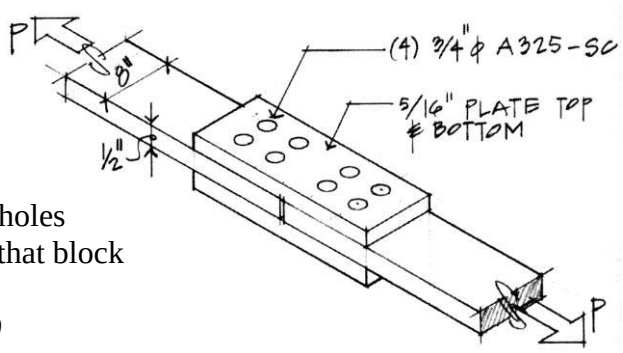
ARCH 331. Assignment #11

Date: 11/7/13, *due 11/14/13* *Pass-fail work*

Problems: as stated (none from Onouye)



(13%) 11A) Determine the capacity of this butt splice based on shear, bearing, and tension. The plates are made of A36 steel and the four bolts on each side of the splice are A325-SC with standard round holes at 3 inch spacing. Assume the hole spacing is such that block shear rupture is not a concern.

(LRFD steel connection analysis)

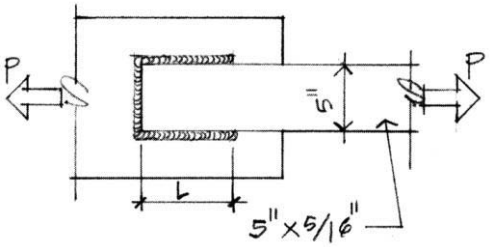
Partial answers to check with: 76.0 k (shear), 156.6 k (bearing), 129.6 k (yielding), 135.9 k (rupture), so ...

(7%)

11B) Determine the capacity of the welded connection shown. The weld size is 3/16 in.. Assume the base metal is A36 steel and electrodes are E70XX in each problem. Use L = 4.5".

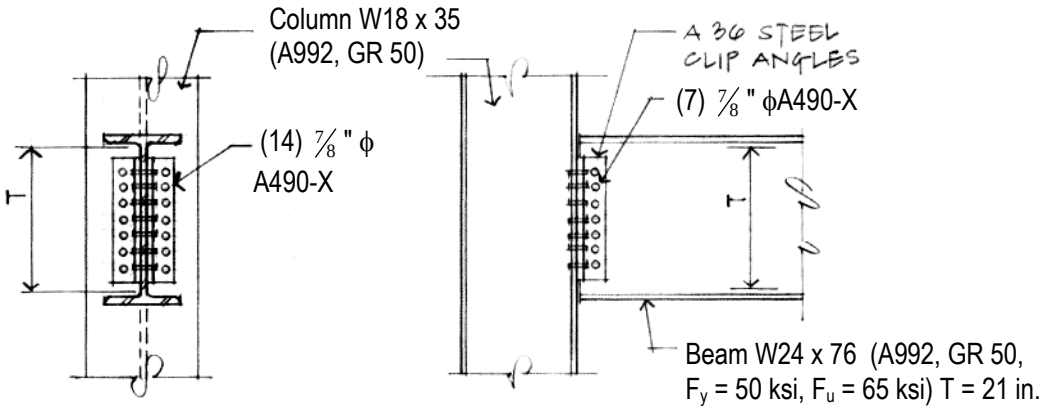
(LRFD steel connection analysis)

Partial answers to check with:
50.625 k (yielding), 58.52 k (shear), so ...



(15%) 11C) Determine the capacity and adequacy of the framed beam connection shown when the factored beam reaction is 300 k and ½" angles of sufficient length are used. The column and beam are A992 steel. The angles are A36 steel with 3" spacing of holes and 1 ¼" edge distances *(see table)*. The bolts are A490-X. *(LRFD steel connection analysis)*

Partial answers to check with:
529.9 k (shear), 314.2 k (bearing), 606.9 k (bearing), 344 k (angles), so ...



