

# DESIGN OF MEMBERS FOR TENSION

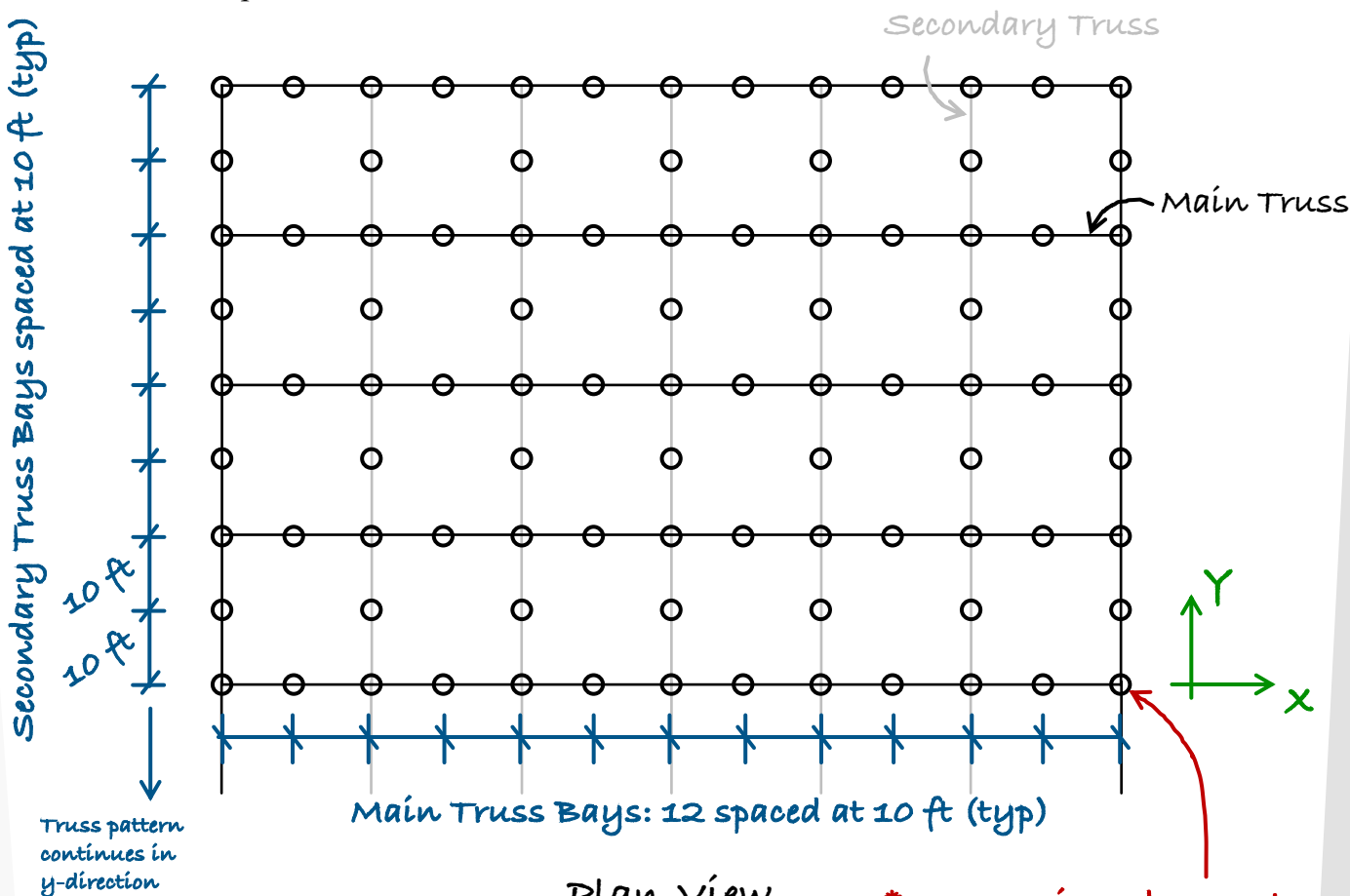
## DESIGN OF SIMPLE BOLTED CONNECTIONS

### [AISC CH. D, J]

#### Overview

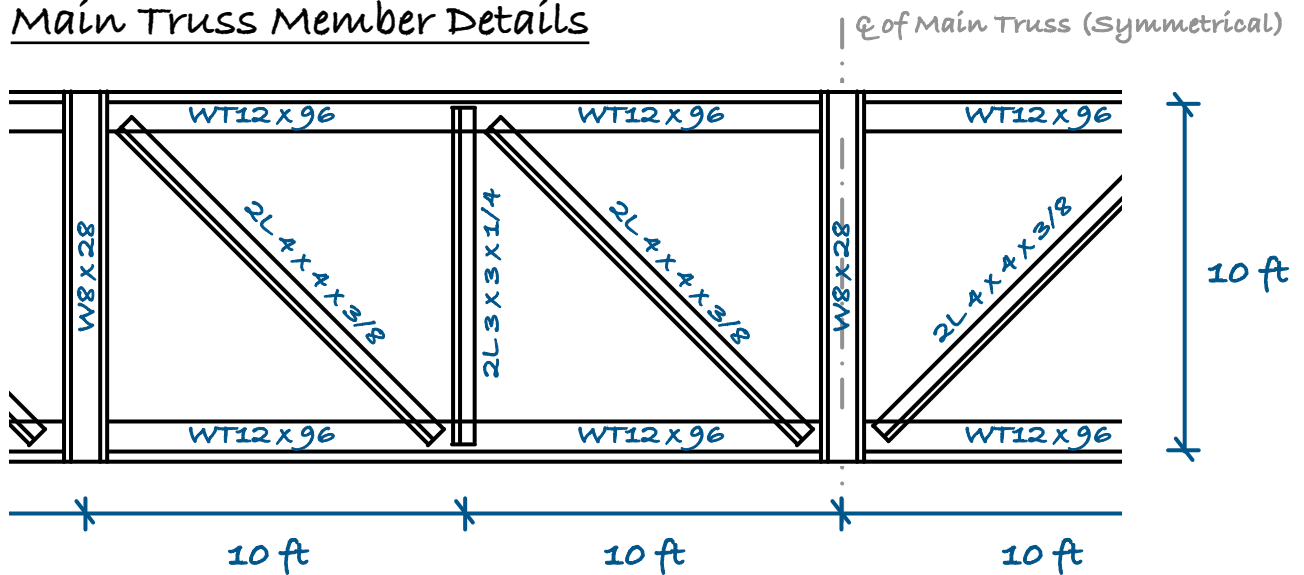
The plan view, member details, and connection details for an existing, complex gymnasium roof truss system are given. The system utilizes two crossing trusses to distribute the roof loads, which will be referred to as **(1) the main truss (x-direction)** and **(2) the secondary truss (y-direction)**. The roof connections are made such that it is assumed the secondary trusses support all loads applied to the roof using one way action. The secondary trusses then frame into the main truss at every other node (you may assume the vertical force is passed through the top node). The main truss carries the secondary trusses and the transferred roof loads to the supports, which are assumed to be pins at either end. The dead weight of the trusses is neglected.

Using LRFD, determine if the bolted double angle diagonal members in the main truss indicated are adequate.

