ARCH 331. Assignment #7

Date: 6/21/13, *due 6/26/13* *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.
<u>Selected problems not required to be worked will be announced in class.</u>

(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

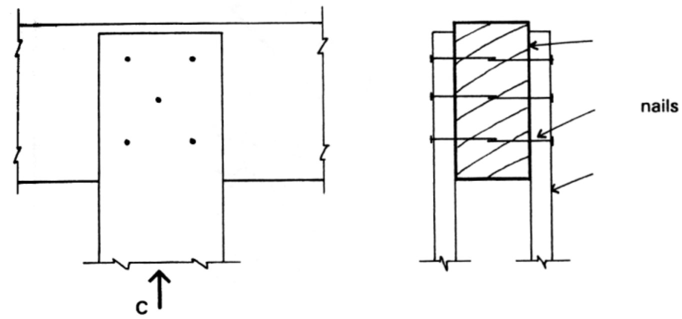

Figure 7a – nailed joint and side view

(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.

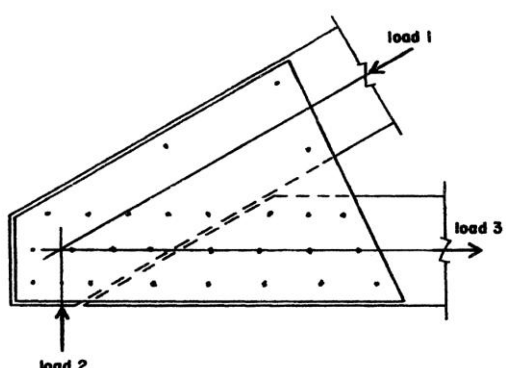

Figure 7b

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				
	2	0.113	6d	48
⅜	2½	0.131	8d	63
	3	0.148	10d	76
	2	0.113	6d	50
½	2½	0.131	8d	65
	3	0.148	10d	78
	3½	0.162	16d	92
	2	0.113	6d	58
¾	2½	0.131	8d	73
	3	0.148	10d	86
	3½	0.162	16d	100
Solid-Sawn Lumber Side Members				
	2½	0.131	8d	90
¾	3	0.148	10d	105
	3½	0.162	16d	121
	4	0.192	20d	138
	3	0.148	10d	118
	3½	0.162	16d	141
1½	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.

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(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.

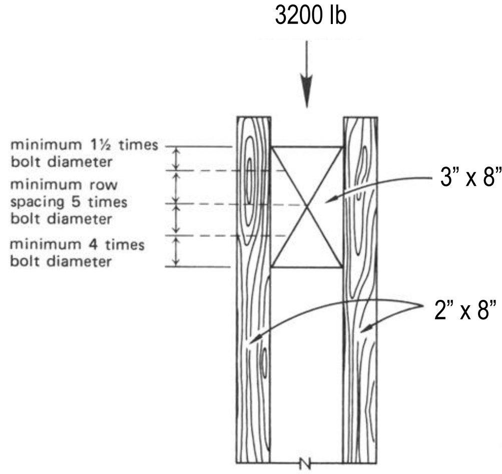


Table 7.1
Holding Power of Bolts

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)								
		3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
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.

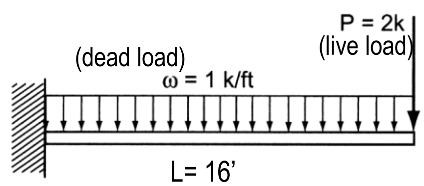
*(**unified** ASD design and deflection)*

F_b = ~~22 ksi~~

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

$E = 30 \times 10^3$ ksi

$\Delta_{LL} = L/260$ and $\Delta_{LL+DL} = L/200$



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 <u>plastic</u> 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, $\phi_b = 0.9$. *(LRFD stress design)*

