

## ARCH 631. Assignment #8

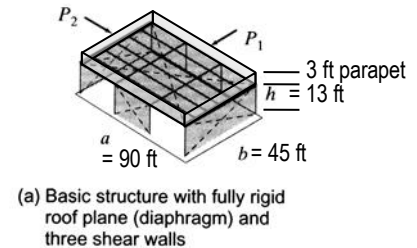
**Date:** 10/17/17, due 11/22/17

Worth 25 pts.

### Problems:

1. A 45 ft x 90 ft structure has the openings and shear walls shown in Figure 14.7 on page 534 (with no rear shear walls). The roof diaphragm is 13 ft from the base, but this structure has a parapet wall extending 3 ft *past* the roof level where the loads are transmitted. Determine the shear forces in the shear walls,  $R_1$ ,  $R_2$  and  $R_3$ , when the design wind load is 23 lb/ft<sup>2</sup>.

Answer:  $R_1 = R_2 = 9,832.5$  lb,  $R_3 = 9,832.5$  lb



2. For the shear wall on the long side ( $R_3$ ) of the building in Problem 1, determine the overturning moment.  
 Answer:  $M_0 = 127,822$  lb-ft
3. If the shear wall on the long side ( $R_3$ ) of the building in Problem 1 is removed, the diaphragm can be considered to behave like a deep truss with a distributed load on it. Determine the maximum force in the top and bottom “chords” from the maximum moment.  
 Answer:  $T = C = 4,916$  lb
4. You are designing a building in seismic zone 3 which is a large auditorium (>300 occupancy) ( $I = 1.25$ ).  $Z = 0.30$ ,  $C = 1.25S/T^{2/3}$ ,  $S = 1.2$ ,  $T = 0.5$ ,  $R_w = 6$ , and the total dead load = 85,000 lbs. What is the base shear?  
 Answer:  $V = 12.6$  kips

5. Complete text problem 16.2 on page 514.

**16.2** With respect to shear stresses alone, what is the required diameter for a bolt in single shear that transfers a shear force of 6000 lb between two plates? Assume that  $F_v = 14,000$  lb/in.<sup>2</sup>

Answer:  $3/4$ -in. diameter.

6. Complete text problem 16.3 on page 514.

**16.3** How many inches of  $1/8$ -in. weld are necessary to transfer a shear force of 6000 lb from one plate to another? Assume that  $F_v = 13,600$  lb/in.<sup>2</sup>

Answer: 5 in.

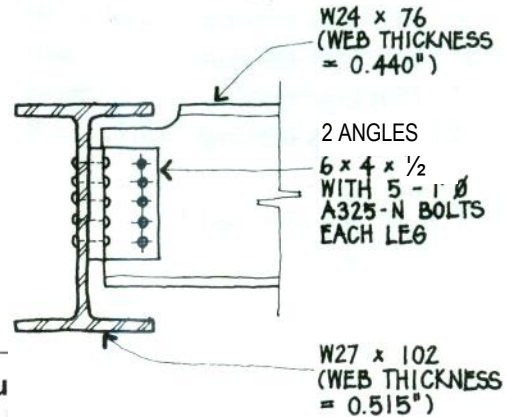
7. Complete text problem 16.4 on page 588. *Note: Assume  $F_v = 14,000$  psi.*

**16.4.** Will a bolt  $1/2$  in. in diameter used in double shear carry a force of 2000 lb? What shear stress is present?

Answer: Yes.  $f_v = 5093$  lb/in.<sup>2</sup>

8. What is the capacity of the connection shown? All connection material is ASTM A36 ( $F_y = 36$  ksi,  $F_u = 58$  ksi), while the beams are A992 ( $F_y = 50$  ksi,  $F_u = 65$  ksi). Assume that the connection angles are adequate with standard holes and 3 in. spacing, and that the coping distances ( $L_{ev}$  &  $L_{eh}$ ) are sufficiently large. Use LRFD design.

*Partial answer:* possible limits are 232, 318, 248.6 or 582 kips, so ...



