DESIGN OF ALL-BOLTED EXTENDED DOUBLE ANGLE, SINGLE ANGLE, AND TEE SHEAR CONNECTIONS

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ABSTRACT

DESIGN OF ALL-BOLTED EXTENDED DOUBLE ANGLE, SINGLE ANGLE, AND TEE SHEAR CONNECTIONS

This report presents a methodology for the design of all-bolted extended double angle, single angle, and tee shear connections. The report covers only the design of extended connections that involve beams and girders, but the principles set forth can be applied to connections to columns as well. Current steel connection design methodologies do not have standards for the design of extended connections which do not require that the beam be coped to allow clearance for the girder flange. Coping is an expensive and time consuming process which fabricators like to avoid if at all possible. Extended connections are a practical way to avoid coping. Using basic mechanics and code specific equations, a practical design for all-bolted extended shear connections can be derived. The derived methodology is used to formulate design tables that simplify the process. This report includes examples of how to use the design tables to design all-bolted extended connections. The tables include design resistances for a wide range of angle and tee materials and bolts diameters, as well as different connection types.

CHAPTER 1
INTRODUCTION

1.1 Background

Many fabricators and erectors prefer the use of high strength bolts over welding which requires more time to make the connection and higher skilled labor. Therefore, many steel fabricators favor using all-bolted connections in order to eliminate the need for shop and/or field welding.

Steel connections are categorized as either fully restrained (FR) or partially restrained (PR). FR connections assume the connections have sufficient stiffness to maintain the angles between intersecting members (American Institute of Steel Construction (AISC) 1999). PR connections assume the connections have insufficient stiffness to maintain the angles between intersecting members (AISC 1999). When connection restraint is ignored, commonly designated as simple framing, the connections have the following requirements:

1. The connections and the connected members shall be adequate to resist the factored gravity loads as "simple beams."
2. The connections and connected members shall be adequate to resist the factored lateral loads.
3. The connections shall have sufficient inelastic rotation capacity to avoid overload of fasteners or welds under combined factored gravity and lateral loads.

The scope of this research project covers only shear connections and their behavior.

In the case of typical beam-to-girder shear connections, the beam must be coped (top coped, bottom coped, or top and bottom coped) in order to provide clearance for the

girder flange/s. Coping requires the flange of the beam be removed to allow for the necessary clearance. Coping not only requires consideration of other limit states, such as lateral-torsional buckling or local buckling at the reduced section, but coping incurs extra cost as well. All-bolted extended shear connections are a possible solution to eliminate coping.

1.2 Objective and Scope of Work

The purpose of this research project is to determine whether all-bolted extended shear connections, specifically single angle, double angle, and tee connections, are feasible. Currently there are no specific provisions in the AISC *Manual of Steel Construction* (2001) for extended connections of any type. The purpose is to analytically simulate the response of all-bolted connections under a range of loading conditions so that the general behavior of the connection can be established. An analytical methodology will be developed using the current 3rd Edition AISC-LRFD Specification and first principles of engineering mechanics (AISC 1999). The results of this procedure will be used to determine applicable limit states and to develop a rational design procedure for all-bolted extended single angle, double angle, and tee connections.

The scope of this project includes a review of past research done in the area of bolted connections and the development of new analytical models based on existing models developed by previous researchers as well as original models developed at the University of Florida. The models will be used to develop design criteria for the new connections, and design strength tables will be developed using the new design criteria.

CHAPTER 2
LITERATURE REVIEW

A great deal of research has been performed regarding the design and behavior of steel connections the past 50 years, the results of which have been used to create Chapter J of the AISC *Manual of Steel Construction* that deals with joints.

2.1 Connection Types

There are several "standard" types of structural steel connections. They are generally classified into three behavior categories: rigid, semi-rigid, and simple. The difference among the three can be shown through a plot of end moment versus end rotation.

