ARCH 331. Assignment #7

Date: 6/20/14, *due 6/25/14* *Pass-fail work*

Problems: supplemental problems (7A, etc.) **and** from Onouye Chapter 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.*
Selected problems not required to be worked will be announced in class.

(7%) 7A) A joint similar to that in Figure 7a is formed with outer members of 1- inch nominal thickness (3/4-in. actual thickness) and 10d common wire nails. If the compression force to be transferred to the two side members having 5 nails each board side is 1200 lb, is the connection adequate? *(wood connection analysis)*

Partial answers to check with: F = 1050 lb

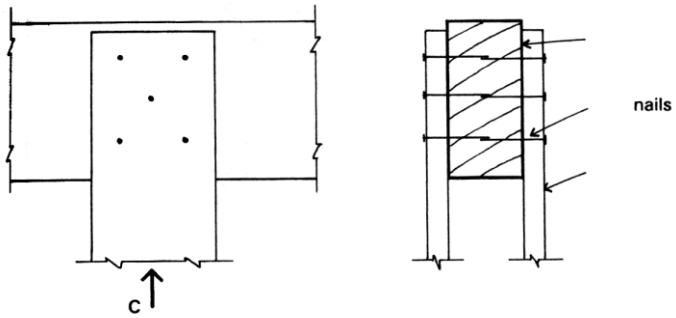


Figure 7a – nailed joint and side view

(7%) 7B) A truss heel joint similar to that in Figure 7b is made with gusset plates of ½-in. plywood and 8d nails. Find the tension force limit for the bottom chord *having 12 nails each plywood side. (wood connection analysis)*

Partial answers to check with:
F = 1560 lb.

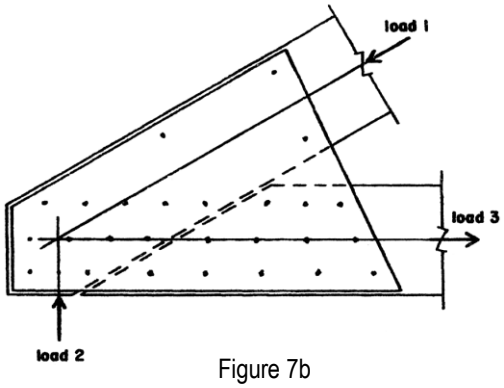


Figure 7b

TABLE 7.1 Lateral Load Capacity of Common Wire Nails (lb/nail)

Side Member Thickness, t_s (in.)	Nail Length, L (in.)	Nail Diameter, D (in.)	Pennyweight	Load per Nail for Douglas Fir-Larch G = 0.50, Z (lb)
Structural Plywood Side Members				
⅜	2	0.113	6d	48
	2½	0.131	8d	63
	3	0.148	10d	76
½	2	0.113	6d	50
	2½	0.131	8d	65
	3	0.148	10d	78
	3½	0.162	16d	92
¾	2	0.113	6d	58
	2½	0.131	8d	73
	3	0.148	10d	86
	3½	0.162	16d	100
Solid-Sawn Lumber Side Members				
¾	2½	0.131	8d	90
	3	0.148	10d	105
	3½	0.162	16d	121
	4	0.192	20d	138
1½	3	0.148	10d	118
	3½	0.162	16d	141
	4	0.192	20d	170
	4½	0.207	30d	186
	5	0.225	40d	205
	5½	0.244	50d	211

Source: Adapted from *National Design Specification for Wood Construction*, 2001 edition (Ref. 3), with permission of the publisher, American Forest & Paper Association.

MORE NEXT PAGE

(8%) 7C) A nominal 3 x 8 in redwood beam is to be supported by two 2 x 8 in. members acting as a spaced column. The minimum spacing and edge distances for the 5/8 inch bolts are shown. How many 5/8 in. bolts will be required to safely carry a load of 3200 lb? Use the chart provided.

(wood connection design)

Partial answer to check with: min n = 3.95.