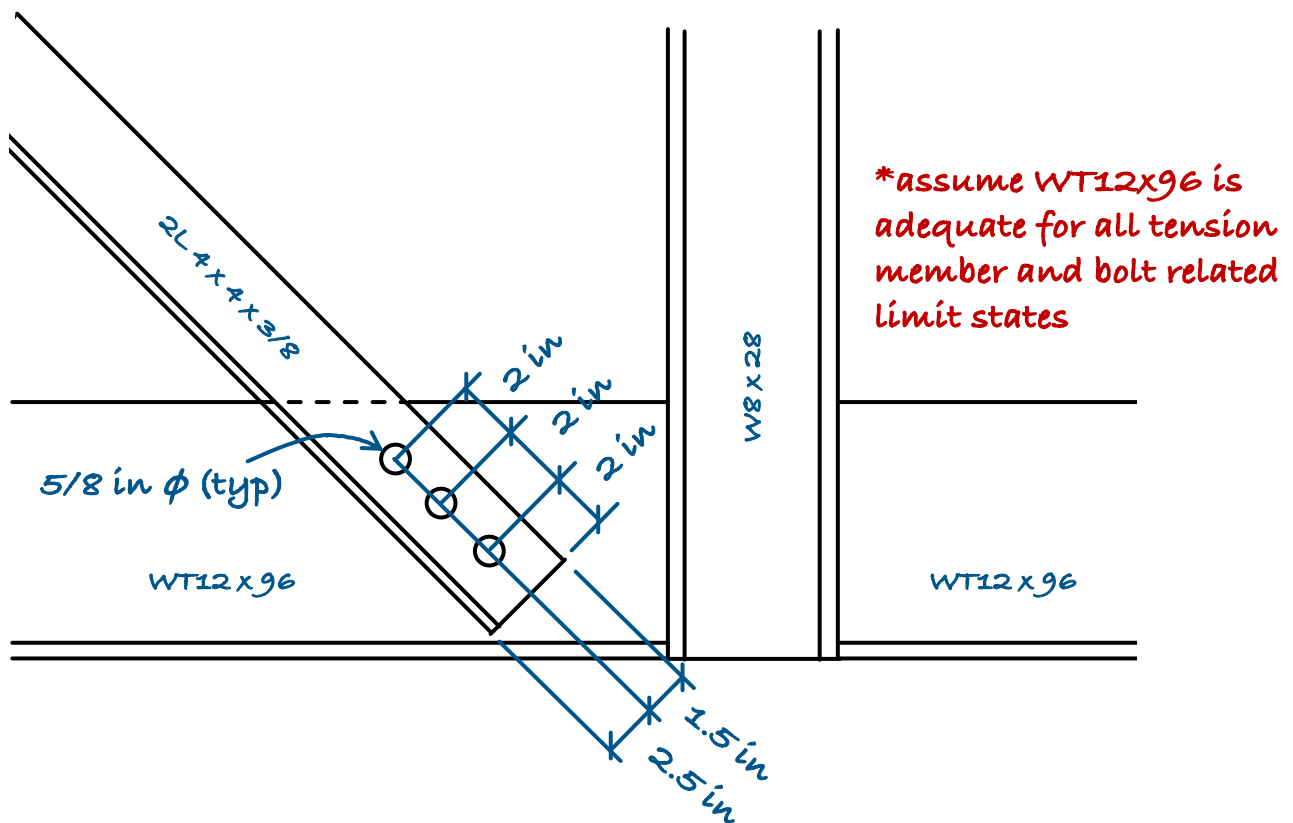


UNIVERSITY  
PROGRAMS

## Main Truss Member Details



## Connection Details



## Material Properties

W shapes and WT shapes: ASTM A992 Steel

L shapes: ASTM A36 Steel

Group A Bolts

## Loads

Dead Load: Corrugated metal roof at 12 psf

Roof Live Load: 20 psf (typ)

