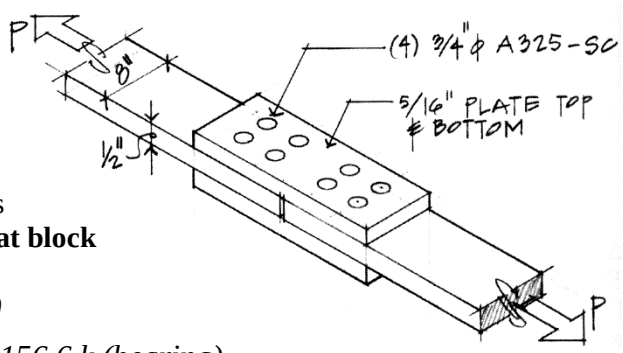
ARCH 331. Assignment #11

Date: 4/5/18, *due 4/12/18* *Pass-fail work*

Problems: supplemental problems (11A, etc.) **and** from Onouye & Kane, Chapter 10



(13%) *10.5 Determine the capacity of this butt splice based on shear, bearing, and ~~net~~ 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.**

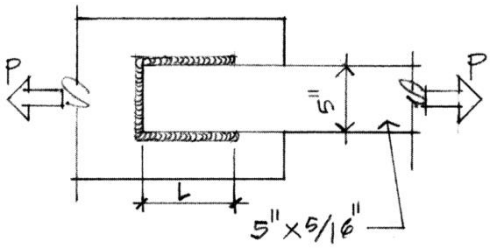
(LRFD steel connection analysis)

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

(7%) *10.10 Determine the ~~shear~~ 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".**

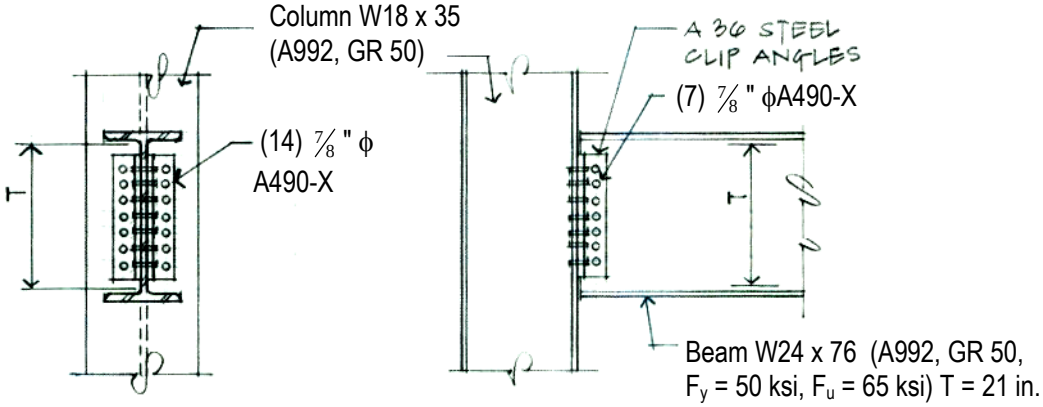
(LRFD steel connection analysis)

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



(15%) 11A) 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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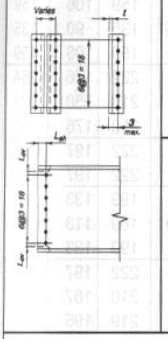
Beam F_y = 50 ksi, F_u = 65 ksi
Angle F_y = 36 ksi, F_u = 58 ksi

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%) 11B) 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%) 11C) 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%) 11D) 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 400 up to 860 psi where $\rho_{max\text{-}0.005}$ =0.0181. 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.