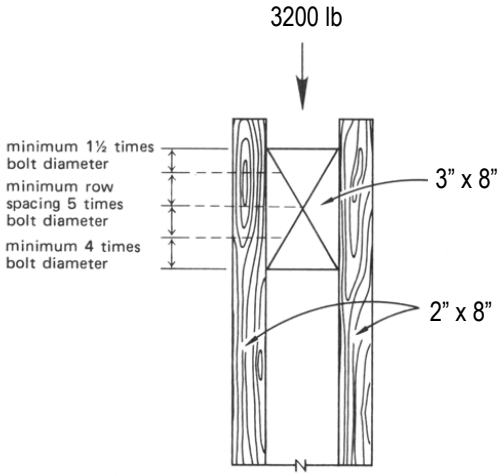


Table 7.1
Holding Power of Bolts

p = Safe loads parallel to grain in pounds
q = Safe loads perpendicular to grain in pounds

Length of Bolt in Main Wood Member[3] (In Inches)		DIAMETER OF BOLT (IN INCHES)								
		⅜	½	⅝	¾	⅞	1	1⅛	1¼	1½
1½	Single p	325	470	590	710	830	945			
	Shear q	185	215	245	270	300	325			
	Double p	650	940	1180	1420	1660	1890			
	Shear q	370	430	490	540	600	650			
2½	Single p		630	910	1155	1370	1575			
	Shear q		360	405	450	495	540			
	Double p	710	1260	1820	2310	2740	3150			
	Shear q	620	720	810	900	990	1080			
3½	Single p			990	1400	1790	2135	2455	2740	3305
	Shear q			565	630	695	760	825	895	1020
	Double p	710	1270	1980	2800	3580	4270	4910	5480	6610
	Shear q	640	980	1130	1260	1390	1520	1650	1780	2040
	Single p					1950	2535	3190	3820	4975

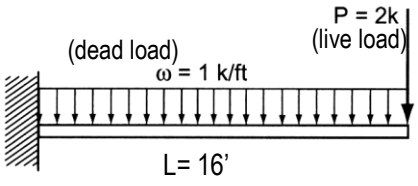
(24%) * **9.1.21** Assuming **A992** steel, select the most economical ~~W8~~ section. Check the shear stress and determine the deflection at the free end. Assume the length is fully braced.

F_b = ~~22 ksi~~ *(**unified** ASD design and deflection)*

F_v = ~~14.5 ksi~~ F_y = 50 ksi

E = 30 x 10^3 ksi

Δ_{LL} = L/260 and Δ_{LL+DL} = L/200



Problem 9.1.21

Partial answers to check with:
(for final section) $Z \geq 66.2$ in^3, $A_{web} \geq 0.935$ in^2, $I \geq 675.8$ in^3

(10%) 7D) For the beam of problem 9.1.21, design the most economical beam for plastic flexure only *(Z_x)* for the dead and live load shown. Make certain to include self weight. The material has the following properties: F_y = 50 ksi, E = 30,000 ksi, ϕ_b = 0.9. *(LRFD design)*