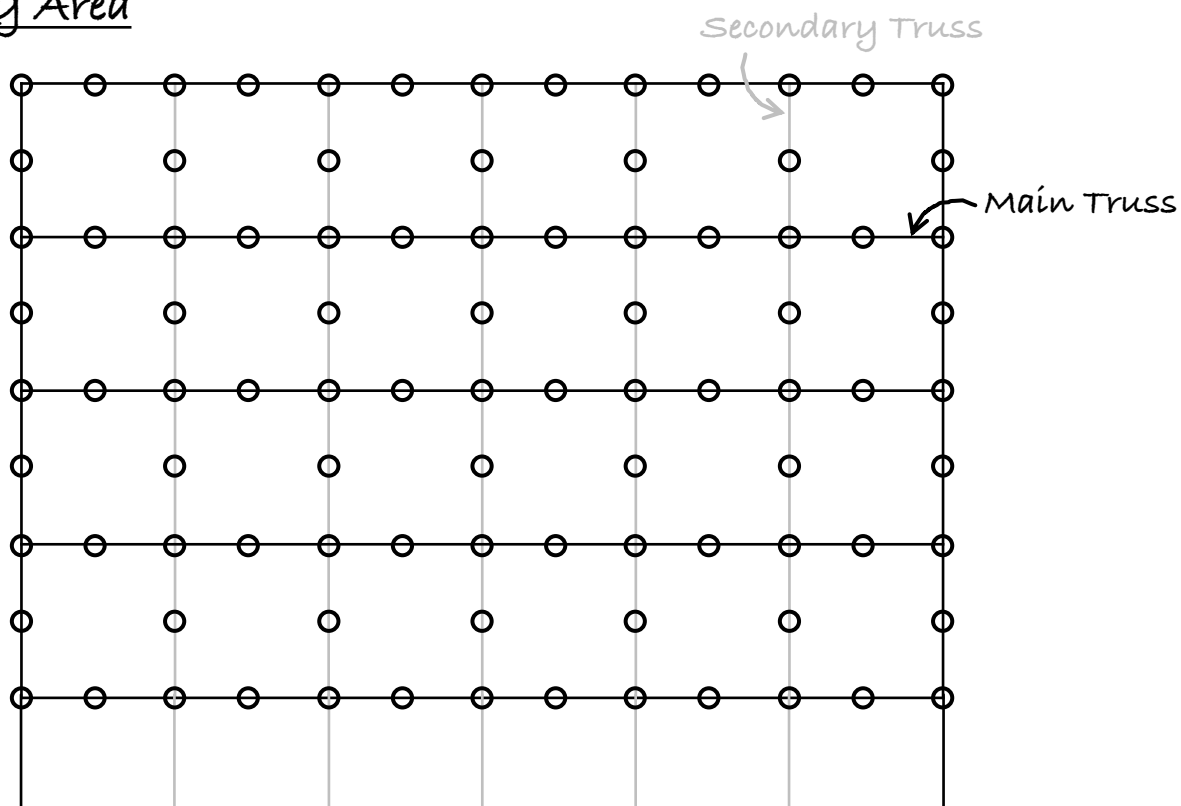


UNIVERSITY  
PROGRAMS

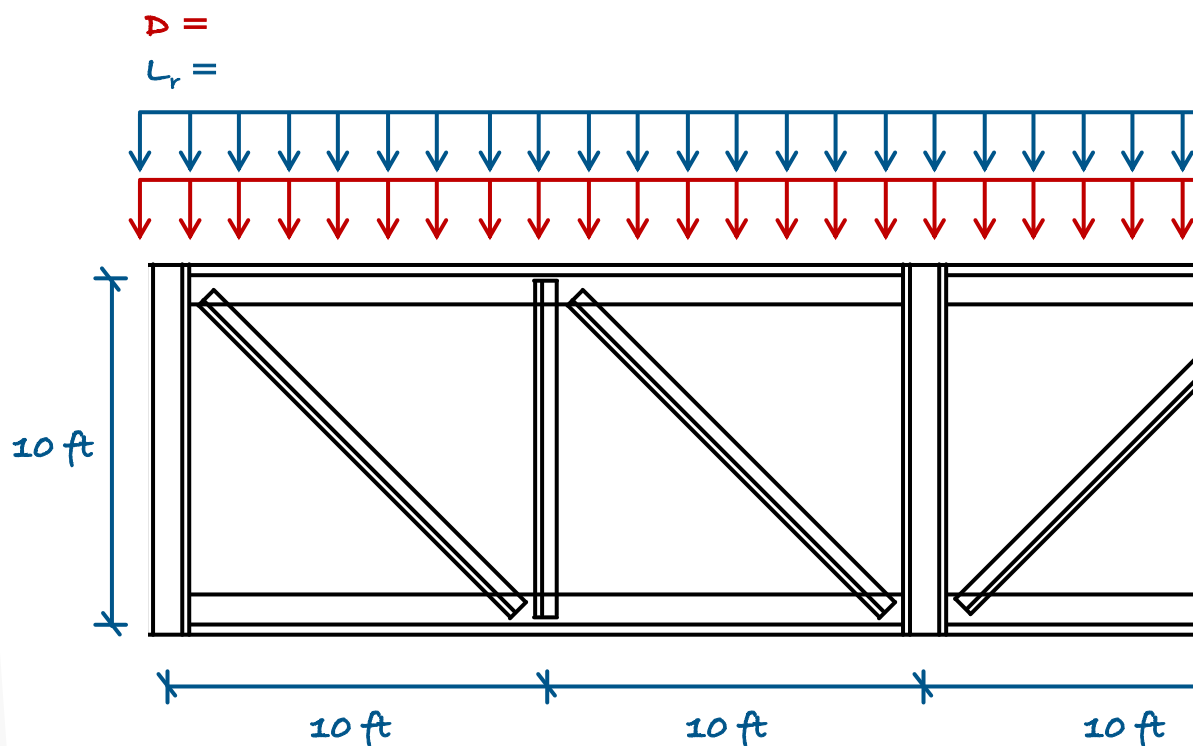
[aisc.org/teachingaids](http://aisc.org/teachingaids)

