

## ARCH 331. Assignment #7

**Date:** 10/10/13, due 10/17/13

*Pass-fail work*

**Problems:** supplemental problems (7A, etc.) **and** from Onouye Chapters 4 & 5

*Notes: Problems marked with a \* have been altered with respect to the problem stated in the text.*

- (6%) 7A) A reinforced concrete slab is 6 in. thick. If the density is  $150 \text{ lb/ft}^3$ , determine the weight per unit area in  $\text{lb/ft}^2$  and in  $\text{kN/m}^2$ . (un-dimensioned figure). (*dimensional analysis & conversions*)

*Partial answer to check with:  $3.59 \text{ kN/m}^2$*

- (12%) 7B) The compressive force in a column to each service (unfactored) load are:  $D = 465 \text{ kN}$ ,  $L = 290 \text{ kN}$ ,  $L_r = 65 \text{ kN}$ ,  $W = 110 \text{ kN}$ ,  $E = 245 \text{ kN}$ . The wind load can also result in a tensile force. Determine the design load for the column based on LRFD using ASCE-7 load combinations (see Note Set 13.6) (*load factors*)

*Partial answer to check with:  $\max\{651, 1054.5, (952 \text{ or } 717, 607), (990.5 \text{ or } 770.5), 1093, (528.5 \text{ or } 308.5), 663.5\} \text{ kN}$ .*

- (12%) 7C) Roof beams that weigh  $50 \text{ lb/ft}$  and are spaced at  $10'$  center to center support an additional dead load of  $30 \text{ lb/ft}^2$ . Code specified roof loads are  $35 \text{ lb/ft}^2$  downward (due to roof live load, snow or rain) and  $25 \text{ lb/ft}^2$  upward or downward (due to wind). Determine the critical loading for LRFD using ASCE-7 load combinations (see Note Set 13.6).

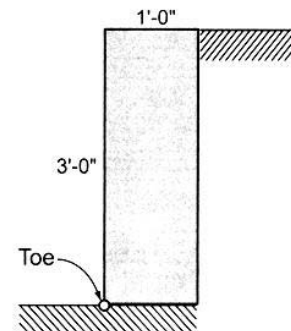
*(load tracing and load factors)*

*Partial answer to check with:  $\max\{490, 595, (1105 \text{ or } 855), (845 \text{ or } 345), 490, (565 \text{ or } 65), 315\} \text{ lb/ft}$ .*

- (20%) \*4.4.1 A gravity retaining wall as shown is subjected to a lateral soil pressure as a result of an equivalent fluid density of  $35 \text{ pcf}$ . Calculate the resultant horizontal force due to pressure against the wall and the wall's factor of safety against overturning. Assume that concrete has a density of  $150 \text{ pcf}$ . Check the bearing pressure under the footing. Assume the allowable bearing pressure is  $3000 \text{ psf}$ . Also check for factor of safety against sliding if the friction coefficient is  $0.62$ .

*(retaining wall behavior)*

*Partial answer to check with:  $SF_{over} = 1.43$ ,  $SF_{slide} = 1.77$ ,  $p_{max} = 2000 \text{ lb/ft}^2$  (under footing)*



Problem 4.4.1

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**with load values**

(20%) \*5.1.4. Draw FBDs and show load conditions for B-1, G-1, and the interior column. **and**

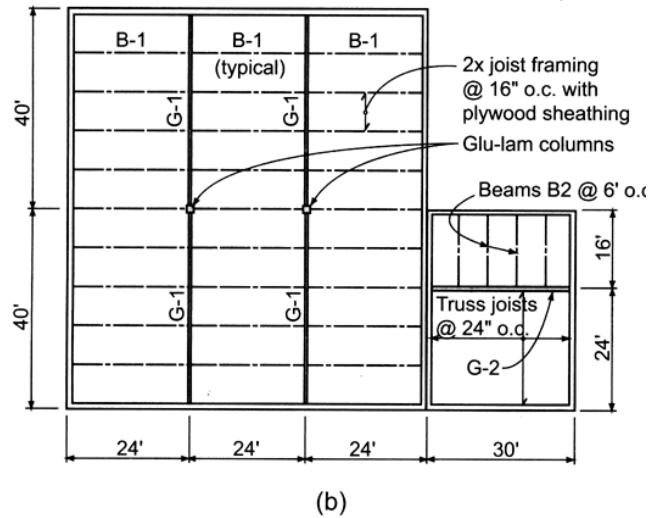
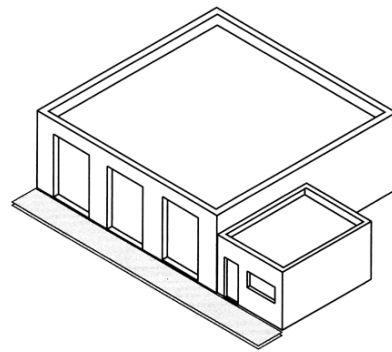
5.1.5. Using the building shown in Problem 5.1.4, draw the FBDs for beam B-2 and girder G-2. Beam B-2 is spaced at 6'-0" o.c. **Find all support reactions.** (load tracing)

