{DL} = 600 k   (unfactored)
P_{LL} = 200 k   (unfactored)

Earthquake Beam Moments: M_{eq} = 500 ft-kips (unfactored)
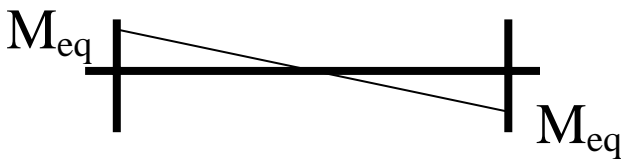
Beam & Column geometry and loading (2D frame):

$\downarrow P_u$

12 ft

M_u

M_u

$\uparrow P_u$

Column loading

w_{DL} w_{LL}

26 ft

Beam loading

$w_u l^2/16$

$w_u l^2/11$ $w_u l^2/11$

M_{eq}

M_{eq}

Gravity moment coeff. (ACI S8.3, interior span)

Earthquake moments (+/-) unfactored