

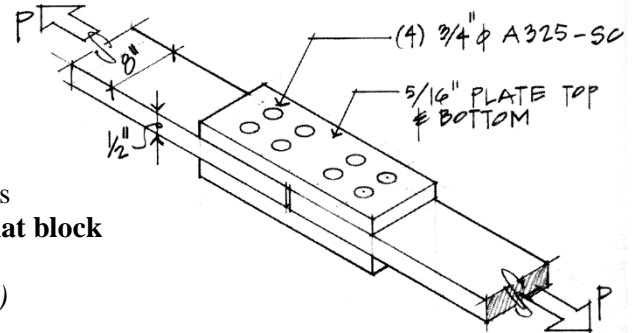
ARCH 331. Assignment #11

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)

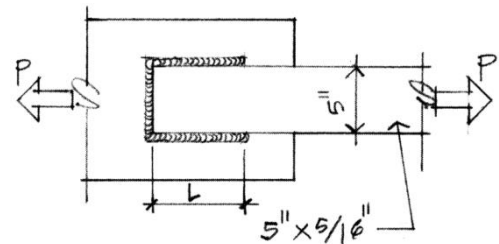
Partial answers to check with: 76.0 k (shear), 156.6 k (bearing), 129.6 k (yielding), 135.9 k (rupture), so ...

- (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 ...

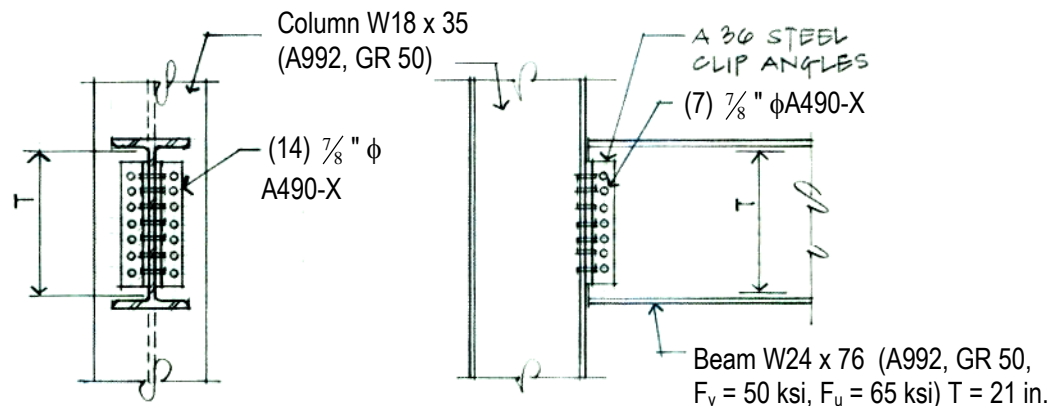


- (15%) 11A) Determine the capacity and adequacy of the framed beam connection shown when the factored beam reaction is 300 k and 1/2" angles of sufficient length are used. The column and beam are A992 steel. The angles are A36 steel with 3" spacing of holes and 1 1/4" edge distances (see table). The 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	Table 10-1 (continued) All-Bolted Double-Angle Connections												
	7 Rows W44, 40, 36, 33, 30, 27, 24	Bolt Group	Thread Cond.	Hole Type	Angle Thickness, in.								
					1/4		5/16		3/8		1/2		
Angle $F_y = 36$ ksi $F_u = 58$ ksi				ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	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
- depth of the compressive stress block
 - acceptability of reinforcement ratio to minimum and maximums
 - design moment capacity. *(reinforced concrete beam analysis)*
- 1) $f_y = 60$ ksi $f'_c = 6000$ psi $A_s = 7.07$ in² $b = 16$ in $d = 30$ in
- 2) $f_y = 60$ ksi $f'_c = 5000$ psi $A_s = 3.01$ in² $b = 12$ in $d = 20$ in
- Partial answers to check with: 1.i) $a = 5.20$ in, ii) $0.0039 > \rho = 0.0147 < 0.0239$,
 iii) $\phi M_n = 872$ k-ft; 2.i) $a = 3.54$ in, ii) $0.0035 > \rho = 0.0125 < 0.0213$, iii) $\phi M_n = 247$ 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/ft³, $b = 16$ 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}), $\rho = 0.0052$ and $\phi M_n = 243$ 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 $\rho_{max-0.005} = 0.0181$. 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.