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

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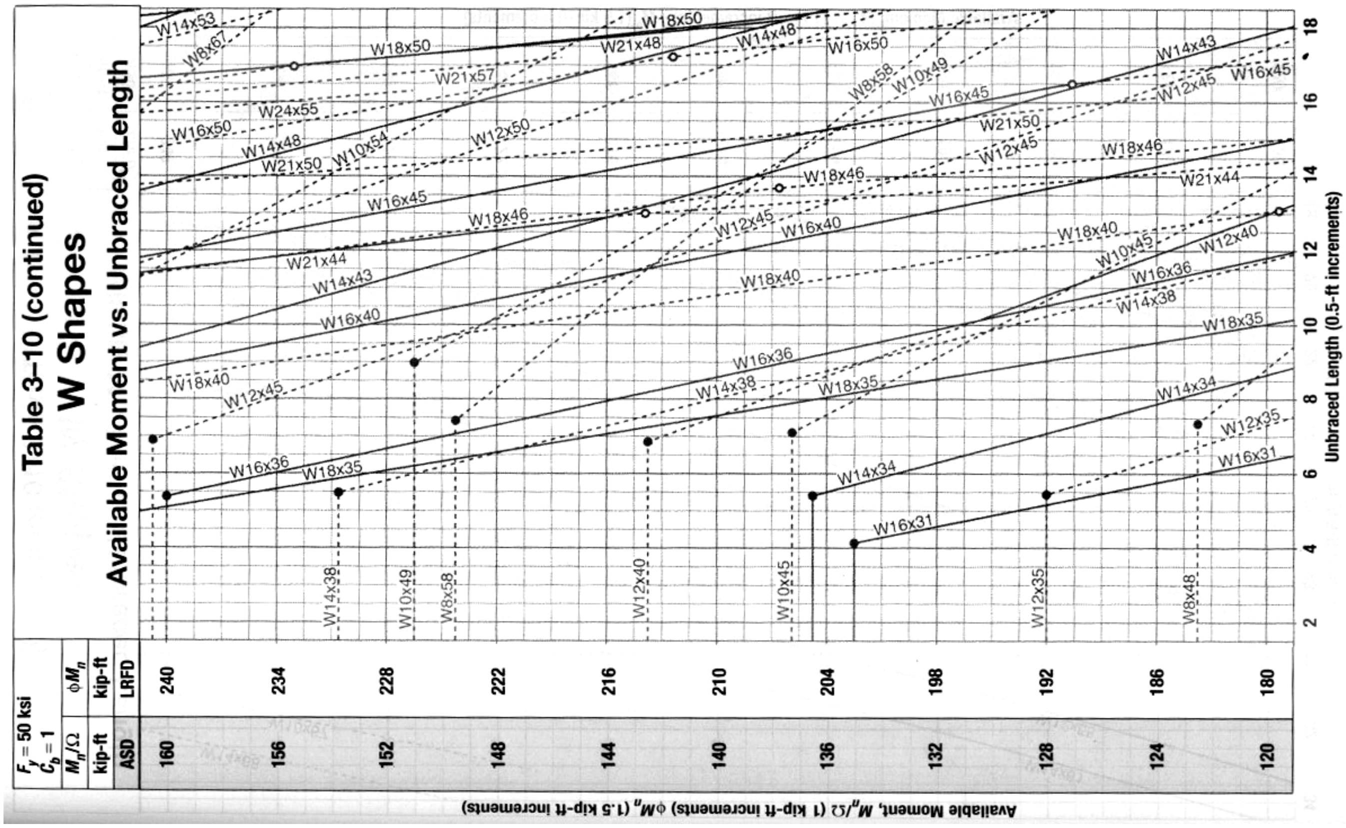
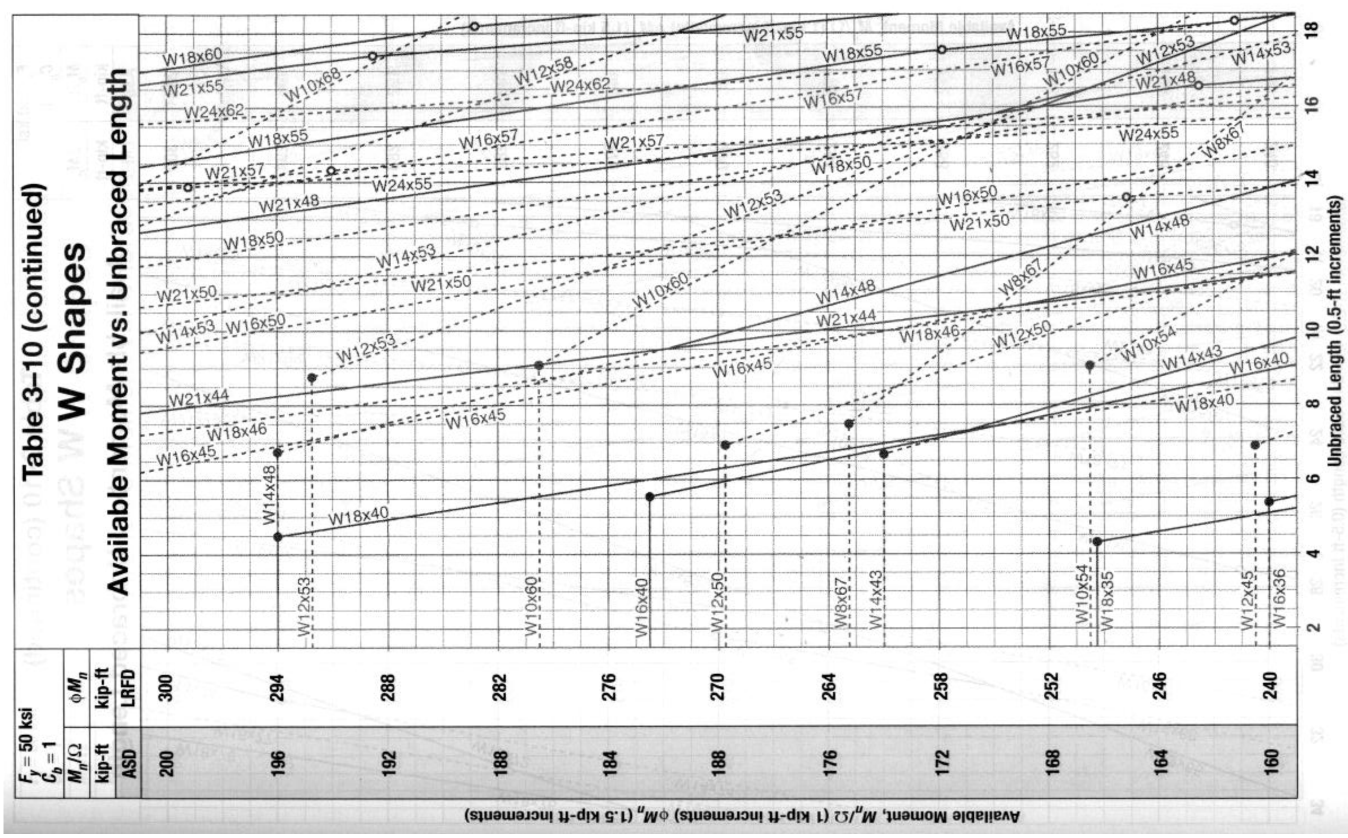
(24%) 7E) For the beam of problem 9.1.21, use the LRFD design method and the following available moment diagram to select the most economical beam with an unbraced length of 7.75 ft and the dead and live load shown. Assume F_{yw} = 50 ksi, and ϕ_b = 0.9. The (unfactored) live load deflection and total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

(LRFD stress 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)





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

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(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)