Partial answer to check with: $Z_x \geq 54.6$ in.^{3}

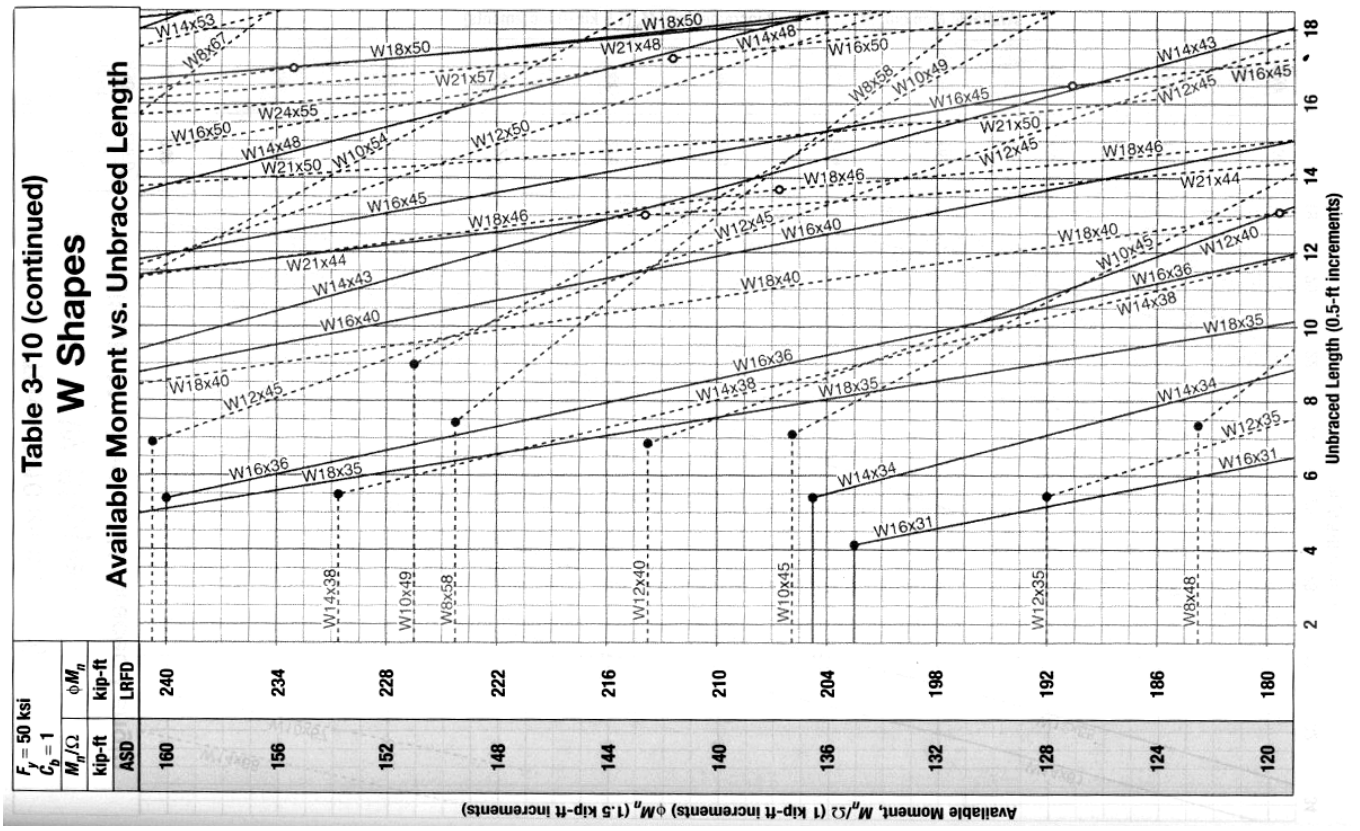
MORE NEXT PAGE

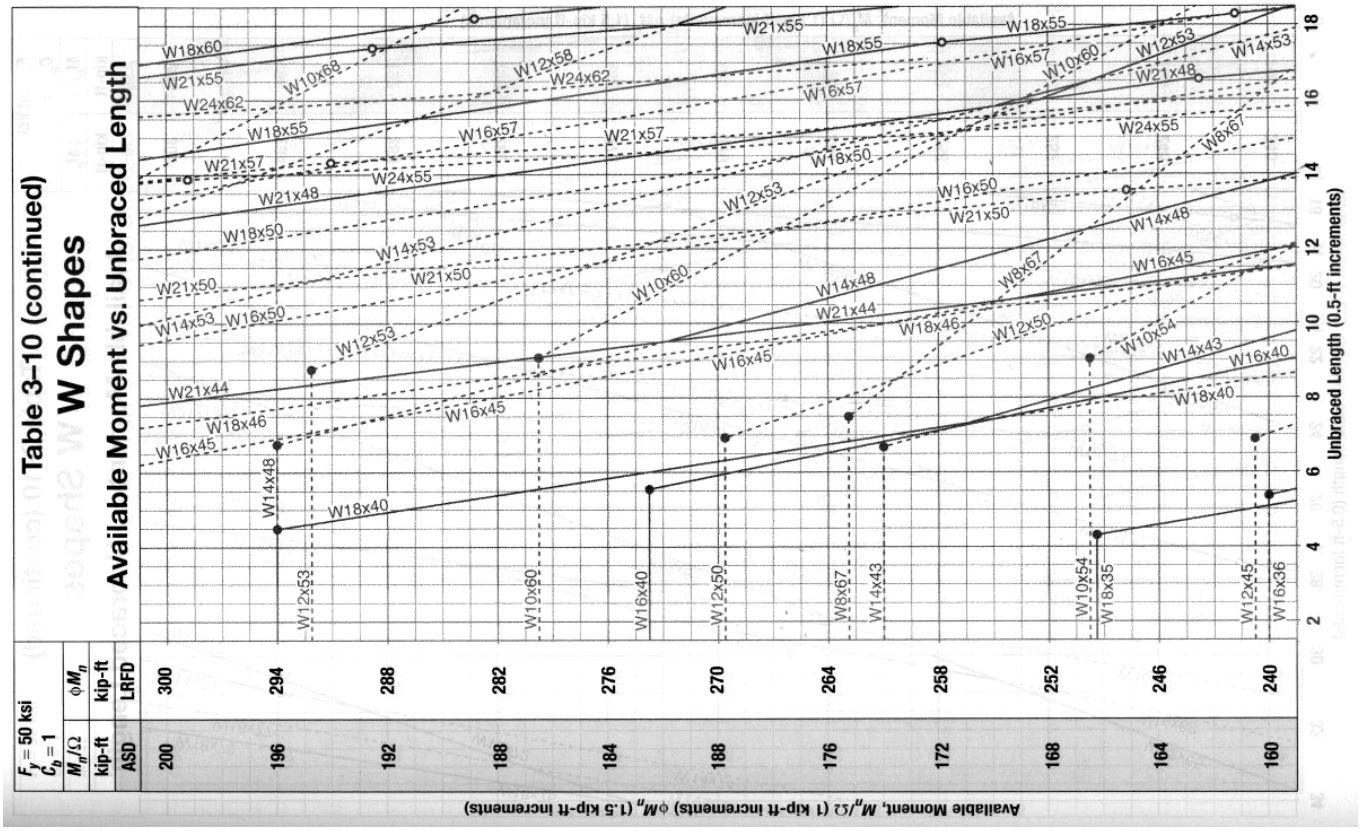
(24%) 7E) For the beam of problem 9.1.21, use the LRFD design method and the following available moment diagram to select the most economical beam with an unbraced length of 7.75 ft and the dead and live load shown. Assume $F_{yw} = 50$ ksi, and $\phi_b = 0.9$. The (unfactored) live load deflection and total load deflections are identical to those in the allowable stress design of problem 9.1.21.