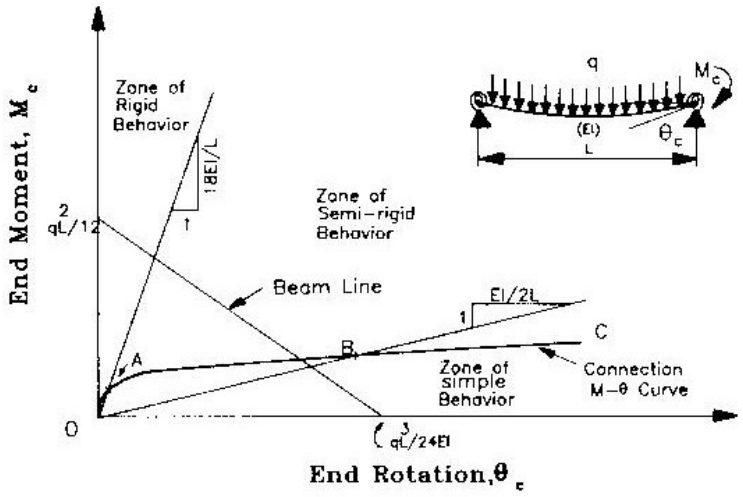

Figure 2.1 Rotational Rigidity of Steel Connections (Astaneh 1989)

The M-θ curve OABC in Figure 2.1 represents the general behavior of connections. Segment OA of the M-θ curve is the segment where connections behave as fully-restrained connection. Connections in this range have an initial rotational restraint

greater than or equal to $\frac{18EI}{L}$ where E is the material's elastic modulus, I is the moment of inertia of the cross-section of the beam and, L is the length of the beam. Connections with an initial rotational restraint less than or equal to $\frac{2EI}{L}$ represented by Segment ABC are considered simply and do not develop any significant moment. The two initial rotational stiffness curves represent the boundaries for a partial-restrained connection. As the figure shows, no connection is truly fixed or truly pinned, but these assumptions greatly simplify the design process. This research project deals only with simple connections which assume that there will be no end moment developed in the beam and that the beam supports will allow unrestrained rotations.

2.2 Bolted Connections

There are two common joining methods in current steel construction: welds and bolts. This research project only deals with bolted connections; therefore, the background information pertains mostly to bolted connections. Bolted connections became popular during the 1950's because previous research had shown that bolts could be used to replace rivets in connections (Kulak et al. 1987). Until that time only rivets were used in connections.

Bolted connections can be tightened to specific levels. The first is a snug tight connection. The bolt is tightened using an ordinary spud wrench to bring the piles, which in this case are the angles or tees and the web of the beam, into firm contact (RCSC 2000). Alternately, a bolt can be pretensioned, in which case it is a pretensioned joint. A bolt must be tightened to its minimum pretension force listed in Table J3.1 of the AISC Specification (AISC 1999). There is no difference in the strength of the two types of

joints, but pretensioning is usually necessary when the connection is subjected to cyclic or tension loads (Kulak et al. 1987). Slip critical connections are required to meet the provisions of Chapter J3.8 of the AISC Specification (AISC 1999). This connection is designed in order to prevent any slip between the faying surfaces. Early research showed that high-strength bolts can be used in a connection in the same manner as rivets (Kulak et al. 1987). This discovery led to the common use of high-strength bolts in connections. Today bolted connections are very popular because they are relatively inexpensive compared to field welding, and they are easy to install.

Bolted shear connections are used in modern steel construction, and extensive research has been conducted on these types of connections (Chen and Lui 1988). There are various types of common shear connections: double angle, single angle, tee, single plate, etc.

The connections that are related to this project include double angle, single angle and tees. Double angle connections are made with two angles, one on each side of the beam to be supported (AISC 1999). These angles may be bolted or welded to the supported beam as well as to the supporting member. Single angle connections are made using an angle on one side of the web of the beam to be supported. This angle is preferably shop bolted or welded to the supporting member and field bolted to the supported beam (AISC 1999). Tee connections are made using a structural tee. The tee is preferably shop bolted or welded to the supporting member and field bolted to the supported beam (AISC 1999).