## Solution

### Tributary Area



### Secondary Truss: Factored Loads [AISC Ch. B, ASCE 7]

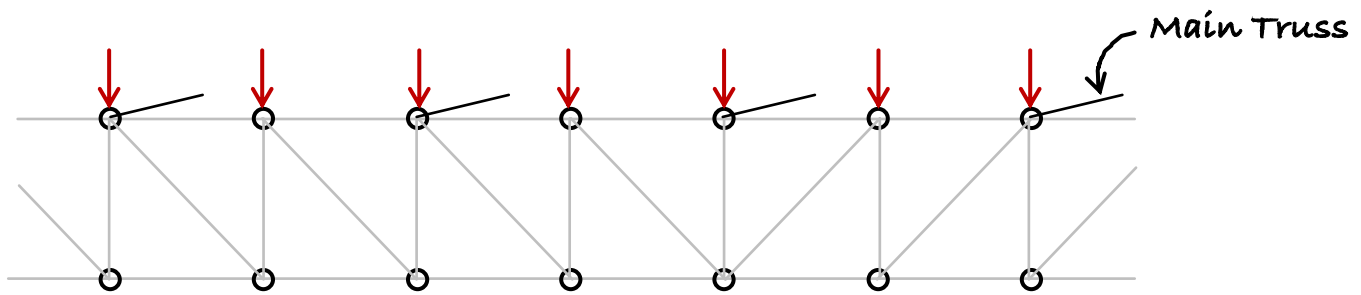


UNIVERSITY  
PROGRAMS

[aisc.org/teachingaids](http://aisc.org/teachingaids)

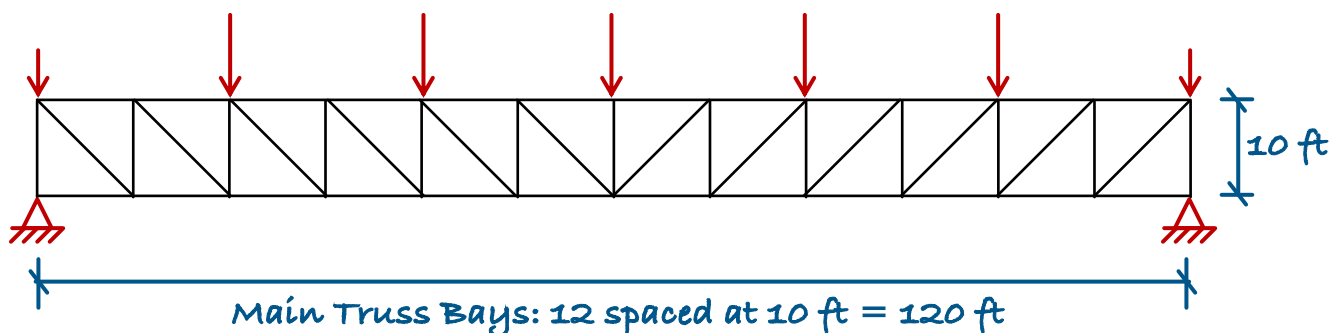
## Solution (cont)