**Table 10-1 (continuation)**  
**All-Bolted Double-Angle Connections**

Beam	$F_y = 50$ ksi $F_u = 65$ ksi		Angle	$F_y = 36$ ksi $F_u = 58$ ksi		Bolt and Angle Available Strength, kips									
						Bolt and Angle Available Strength, kips									
5 Rows W30, 27, 24, 21, 18	Bolt Group	Thread Cond.	Hole Type	Angle Thickness, in.											
				1/4		5/16		3/8		1/2					
				ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD		
	Group A	N	STD	77.2	116	96.5	145	116	174	154	232				
		X	STD	77.2	116	96.5	145	116	174	154	232				
		SC Class A	STD	77.2	116	96.5	145	115	173	115	173				
			OVS	69.1	104	86.3	129	98.2	147	98.2	147				
		SC Class B	STD	77.2	116	96.5	145	115	173	115	173				
			OVS	69.1	104	86.3	129	104	155	138	207				
	Group B	N	STD	77.2	116	96.5	145	116	174	154	232				
		X	STD	77.2	116	96.5	145	116	174	154	232				
		SC Class A	STD	77.2	116	96.5	145	116	174	145	217				
			OVS	69.1	104	86.3	129	104	155	123	184				
		SC Class B	STD	77.2	116	96.5	145	116	174	145	217				
			OVS	69.1	104	86.3	129	104	155	138	207				
<b>Beam Web Available Strength per Inch Thickness, kips/in.</b>															
Hole Type		STD				OVS				SSLT					
		$L_{eh}^*$ , in.													
$L_{ev}$ , in.		1 1/2		1 3/4		1 1/2		1 3/4		1 1/2		1 3/4			
		ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD		
Coped at Top Flange Only	1 1/4	182	273	190	285	163	244	171	256	178	267	186	279		
	1 3/8	184	277	193	289	165	247	173	260	180	271	189	283		
	1 1/2	187	280	195	293	167	251	176	263	183	274	191	286		
	1 5/8	189	284	197	296	170	255	178	267	185	278	193	290		
	2	197	295	205	307	177	266	185	278	193	289	201	301		
Coped at Both Flanges	1 1/4	173	260	173	260	155	232	155	232	173	260	173	260		
	1 3/8	178	267	178	267	160	239	160	239	178	267	178	267		
	1 1/2	183	274	183	274	165	247	165	247	183	274	183	274		
	1 5/8	188	282	188	282	169	254	169	254	185	278	188	282		
	2	197	295	202	303	177	266	184	276	193	289	201	301		
Uncoped		380	570	380	570	351	527	351	527	380	570	380	570		
Support Available Strength per Inch Thickness, kips/in.		Notes: STD = Standard holes OVS = Oversized holes SSLT = Short-slotted holes transverse to direction of load N = Threads included X = Threads excluded SC = Slip critical													
Hole Type	ASD	LRFD	* Tabulated values include 1/4-in. reduction in end distance, $L_{eh}$ , to account for possible under-run in beam length.												
STD/SSLT	761	1140	Note: Slip-critical bolt values assume no more than one filler has been provided or bolts have been added to distribute loads in the fillers.												
OVS	702	1050													