(LRFD design)

Partial answer to check with: $M_u = 204.8$ k-ft, $V_u = 22.4$ k, (when the final section has been chosen, it must have: $I_{req'd} \geq 675.8$ in^4, $\phi M_n \geq 211.7$ k-ft. $\phi V_n \geq 23.9$ k.)

MORE NEXT PAGE (Available Moment Diagrams)





MORE NEXT PAGE

(8%) 7F) A long span steel joist with a span of 80 feet is required to support a roof. The joists are spaced at 4 ft apart, the dead load is 12 lb/ft^2, the live load is 28 lb/ft^2 and the live load deflection is limited to L/360 (which is that used to determine the live load limit based on deflection in the Joist catalogue tables). Remembering to estimate a joist weight, use the table provided to select the most economical joist that can be used. *(LRFD open web joist charts)*

Partial answers to check with: 44LH likely

STANDARD LOAD TABLE FOR LONGSPAN STEEL JOISTS, LH-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown in Pounds per Linear Foot (plf)

Joist Designation	Approx. Wt in Lbs. Per Linear Ft. (Joists Only)	Depth in inches	SAFELOAD* in Lbs. Between		CLEAR SPAN IN FEET															
			47-59	60-64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
40LH08	16	40	24900	24900	381	370	361	351	342	333	325	316	309	301	294	288	280	274	267	261
					150	144	138	132	127	122	117	112	108	104	100	97	93	90	86	83
40LH09	21	40	32700	32700	498	484	472	459	447	436	424	414	403	394	384	375	366	358	349	342
					196	188	180	173	166	160	153	147	141	136	131	126	122	118	113	109
40LH10	21	40	36000	36000	550	535	520	507	493	481	469	457	445	435	424	414	403	393	382	373
					216	207	198	190	183	176	169	162	156	150	144	139	134	129	124	119
40LH11	22	40	39300	39300	598	582	567	552	537	523	510	498	484	472	462	450	439	429	418	409
					234	224	215	207	198	190	183	176	169	163	157	151	145	140	135	130
40LH12	25	40	47850	47850	729	708	688	670	652	636	619	603	588	573	559	546	532	519	507	495
					285	273	261	251	241	231	222	213	205	197	189	182	176	169	163	157
40LH13	30	40	56400	56400	859	835	813	792	771	750	730	712	694	676	660	643	628	613	598	585
					334	320	307	295	283	271	260	250	241	231	223	214	207	199	192	185
40LH14	35	40	64500	64500	984	957	930	904	880	856	834	813	792	772	753	735	717	699	682	666
					383	367	351	336	323	309	297	285	273	263	252	243	233	225	216	209
40LH15	36	40	72150	72150	1101	1068	1036	1006	978	949	924	898	874	850	828	807	786	766	747	729
					427	408	390	373	357	342	328	315	302	290	279	268	258	248	239	230
40LH16	42	40	79500	79500	1212	1194	1176	1158	1141	1126	1095	1065	1036	1009	982	957	933	909	886	864
					469	455	441	428	416	404	387	371	356	342	329	316	304	292	282	271
			52-59	**60-72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**
44LH09	19	44	30000	30000	408	397	388	379	370	363	354	346	339	331	324	316	310	303	297	291
					158	152	146	141	136	131	127	122	118	114	110	106	103	99	96	93
44LH10	21	44	33150	33150	450	439	429	418	408	399	390	381	373	364	357	349	342	334	327	321
					174	168	162	155	150	144	139	134	130	125	121	117	113	110	106	103
44LH11	22	44	35850	35850	487	475	465	453	442	433	423	414	403	396	387	378	370	363	354	348
					188	181	175	168	162	157	151	146	140	136	131	127	123	119	115	111
44LH12	25	44	44400	44400	603	589	574	561	547	534	520	508	496	484	472	462	450	439	430	420
					232	224	215	207	200	192	185	179	172	166	160	155	149	144	139	134
44LH13	30	44	52650	52650	715	699	681	666	649	634	619	606	592	579	565	553	541	529	519	507
					275	265	254	246	236	228	220	212	205	198	191	185	179	173	167	161
44LH14	31	44	60600	60600	823	801	780	759	739	721	703	685	669	654	637	622	609	594	580	568
					315	302	291	279	268	259	249	240	231	223	215	207	200	193	187	181
44LH15	36	44	70500	70500	958	934	912	889	868	847	826	805	786	768	750	732	714	699	682	667
					366	352	339	326	314	303	292	281	271	261	252	243	234	227	219	211
44LH16	42	44	81300	81300	1105	1078	1051	1026	1002	978	955	933	912	891	870	852	832	814	796	780
					421	405	390	375	362	348	336	324	313	302	291	282	272	263	255	246
44LH17	47	44	87300	87300	1185	1170	1153	1138	1125	1098	1072	1048	1024	1000	978	957	936	915	895	876
					450	438	426	415	405	390	376	363	351	338	327	316	305	295	285	276
			56-59	**60-80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
48LH10	21	48	30000	30000	369	361	354	346	339	331	325	318	312	306	300	294	288	282	277	271
					141	136	132	127	123	119	116	112	108	105	102	99	96	93	90	87
48LH11	22	48	32550	32550	399	390	382	373	366	358	351	343	337	330	324	318	312	306	300	294
					152	147	142	137	133	129	125	120	117	113	110	106	103	100	97	94
48LH12	25	48	41100	41100	504	493	483	472	462	451	442	433	424	415	408	399	391	384	376	369
					191	185	179	173	167	161	156	151	147	142	138	133	129	126	122	118
48LH13	29	48	49200	49200	603	589	576	564	552	540	529	517	507	498	487	477	468	459	450	441
					228	221	213	206	199	193	187	180	175	170	164	159	154	150	145	141
48LH14	32	48	58050	58050	712	696	681	666	651	637	624	610	598	585	574	562	550	540	529	519
					269	260	251	243	234	227	220	212	206	199	193	187	181	176	171	165
48LH15	36	48	66750	66750	817	799	781	765	748	732	717	702	687	672	658	645	633	619	607	595
					308	298	287	278	269	260	252	244	236	228	221	214	208	201	195	189
48LH16	42	48	76950	76950	943	922	901	882	864	844	826	810	792	777	760	745	730	715	702	688
					355	343	331	320	310	299	289	280	271	263	255	247	239	232	225	218
48LH17	47	48	86400	86400	1059	1035	1012	990	969	948	928	909	889	871	853	837	820	804	787	772
					397	383	371	358	346	335	324	314	304	294	285	276	268	260	252	245

MORE NEXT PAGE

(12%) 7G) If a simply supported 36 ft parallel chord open-web joist has 12 panels at 3 ft for the top chord and the support reactions shown, *use the method of sections* to determine the member forces in the top chord, bottom chord, and the web for the section indicated in the figure at the section location shown for LRFD design. The joists are 2 ft. on center, the distributed load over the top of the truss is 25 lb/ft^2 dead load and 70 lb/ft^2 live load and the self weight is 12.2 lb/ft. *NOTE: Remember that the tributary width for the end joints is only half what it is for the rest of the top joints.* *(load tracing and method of sections)*

Partial answers to check with:
top chord = 14.6 k (C)
bottom chord = 16.7 k (T)
web (diagonal) = 3.8 k (C)