### Secondary Truss: Factored Loads (cont)



### Main Truss: Factored Loads

Secondary Truss frames into Main Truss Every Other Node



### Main Truss: Analysis in MASTAN2

Input members from Main Truss Member Details along with Main Truss Factored loads >> Run Analysis >> Determine highest tension in diagonals

Solution (cont)

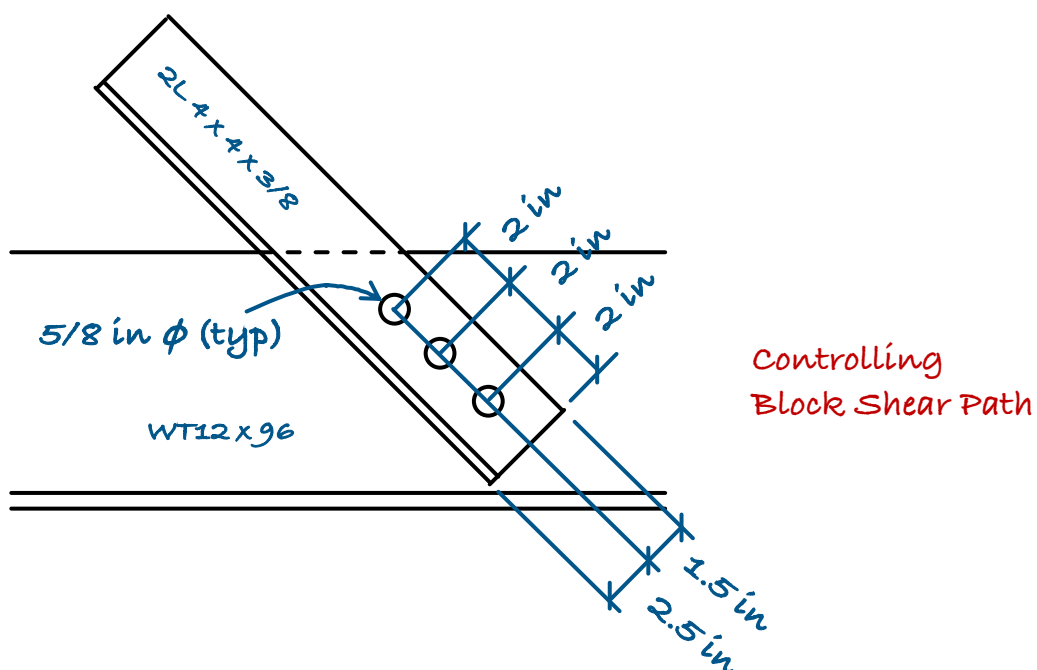
Yielding [AISC Ch. D2]

Tensile Rupture [AISC Ch. D2, D3]



Solution (cont)