Research has shown that almost all rotation is provided in the detail material, usually either angles or plates (Kennedy 1969). A typical deformed shape can be seen in

Figure 2.2. As Figure 2.2 shows, most of the rotation in the connection occurs in the legs of the angle that are in the plane of the supporting member. This is relevant because the behavior of extended connections should be similar. The gage distance for the "in-plane" legs for extended and normal shear connections is the same.

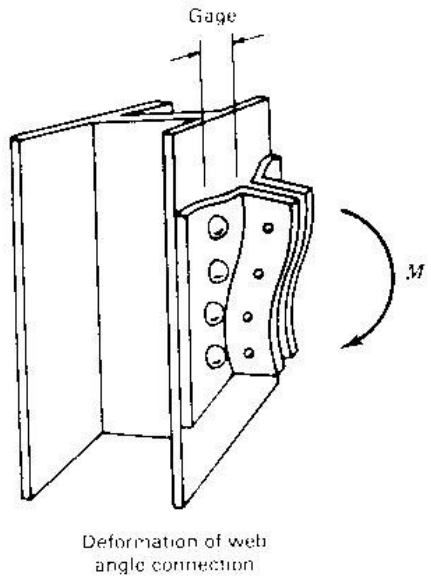

Figure 2.2 Deformation of Web Angle Connection (Kulak et al. 1987)

2.3 Moment-Rotation Behavior of Shear Connections

One possible moment-rotation relationship for bolted double and single angle shear connections was quantified by Kishi and Chen (1990) using a power model relationship between moment in the connection and end rotation. The general deformation of the connection was based on the following assumptions:

1. The center of rotation of the connection was near the mid-depth of the beam during the first few increments of loading.

2. The deformation and subsequent tearing of the connection angles resulted primarily from bending moment, and the effect of shear deformation on the connection behavior was relatively small.

The yield mechanisms depicted in Figure 2.3 were also used in determining the moment-rotation relationship:

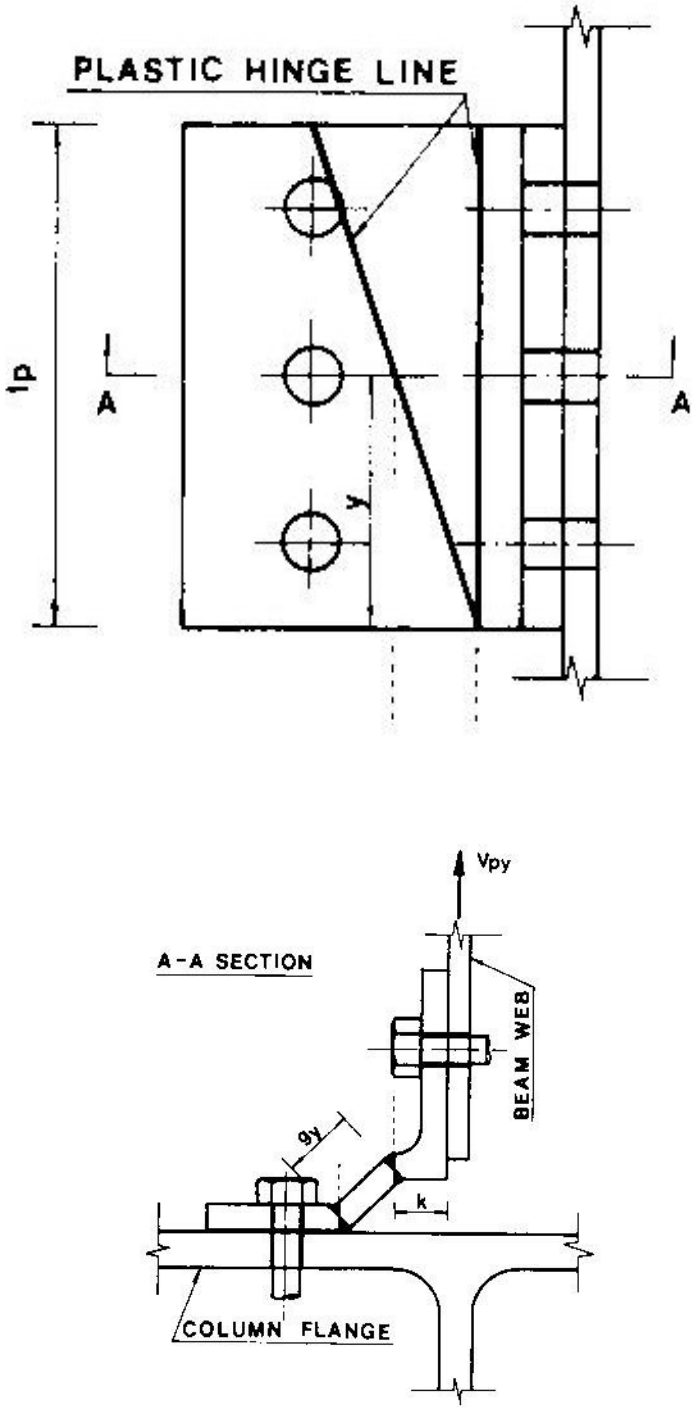

Figure 2.3 Mechanism of the Part of the Angle Connected to the Column Flange at the Ultimate Condition (Kishi and Chen 1990)

The final form of the moment-rotation relationship is given by Equation 2.1 (Kishi and Chen 1990).

$$M = \frac{R_{ki}\Theta_r}{\left(1+\left(\Theta_r / \Theta_0\right)^n\right)^{1/n}} \qquad \text{(Eq. 2.1)}$$

Where:

M = moment in connection (kip-in)

R_{ki} = initial connection stiffness (kip-in)

Θ_r = a rotation of connection (radians)

Θ_0 = a reference plastic rotation (radians)

n = shape factor

The initial connection stiffness is given by Equation 2.2 (Kishi and Chen 1990).

$$R_{ki} = \frac{Gt^3}{3}\frac{\alpha\cosh(\alpha\beta)}{(\alpha\beta)\cosh(\alpha\beta)-\sinh(\alpha\beta)} \qquad \text{(Eq. 2.2)}$$

Where:

G = shear modulus of the steel (ksi)

t = thickness of angle leg (in)

α = 4.2967

$\beta = g_1 / l_p$

Where:

g_1 = gage distance (in)

l_p = length of angle (in)

The reference plastic rotation is given by Equation 2.3 (Kishi and Chen 1990).

$$\Theta_0 = \frac{M_u}{R_{ki}} \qquad \text{(Eq. 2.3)}$$

Where:

M_u = ultimate moment capacity of connection

The model was verified by comparison to various experimental results (Kishi and Chen 1990). The model agrees with Astaneh's recommendations for simple connections, where a simple connection is one that develops a moment at the beam end less than or equal to 20% of the fixed end moment (Astaneh 1989). Most experiments, such as the ones Kishi and Chen used to verify their power model, have been performed for beam-to-column connections only, and have not been directly performed for beam-to girder connections.

2.4 Coping of Beams

Beam-to-girder shear connections are quite common in steel structures, but they can be quite complicated to design. Most beam-to-girder shear connections require that the beam be coped as shown in Figure 2.4 in order to allow clearance for the girder flange and to maintain the floor elevation.

A beam cope requires time and incurs cost to make, and it also reduces the strength of the section that must be accounted for by the designer. This coped section possesses a reduced bending and torsional stiffness, so that buckling, both local and lateral, need be considered (Cheng 1993). High stress concentrations at the coped corner can also induce localized yielding that might cause the beam to fail in inelastic local buckling (Yam et al. 2003).

