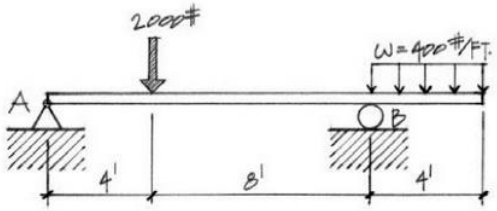
ARCH 331. Assignment #8

Date: 3/8/18, *due 3/22/18* *Pass-fail work*

Problems: supplemental problems (8A, etc.) **and** from Onouye & Kane, Chapters 8 & 9
*Notes: Problems marked with a * have been altered with respect to the problem stated in the text. Multiframe or other methods may be used for V & M diagrams and maximums **when the method is not specified**.*

supporting a floor is to be a glue-lam member.

(20%) * 8.2 The single overhang beam ~~uses a 4 × 12 S4S Douglas fir–Larch No. 1 member.~~ Determine the ~~maximum bending strength developed. Is it safely designed? (F_b = 1,300 psi)~~ most economical member to use assuming a self weight of 10 lb/ft, normal load duration (C_D = 1), tabulated stresses of F_b = 2000 psi and F_v = 250 psi, E = 1.7 x 10^6 psi. Calculated and locate the maximum deflection due *only* to the 400 lb/ft for the member found.



***Use *superpositioning* with the Beam Diagrams and Formulas to get support reactions to construct the V & M diagrams.**

(timber strength design and deflection)

Partial answer to check with: $S_{req'd} \geq 26.4$ in.^{3}, $A_{req'd} \geq 9.8$ in.^{2}, and $\Delta > 0.273$ in.

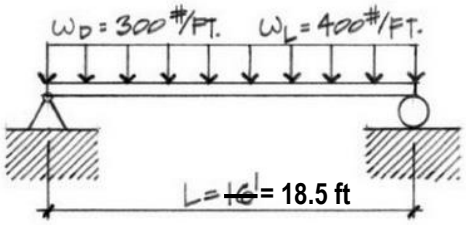
economical

(35%)* 8.22 Design a Douglas fir–Larch No. 1 beam to support the load shown. Assume a 7-day live load (construction) duration.

$F_b = 1{,}300$ psi
$F_v = 85$ psi
$E = 1.6 \times 10^6$ psi
$\Delta_{allow_{(LL)}} = L/360$

(timber beam design)

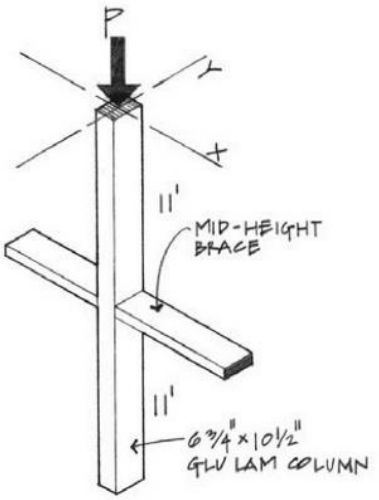
*γ = 32 lb/ft^3
*$\Delta_{allowed\ (LL+DL)} = L/240$



Partial answers to check with:
$S_{req'd} \geq 221.1$ in.^{3}, $A_{req'd} \geq 91.4$ in^2. First trial self weight ≈ 23 lb/ft. (Expect more trials). Final sections may have S > 230 in.^{3} and $\Delta_{(LL)} \approx 0.3$-0.4 in., and $\Delta_{(LL+DL)} \approx 0.5$-0.6 in.

(20%) *9.18 Determine the axial load capacity of a $6\frac{3}{4}'' \times 10\frac{1}{2}''$ glu-lam column $(A = 70.88\ \text{in.}^2)$ assuming lateral bracing about the weak axis at the midheight level. Assume pin connections top and bottom in both directions of buckling (F_c = 1,650 psi; E'_{min} = 915.3 x 10^3 psi)
* Assume the critical load duration is for ten minute wind load.

(timber column analysis)



Partial answers to check with:
F'_c = 1051 psi, P_a = 74.5 k

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(20%) * 9.21 Determine the minimum size column (Southen Pine Dense No. 1) required to support an axial load of P ~~= 25 k~~ 6 x = 12.5 kips assuming an effective column length $\ell_e = 16'$. Assume the load duration is normal. For Southern pine dense No.1, E''_{min} = 584 x 10^3 psi, and the tabulated compressive stress parallel to the grain, F_c = 975 psi.
(*timber column design)*

no figure

Partial answers to check with: F'_c = 351 psi, $A_{req'd} \geq 35.6$ in^2 and a section MUST satisfy this requirement

(5%) 8A) Determine the minimum size square column of Douglas Fir Larch, No. 1 grade to support an axial load of 30 k for an effective length of 12 ft under snow load using the provided design tables. *(timber column design charts)*

Partial answers to check with: possible capacities {3.7 k, 17.6 k, 47.3 k}

Table 12 Allowable Column Loads—Selected Species/Sizes.