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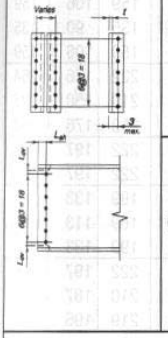
Beam F_y = 50 ksi, F_u = 65 ksi
Angle F_y = 36 ksi, F_u = 58 ksi

Table 10-1 (continued)
All-Bolted Double-Angle Connections
7/8-in. Bolts

Bolt and Angle Available Strength, kips

7 Rows, W44, 40, 36, 33, 30, 27, 24	Bolt Group	Thread Cond.	Hole Type	Angle Thickness, in. 1/4 ASD	1/4 LRFD	5/16 ASD	5/16 LRFD	3/8 ASD	3/8 LRFD	1/2 ASD	1/2 LRFD
	Group A	N	STD	115	172	144	215	172	258	227	341
		X	STD	115	172	144	215	172	258	230	344
		SC Class A	STD	115	172	123	185	123	185	123	185
			OVS	105	157	105	157	105	157	105	157
			SSLT	113	170	123	185	123	185	123	185
		SC Class B	STD	115	172	144	215	172	258	206	308
			OVS	110	165	137	206	165	247	175	262
			SSLT	113	170	142	213	170	255	206	308
	Group B	N	STD	115	172	144	215	172	258	230	344
		X	STD	115	172	144	215	172	258	230	344
		SC Class A	STD	115	172	144	215	155	233	155	233
			OVS	110	165	132	198	132	198	132	198
			SSLT	113	170	142	213	155	233	155	233
		SC Class B	STD	115	172	144	215	172	258	230	344
			OVS	110	165	137	206	165	247	220	329
			SSLT	113	170	142	213	170	255	227	340

(18%) 11D) For the singly reinforced concrete beam sections described below, determine
i) depth of the compressive stress block
ii) acceptability of reinforcement ratio to minimum and maximums
iii) design moment capacity. *(reinforced concrete beam analysis)*

1) f_y = 60 ksi f'_c = 6000 psi A_s = 7.07 in^2 b = 16 in d = 30 in
2) f_y = 60 ksi f'_c = 5000 psi A_s = 3.01 in^2 b = 12 in d = 20 in

Partial answers to check with: 1.i) a = 5.20 in, ii) 0.0039 > ρ = 0.0147 < 0.0239, iii) ϕM_n = 872 k-ft; 2.i) a = 3.54 in, ii) 0.0035 > ρ = 0.0125 < 0.0213, iii) ϕM_n = 247 k-ft

(22%) 11E) A rectangular concrete beam is to be designed using f'_c = 3000 psi, f_y = 40 ksi, density of 150 lb/ft^3, b = 16 in., d = 32 in., and h = 36 in. for a simply supported span of 35 feet. Determine the area of steel required to carry superimposed loads (*not* including self weight) of 150 lb/ft dead and 400 lb/ft live. Assume the maximum coarse aggregate size is 1 in.. Check if the steel fits and if the steel reinforcement ratio is within limit. *(reinforced concrete beam design)*

Partial answers to check with: M_u = 235.8 k-ft, R_n < 200 psi (ρ_{min}), ρ = 0.0052 and ϕM_n=243 k-ft

(25%) 11F) Design a rectangular beam for a 22-ft simple span if a dead load of 2 k/ft (including an estimated self weight) and a live load of 2.9 k/ft are to be supported. Use f'_c = 4000 psi and f_y = 60 ksi, The height of the beam should be between 1.5 to 2 times the width (which should be in whole inches). Assume there are #3 U stirrups and a minimum of 1" clearance between bars and between rows (3/4" aggregate). Do not use bars larger than #11's.
(reinforced concrete beam design)

Partial answers to check with: M_u = 425.9 k-ft. Your R_n with chosen b & h can range from 290 up to 470 psi where ρ_{max} =0.0205. To check if the bars fit, subtract 3.75 in for cover and stirrups, the total number of bar diameters and spaces (no. of bars – 1) of 1 inch each. (Bars larger than #8's have custom diameters.) If the number is negative, the section is invalid. If your final reinforcement ratio is bigger than the max, the section is invalid.