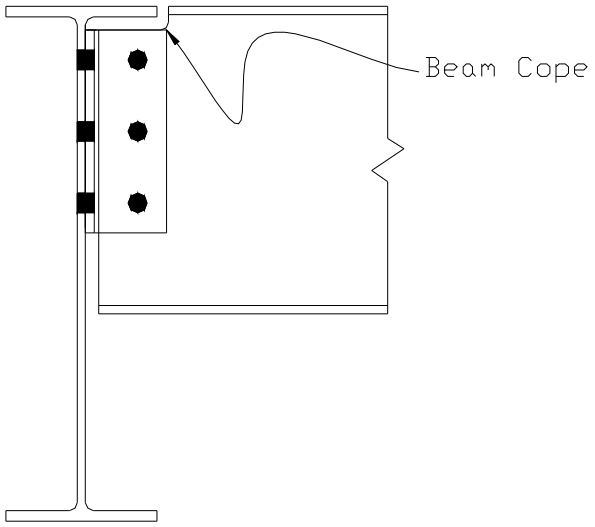

Figure 2.4 Beam Cope

The AISC-LRFD Specification (Appendix F1) requires that coped beams be checked for flexural yielding and local web buckling at the coped section (AISC 1999). This is computationally time consuming because it requires that the coped section properties be calculated. For wide flange sections, this calculation process has been simplified in the AISC Manual (2001) through design aids which have been created that provide these reduced coped section properties.

Today, it is also standard practice to grind the coped area smooth after the flame cutting process in order to avoid the likelihood of fatigue cracks developing if the beam is placed under cyclic loading.

2.5 Tee Connection Behavior

Much research conducted on shear connections focuses on angles, but there has been research conducted on the behavior of tees (Astaneh and Nader 1990). Inelastic analyses of the beams indicate that the end rotation of a simply supported beam approaches 0.03 radians when the mid-span bending moment reaches 99% of the plastic moment (Astaneh 1989). Tee connections allow this behavior as long as the tee meets the following criterion:

3. The bolt diameter to the tab (stem) thickness ratio must be greater than or equal to two $\left(d/t \geq 2\right)$. This criterion guarantees that the tab (stem) experiences ductile bearing failure before the bolts fracture in shear (Thornton 1996).

2.6 Conclusion

The previous research mentioned here has been used to determine a design methodology for all-bolted extended double angle, single angle, and tee connections. The Kishi and Chen model shows that the plastic hinge is developed in the in-plane or girder connected angle legs. This assumption is used in the development of the design tables. The load passes through the centerline of the girder. The plastic hinge is assumed to develop at the centerline of the girder which requires that the outstanding leg bolts be designed for an eccentric load. Prying action can be ignored because the plastic hinge is developed at the girder web.

The extended connection does not require the beam to be coped, so the limit states due to coping do not need to be checked. This reduces the amount of work needed to develop the design tables.

CHAPTER 3
OPTIMUM BAY STUDY

3.1 Bay Studies Program

The Excel spreadsheet Bay Studies 4.1 (AISC 2003) is used to determine a practical range of beam and girder sizes, as well as connection loadings (factored end reactions). The spreadsheet provides a range of beam and girder sizes for user defined parameters such as girder and beam length, loading, composite action, etc. The spreadsheet also provides a materials cost per beam, so that a price estimate can be constructed.

3.2 Bay Study Parameters

3.2.1 Bay Geometry

A range of bays from 20 foot x 20 foot to 40 foot x 40 foot is considered practical, and is used in this study. The bay dimensions are varied in 5-foot increments with no more than 10 feet between the girder length and beam length in any particular bay and vice versa. In order to have a comprehensive number of section sizes, the number of filler beams varies from one per bay to four per bay. The total number of bay geometries considered is 40.

3.2.2 Steel Deck and Slab Properties

The steel deck properties are constant for the whole study, so that the dead load weight added by the steel deck and concrete will not be a factor in the study. The 2-inch deep steel deck is given an average rib width of 6 inches, and a rib spacing of 12 inches. These values are consistent with typical steel deck used in low to mid-rise steel frame

building construction. The concrete for the slab is 3000 psi concrete with a specific weight of 145 pounds per cubic foot (pcf). The concrete slab extends 3 inches above the steel deck, for a total slab depth of 5 inches. The construction is considered to be unshored, which is a common practice.

