ARCH 631. Assignment #2

Date: 1/18/18, *due 2/1/18* *Worth 25 pts.*

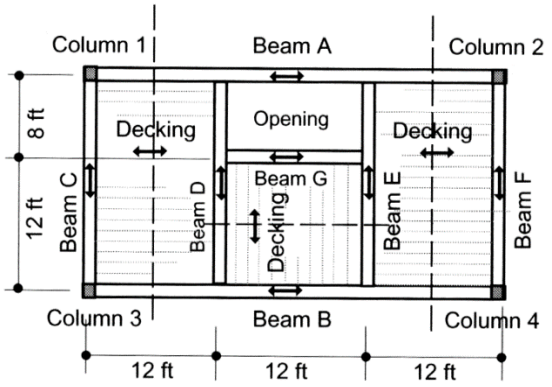
Problems:

1. Complete text problem 3.6 on page 120 but change the area loading to 75 lb/ft^2.

3.6 Determine the reactions to Beam D in Figure 3.22 Assume that the average dead and live load is ~~60 lbs/ft^2.~~ 75 lbs/ft^2.

Answers: ~~4896 lb., 4464 lb.~~ 6120 lb., 5580 lb.

Figure 3.22



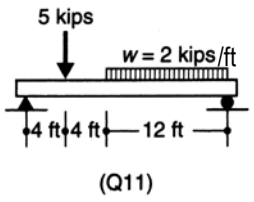
2. What is the maximum bending moment in Beam D of Figure 3.22 for the load given in Problem 1.

Answer: 34,560 lb-ft

3. Complete text problem 2.20 on page 85.

2.20 Draw shear and moment diagrams for the beam analyzed in Question 2.11 [Figure 2.59 (Q11)].

Answer: V_{max} = 17.8 k and M_{max} = 79.2 ft-k.



(Q11)

4. Complete text problem 6.7 on page 273. *(Note: The answer for bending stress should be 957 psi, and the answer for deflection should be 0.27 in.)*

6.7 A simply supported beam 12 ft long carries a uniformly distributed load of 100 lb/ft. Assume that the beam is $1\frac{1}{2}$ in. × $9\frac{1}{2}$ in. in cross section and is laterally braced. Assume also that the beam is made of timber that has an allowable stress in bending of 1200 lb/in.^{2} and in shear of 150 lb/in.^{2} Is the beam safe with respect to bending and shear stress considerations? What is the maximum deflection of the beam? Assume that $E = 1.6 \times 10^6$ lb/in.^{2} Is this deflection acceptable?

957

Answer: $(f_b = \text{~~959~~}) < (F_b = 1200)$, ∴ safe in bending; $(f_v = 63.1) < (F_v = 150)$, ∴ safe in shear; and $\text{~~(0.29)~~} < (L/240 = 0.6)$, ∴ deflections are okay.

(0.27)

5. Complete text problem 6.8 on page 273 for ASD *only*. (See Table A.17.1 provided.)

6.8. A simply supported steel beam will be used to span 30 ft and to support a uniformly distributed live load of 400 lb/ft. Assume that the yield stress in bending is 50,000 lb/in.^{2}, and that allowable bending stress is 33,000 lb/in.^{2} Use ~~both~~ ASD ~~and LRFD~~ methods to determine the most efficient wide-flange shape to be used, based on a bending-stress analysis. ~~Assume a factor of 1.6 for live loads when using LRFD methods,~~ and use one of the shapes listed in Appendix 17. Ignore dead loads due to self weight.

***Partial** Answer*: $S_{req'd} \geq$ 16.4 in^3

6. What is the SEI/ASCE 7-10 letter designation for roof live load? Provide the factored load combinations expressions for *strength design* that it is used in.

7. What is the minimum required live load for occupancy or use of a bowling alley, a cell block in a penal institution, and an operating room of a hospital? How much area dead load from weight would you design the cell block walls for if they are to be 8 in. concrete hollow block with light aggregate?

TABLE A.17.1 Member Properties

			AXIS X-X				AXIS Y-Y				AXIS X-X
Shape	Area (in.^{2})	Web Thickness (in.)	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	Z_x (in.^{3})	I_y (in.^{4})	S_y (in.^{3})	r_y (in.)	Z_y (in.^{3})	S_x (mm^3 × 10)
W 36 × 282	82.9	0.885	19,600	1050	15.4	1,190	1200	144	3.8	223	17190
W 33 × 201	59.2	0.715	11,600	686	14	773	749	95.2	3.56	147	11231
W 30 × 99	29.1	0.520	3990	269	11.7	312	128	24.5	2.1	38.6	4404
W 27 × 102	30	0.515	3620	267	11	305	139	27.8	2.15	27.8	4371
W 14 × 90	26.5	0.440	999	143	6.14	157	362	49.9	3.7	75.6	2341
W 21 × 68	20	0.430	1480	140	8.6	160	64.7	15.7	1.8	24.4	2292
W 14 × 82	24	0.510	881	123	6.05	139	148	29.3	2.48	44.8	2014
W 14 × 74	21.8	0.450	795	112	6.04	126	134	26.6	2.48	40.5	1834
W 18 × 60	17.6	0.415	984	108	7.47	123	50.1	13.3	1.69	20.6	1768
W 16 × 50	14.7	0.380	659	81	6.68	92	37.2	10.5	1.59	16.3	1326
W 12 × 26	7.65	0.230	204	33.4	5.17	37.2	17.3	5.34	1.51	8.17	547
W 8 × 31	9.12	0.285	110	27.5	3.47	30.4	37.1	9.27	2.02	14.1	450
W 10 × 22	6.49	0.240	118	23.2	4.27	26	11.4	3.97	1.33	6.1	380
W 8 × 24	7.08	0.245	82.7	20.9	3.42	23.1	18.3	5.63	1.61	8.57	342
W 8 × 18	5.26	0.230	61.9	15.2	3.43	17	7.97	3.04	1.23	4.66	249
C 9 × 15	4.41	0.285	51	11.3	3.4	13.6	1.91	1.01	0.661	2.04	185
C 6 × 13	3.81	0.437	17.3	5.8	2.13	7.29	1.05	0.642	0.525	1.35	95

The beams in the table are arranged according to their relative S values in descending order of magnitude. The first entry in a group represents a light member and one with a relatively large section modulus. It is thus an efficient and often preferred member. W: wide-flange shape; C: channel shape; MC: miscellaneous shape; WT: structural tees cut from W shapes. Typical designation:

W 21 × 68
- 68 — weight per linear foot, lb
- 21 — nominal depth
- W — shape designation