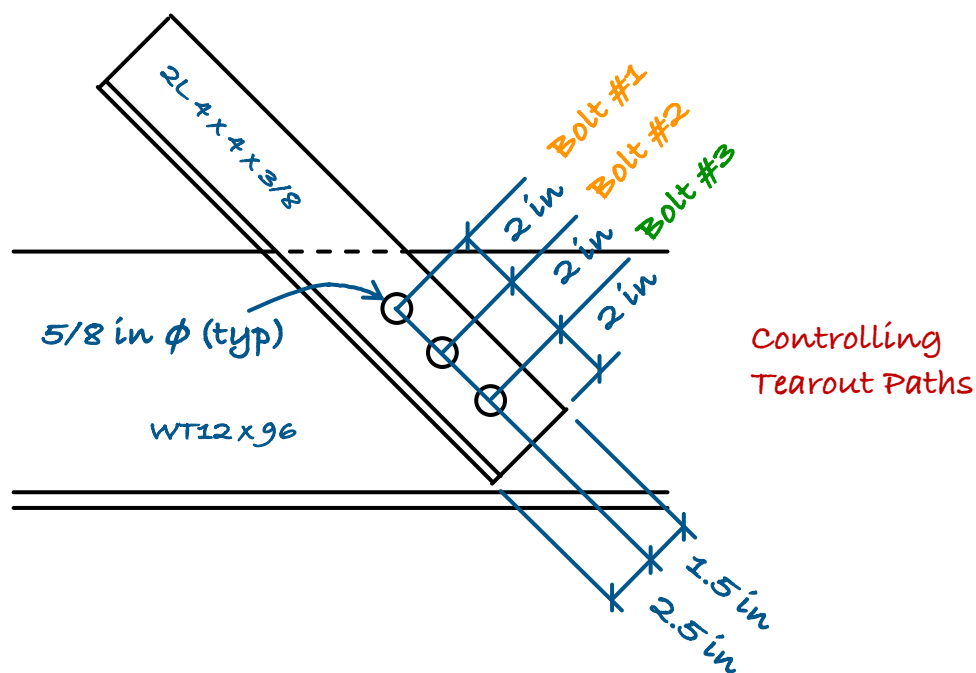
Block Shear [AISC Ch. J4.3]



Solution (cont)

Bearing Strength [AISC Ch. J3.10(1)]

Tearout Strength [AISC Ch. J3.10(2)]



UNIVERSITY  
PROGRAMS

[aisc.org/teachingaids](http://aisc.org/teachingaids)

# Solution (cont)

## Bolt Shear [AISC Ch. J3.6, Table 7-1]

Table 7-1 Available Shear Strength of Bolts, kips												
Nominal Bolt Diameter, $d$ , in.					$\frac{5}{8}$		$\frac{3}{4}$		$\frac{7}{8}$		1	
Nominal Bolt Area, in. <sup>2</sup>					0.307		0.442		0.601		0.785	
Designation	Thread Cond.	$F_{nv}/\Omega$ (ksi)	$\phi F_{nv}$ (ksi)	Load- ing	$r_n/\Omega$	$\phi r_n$	$r_n/\Omega$	$\phi r_n$	$r_n/\Omega$	$\phi r_n$	$r_n/\Omega$	$\phi r_n$
		ASD	LRFD		ASD	LRFD	ASD	LRFD	ASD	LRFD		
Group A	N	27.0	40.5	S D	8.29 16.6	12.4 24.9	11.9 23.9	17.9 35.8	16.2 32.5	24.3 48.7	21.2 42.4	31.8 63.6
	X	34.0	51.0	S D	10.4 20.9	15.7 31.3	15.0 30.1	22.5 45.1	20.4 40.9	30.7 61.3	26.7 53.4	40.0 80.1
Group B	N	34.0	51.0	S D	10.4 20.9	15.7 31.3	15.0 30.1	22.5 45.1	20.4 40.9	30.7 61.3	26.7 53.4	40.0 80.1
	X	42.0	63.0	S D	12.9 25.8	19.3 38.7	18.6 37.1	27.8 55.7	25.2 50.5	37.9 75.7	33.0 65.9	49.5 98.9
Group C	N	45.0	67.5	S D	— —	— —	— —	— —	— —	— —	35.3 70.7	53.0 106
	X	56.5	84.8	S D	— —	— —	— —	— —	— —	— —	44.4 88.7	66.6 133
A307	Not applicable	13.5	20.3	S D	4.14 8.29	6.23 12.5	5.97 11.9	8.97 17.9	8.11 16.2	12.2 24.4	10.6 21.2	15.9 31.9

## Bolt Limit State Summary

Bolt #	Bearing Strength	Tearout Strength	Bolt Shear Strength	Limiting $\phi R_n$
1				
2				
3				
			TOTAL =	



UNIVERSITY  
PROGRAMS