3.2.3 Loading

The loading for the bays is broken down into four components: dead load, live load, superimposed dead load, and construction live load. The dead load is the combined weight of the steel deck and concrete slab, which is calculated by the spreadsheet to be 51.8 pounds per square foot (psf). The live load is 125 psf which covers a broad range of loading conditions. The superimposed dead load is 20 psf which is the default value for the spreadsheet. The construction live load is also 20 psf which is the default value. The spreadsheet allows for live load reduction, but live load reduction is not considered in the study.

3.2.4 Vibration Criteria and Deflections

The program allows for vibration to be considered in the design process or for a vibrations check to be made. The program allows the user to change the percentage of superimposed dead and live load that participates in damping. Also, the damping ratio for the floor system may be set by the user as well. No vibration check or design is used for the study.

The deflections allowed for the beam and girders may also be set by the user. The limits may be input as either absolute deflections or in limiting deflection ratios, such as L/240. The spreadsheet checks the deflection from live load, dead load, and superimposed dead load. The spreadsheet also checks deflections from combined loading

effects. The allowable deflection ratios are kept at the default values of L/240 for the dead load, and L/360 for the superimposed dead and live loads.

3.2.5 Shear Studs and Composite Action

The spreadsheet allows the user to define the range of composite action allowable (if any) for the member. The spreadsheet allows a minimum and maximum percentage of composite action in the member. The minimum for the study is 25% composite action, and the maximum is 75% composite action. The studs are 3/4-inch in diameter and 4 inches in height and cost $2.50 per stud. This is considered typical for a 5-inch deep slab. The spacing of the shear studs are within the design criteria given in Chapter I of the AISC Specification, which is the default value (AISC 1999). The spreadsheet also lets the users define the spacing limits if they so desire. In this study, the default values are used.

3.2.6 Member Selection and Camber

The spreadsheet allows the user to define the range of wide flange shapes that may be selected. The default values are W12 to W33 shapes for beams, and W18 to W33 shapes for girders. The study uses the default values for both the beams and the girders.

The spreadsheet also allows the user to set the amount of camber (if any) that may be used in the beams and girders. The user can set the minimum and maximum amount of camber to be used, and the camber increment. The default value for the minimum camber is 0.75 inches, and the maximum value is 2 inches. The default camber increment is 0.25 inches. The spreadsheet requires that the amount of dead load to be cambered be set. The default is 75% of the dead load. The default cost of cambering is $20.00 per beam for 2 inches of camber. The study uses all the default values for cambering.

3.3 Optimum Bay Study Results

The results from the spreadsheet are given in a table format. An example is given in Figure 3.1:

Parametric Bay Studies: Output Summary

Project Name: USA Office
Scheme: 27' x 40'
Project Location New York
Company AAARF, Inc.
Analyzed by: JRE **Date:** 3/27/03

Design Criteria

Beam Length =	20 ft	Steel Design Code: LRFD 3rd Edition	Optimized for Cost
Girder Length =	20 ft	Building Code: ASCE 7-02	Vibration Check
Beam Spacing =	10.0 ft		

Results for Floor System Designed for Strength and Deflection Limits

The three most economical beams and girders are shown below.