Eff.										4 × 4	A = 12.25	4 × 6	A = 19.25	4 × 8	A = 25.38
Col.	l/d	(l/d)sq	Fce	Fce/Fc*		Cp		F'c(psi)		P_a (k)		P_a (k)		P_a (k)	
Len(ft)				Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow
4	13.71	188.08	2871.09	1.91	1.66	.8594	.8325	1289	1436	15.8	17.6	24.8	27.6	32.7	36.4
5	17.14	293.88	1837.50	1.23	1.07	.7573	.7138	1136	1231	13.9	15.1	21.9	23.7	28.8	31.3
6	20.57	423.18	1276.04	0.85	0.74	.6324	.5799	949	1000	11.6	12.3	18.3	19.3	24.1	25.4
7	24.00	576.00	937.50	0.63	0.54	.5184	.4611	778	795	9.5	9.7	15.0	15.3	19.7	20.2
8	27.43	752.33	717.77	0.48	0.42	.4194	.3750	629	647	7.7	7.9	12.1	12.5	16.0	16.4
9	30.86	952.16	567.13	0.38	0.33	.3439	.3035	516	524	6.3	6.4	9.9	10.1	13.1	13.3
10	34.29	1175.51	459.38	0.31	0.27	.2869	.2529	430	436	5.3	5.3	8.3	8.4	10.9	11.1
11	37.71	1422.37	379.65	0.25	0.22	.2355	.2090	353	361	4.3	4.4	6.8	6.9	9.0	9.2
12	41.14	1692.73	319.01	0.21	0.18	.2000	.1728	300	298	3.7	3.7	5.8	5.7	7.6	7.6
13	44.57	1986.61	271.82	0.18	0.16	.1728	.1544	259	266	3.2	3.3	5.0	5.1	6.6	6.8
14	48.00	2304.00	234.38	0.16	0.14	.1544	.1357	232	234	2.8	2.9	4.5	4.5	5.9	5.9
Eff.										6 × 6	A = 30.25	6 × 8	A = 41.25	6 × 10	A = 52.25
Col.	l/d	(l/d)sq	Fce	Fce/Fc*		Cp		F'c(psi)		P_a (k)		P_a (k)		P_a (k)	
Len(ft)				Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow
5	10.91	119.01	4033.33	4.03	3.51	0.9425	0.9325	943	1072	28.5	32.4	38.9	44.2	49.2	56.0
6	13.09	171.37	2800.93	2.80	2.44	0.9119	0.896	912	1030	27.6	31.2	37.6	42.5	47.6	53.8
7	15.27	233.26	2057.82	2.06	1.79	0.8720	0.8475	872	975	26.4	29.5	36.0	40.2	45.6	50.9
8	17.45	304.66	1575.52	1.58	1.37	0.8218	0.7873	822	905	24.9	27.4	33.9	37.3	42.9	47.3
9	19.64	385.59	1244.86	1.24	1.08	0.7597	0.7169	760	824	23.0	24.9	31.3	34.0	39.7	43.1
10	21.82	476.03	1008.33	1.01	0.88	0.6944	0.6453	694	742	21.0	22.4	28.6	30.6	36.3	38.8
11	24.00	576.00	833.33	0.83	0.72	0.6235	0.5694	624	655	18.9	19.8	25.7	27.0	32.6	34.2
12	26.18	685.49	700.23	0.70	0.61	0.5586	0.5062	559	582	16.9	17.6	23.0	24.0	29.2	30.4
13	28.36	804.50	596.65	0.60	0.52	0.5000	0.4475	500	515	15.1	15.6	20.6	21.2	26.1	26.9
14	30.55	933.02	514.46	0.51	0.45	0.4406	0.3975	441	457	13.3	13.8	18.2	18.9	23.0	23.9

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Table 12 Allowable Column Loads—Selected Species/Sizes. (Continued)

Eff.										8×8	A = 56.25	8×10	A = 71.25	8×12	A = 86.25
Col.	l/d	(l/d)sq	Fce	Fce/Fc*		Cp		F'c(psi)		P_a (k)		P_a (k)		P_a (k)	
Len(ft)				Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow	Norm	Snow
8	12.80	163.84	2929.69	2.93	2.55	.9163	.9014	916	1037	51.5	58.3	65.3	73.9	79.0	89.4
9	14.40	207.36	2314.81	2.31	2.01	.8888	.8680	889	998	50.0	56.1	63.3	71.1	76.7	86.1
10	16.00	256.00	1875.00	1.88	1.63	.8566	.8286	857	953	48.2	53.6	61.0	67.9	73.9	82.2
11	17.60	309.76	1549.59	1.55	1.35	.8175	.7834	818	901	46.0	50.7	58.2	64.2	70.5	77.7
12	19.2	368.64	1302.08	1.30	1.13	.7731	.7315	773	841	43.5	47.3	55.1	59.9	66.7	72.6
13	20.8	432.64	1109.47	1.11	0.96	.7258	.6767	726	778	40.8	43.8	51.7	55.4	62.6	67.1
14	22.4	501.76	956.63	0.96	0.83	.6767	.6235	677	717	38.1	40.3	48.2	51.1	58.4	61.8
15	24.00	576.00	833.33	0.83	0.72	.6235	.5694	624	655	35.1	36.8	44.4	46.7	53.8	56.5
16	25.60	655.36	732.42	0.73	0.64	.5747	.5244	575	603	32.3	33.9	40.9	43.0	49.6	52.0
17	27.20	739.84	648.79	0.65	0.56	.5303	.4744	530	546	29.8	30.7	37.8	38.9	45.7	47.1
18	28.80	829.44	578.70	0.58	0.50	.4873	.4336	487	499	27.4	28.0	34.7	35.5	42.0	43.0
19	30.40	924.16	519.39	0.52	0.45	.4475	.3975	448	457	25.2	25.7	31.9	32.6	38.6	39.4
20	32.00	1024.00	468.75	0.47	0.41	.4122	.3673	412	422	23.2	23.8	29.4	30.1	35.6	36.4