**Loads:**

- Snow = 25 psf
- Roofing and decking = 10 psf
- Truss joists = 3 psf
- Insulation, mech., and elect. = 5 psf
- Beam B-2 = 12 pounds per lineal foot
- Girder G-2 = 40 plf.
- Beams B-1 = 15 lb./ft.
- Girders G-1 = 50 lb./ft.

*Partial answer to check with:*

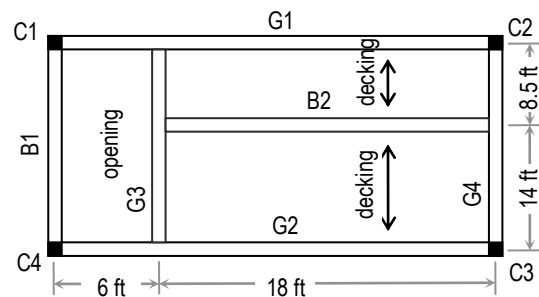
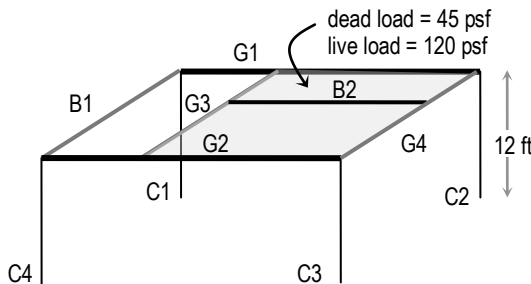
- B-1:  $w = 335 \text{ lb/ft}$ , reaction = 4020 lb
- G-1: 4 loads of 8040 lb and  $w (50 \text{ lb/ft})$ , reaction = 17.08 k; column: 2 girder and 2 beam reactions = 42.2 k
- B-2:  $w = 252 \text{ lb/ft}$ , reaction = 2016 lb
- G-2: 4 loads of 2016 and  $w = 556 \text{ lb}$ , reaction = 12,372 lb (note: the truss joist load is in  $\text{lb/ft}^2$  and acts on G-2)



Problem 5.1.4 (a) Warehouse/office building. (b) Roof framing plan. (c) Roof framing—typical section.

(25%) 7D) The floor framing plan is subject to uniform distributed loads of: dead load = 45 psf, live load = 120 psf. Determine the resulting reactions by the beams & load on the columns. (load tracing)

*Partial answer to check with:*  $R_{B2} = 16706.25 \text{ lb}$ ,  $R_{G3@G1} = 10395 \text{ lb}$ ,  $R_{G1@C1} = 12529.7 \text{ lb}$ ,  $P_{onC2} = 20,882.8 \text{ lb}$ .



(5%) 7E) For the frame of problem 7D, use Multiframe software to find the column loads to verify your work from load tracing by constructing a 3D model (View 3D). Use the standard steel section you have been assigned which is posted in My Grades on eCampus. Submit the data file (.mfd) on eCampus (under Assignments: Assignment 7) and provide a print of the bending moment (M) and axial force (P) diagrams. Be careful to make joints on all the girders at the location of beam supports. Model the column bases as fixed. **Do not use panels**, but put on linearly distributed loads on **G1, B2 and G2 only**. Model the beam ends with *rotational releases* using the member restraint menu and release (check) the major moment resistance,  $M_z$ , for each end.