**Table 7-4**  
**Available Bearing Strength at Bolt Holes**  
**Based on Bolt Spacing**  
kips/in. thickness

Hole Type	Bolt Spacing, $s$ , in.	$F_b$ , ksi	Nominal Bolt Diameter, $d$ , in.											
			$5/8$		$3/4$		$7/8$		$1$					
			$r_n/\Omega$	LRFD	$r_n/\Omega$	LRFD	$r_n/\Omega$	LRFD	$r_n/\Omega$	LRFD				
STD	$2\frac{1}{2}s$ $d_b$	58	34.1	51.1	41.3	62.0	48.6	72.9	55.8	83.7	58.8	83.7		
		65	38.2	57.3	46.3	69.5	54.4	81.7	62.6	93.8	65.8	93.8		
SSLT	3 in.	58	43.5	65.3	52.2	78.3	60.9	91.4	67.4	101	74.4	101		
		65	48.8	73.1	58.5	87.8	68.3	102	75.6	113	81.4	113		
SSLP	$2\frac{1}{2}s$ $d_b$	58	27.6	41.3	34.8	52.2	42.1	63.1	47.1	70.7	52.8	79.2		
		65	30.9	46.3	39.0	58.5	47.1	70.7	52.8	79.2	58.8	88.1		
OVS	3 in.	58	43.5	65.3	52.2	78.3	60.9	91.4	67.4	101	74.4	101		
		65	48.8	73.1	58.5	87.8	68.3	102	75.6	113	81.4	113		
LSP	$2\frac{1}{2}s$ $d_b$	58	29.7	44.6	37.0	55.5	44.2	66.3	49.3	74.0	55.3	82.9		
		65	33.3	50.0	41.4	62.2	49.6	74.3	55.3	82.9	60.9	91.4		
LSLT	3 in.	58	43.5	65.3	52.2	78.3	60.9	91.4	67.4	101	74.4	101		
		65	48.8	73.1	58.5	87.8	68.3	102	75.6	113	81.4	113		
STD, SSLT, LSLT	$2\frac{1}{2}s$ $d_b$	58	3.62	5.44	4.35	6.53	5.08	7.61	5.80	8.70	6.50	9.75		
		65	4.06	6.09	4.88	7.31	5.69	8.53	6.50	9.75	7.31	10.9		
SSLP, OVS, LSLP	3 in.	58	28.4	42.6	34.4	51.7	40.5	60.7	46.5	69.8	52.1	78.2		
		65	31.8	47.7	38.6	57.9	45.4	68.0	52.1	78.2	58.8	88.1		
STD, SSLT, LSLT	$s \geq s_{min}$	58	36.3	54.4	43.5	65.3	50.8	76.1	56.2	84.3	63.0	94.5		
		65	40.6	60.9	48.8	73.1	56.9	85.3	63.0	94.5	70.7	107		
SSLP, OVS, LSLP	$s \geq s_{min}$	58	43.5	65.3	52.2	78.3	60.9	91.4	67.4	101	74.4	101		
		65	48.8	73.1	58.5	87.8	68.3	102	75.6	113	81.4	113		
Spacing for full bearing strength $s_{min}$ , in.	STD, SSLT, LSLT	58	1 <sup>15</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>		
		65	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>		
Minimum Spacing <sup>a</sup> = $2\frac{1}{2}s$ , in.	SSLP, OVS, LSLP	58	1 <sup>15</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>		
		65	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>		

STD = standard hole  
 SSLT = short-slotted hole oriented transverse to the line of force  
 SSLP = short-slotted hole oriented parallel to the line of force  
 OVS = oversized hole  
 LSLP = long-slotted hole oriented parallel to the line of force  
 LSLT = long-slotted hole oriented transverse to the line of force

Note: Spacing indicated is from the center of the hole or slot to the center of the adjacent hole or slot in the line of force. Hole deformation is considered. When hole deformation is not considered, see AISC Specification Section J3.10.

<sup>a</sup> Decimal value has been rounded to the nearest sixteenth of an inch.

**Table 7-1**  
**Available Shear Strength of Bolts, kips**

ASTM Desig.	Group	Thread Cond.	Nominal Bolt Diameter, $d$ , in.											
			$5/8$		$3/4$		$7/8$		$1$					
			$F_u/\Omega$	LRFD	$F_u/\Omega$	LRFD	$F_u/\Omega$	LRFD	$F_u/\Omega$	LRFD				
Group A	N	S	8.29	12.4	11.9	17.9	16.2	24.3	21.2	31.8	28.8	42.4	38.8	58.8
			16.6	24.9	23.9	35.8	32.5	48.7	42.4	63.6	58.8	88.1	81.4	121
Group B	X	D	10.4	15.7	15.0	22.5	20.4	30.7	26.7	40.0	37.0	54.4	49.6	74.0
			20.9	31.3	30.1	45.1	40.9	61.3	53.4	80.1	74.4	107	98.9	145
A307	-	D	4.14	6.23	5.97	8.97	8.11	12.2	10.6	15.9	12.2	18.2	16.6	24.4
			8.29	12.5	11.9	17.9	16.2	24.4	21.2	31.9	28.8	42.4	38.8	58.8

Note: For end loaded connections greater than 38 in., see AISC Specification Table J3.2 footnote b.

$\Omega = 2.00$   
 $\phi = 0.75$