Beams	Studs	Camber	$ Steel	$ Studs	$ Camber	$ Total	Vibration
W12X19	14	0.00"	$95	$35	$0	$130	OK
W14X22	12	0.00"	$110	$30	$0	$140	OK
W16X26	14	0.00"	$130	$35	$0	$165	OK

Girders	Studs	Camber	$ Steel	$ Studs	$ Camber	$ Total	Vibration
W18X35	7,0,7	0.00"	$175	$35	$0	$210	OK
W18X40	8,0,8	0.00"	$200	$40	$0	$240	OK
W21X44	8,0,8	0.00"	$220	$40	$0	$260	OK

Select a Beam and a Girder Below from the Optimal Choices Shown Above to Calculate Floor System Cost and Weight

Choose Beam: W12X19

Choose Girder: W18X35

Combined Mode Vibration = OK
Floor Steel Weight = 3.65 lb/ft^2
Floor Total Cost = $1.18 /ft^2

Figure 3.1 Bay Studies 4.1 (2003) Results for 20-Foot by 20-Foot Bay with a 10-Foot Beam Spacing

The spreadsheet also provides the calculation worksheet for the beams and girders as shown in Figure 3.2.

The reactions, beam sizes, and girder sizes are recorded and the data is reduced for the 40 cases. Table 3.1 shows the reduced data from the optimum bay study. The range

of girders is W18x35 to W33x130 with most being W24's or smaller. The range of beams is W12x14 to W27x84 with most being W21's or smaller. Additionally, the factored end reaction is provided.

Line Loads (k/ft)

DL	SDL	LL	Red %	CLL
0.537	0.200	1.250	0.0%	0.200

Shear

Maximum Factored Shear, Vu	29 k
Shear Strength, ϕVn	77 k

Moments

Condition	Load Combo	Mu (k*ft)	Phi	ϕMn (k*ft)
Pre Composite	1.2DL+1.6CLL	48.2	0.9	93
Composite	1.4(DL+SDL)	51.6	0.85	152
Composite	1.2(DL+SDL)+1.6LL	144.2	0.85	152

Reactions

DL Reaction	5.4 kips
SDL Reaction	2.0 kips
LL reaction	12.5 kips
CLL reaction	2.0 kips
Total Reaction	28.85 kips

Deflection

		Δ/L
	Camber 0.00 in	
DL	0.51 in	468
LL	0.40 in	600
SDL	0.06 in	3752
Total (DL+LL+SDL-Camber)	0.98 in	246

Cost per Beam

Steel	$95	
Studs	$35	
Camber	$0	
Total	$130	$0.65 /ft^2

Weight

Total/Beam	380 lbs
Steel psf	1.90 psf

Figure 3.2 Bay Studies 4.1 (2003) Beam Calculation Sheet for 20-Foot by 20-Foot Bay with a 10-Foot Beam Spacing

Table 3.1 Range of Girders and Beams for Typical Bay Framing Dimensions

Range of Girders and Beams for Typical Bay Framing Dimensions					
Bay Size 20-feet x 20-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
20	W18x35	20	W12x19	10	29
20	W18x35	20	W12x14	6.67	19
20	W18x35	20	W12x14	5	14
Bay Size 20-feet x 30-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
20	W18x40	30	W18x35	10	44
20	W18x35	30	W14x22	6.67	29
Bay Size 25-feet x 20-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
25	W21x44	20	W14x22	12.5	35
25	W21x44	20	W12x16	8.33	24
25	W18x40	20	W12x14	6.33	18
25	W18x35	20	W12x14	5	14
Bay Size 25-feet x 25-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
25	W21x44	25	W16x31	12.5	45
25	W21x44	25	W16x26	8.33	30
25	W21x44	25	W12x17	6.33	23
25	W21x44	25	W12x12	5	18
Bay Size 25-feet x 35-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
25	W24x62	35	W24x55	12.5	64
25	W24x55	35	W18x35	8.33	42
Bay Size 30-feet x 20-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
30	W24x55	20	W16x26	15	43
30	W21x44	20	W12x19	10	29

Table 3.1-Continued

Range of Girders and Beams for Typical Bay Framing Dimensions (cont.)					
Bay Size 30-feet x 25-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
30	W24x55	25	W18x35	15	54
30	W24x55	25	W16x26	10	36
30	W24x55	25	W14x22	7.5	27
30	W24x55	25	W12x14	6	22
Bay Size 30-feet x 30-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
30	W24x76	30	W21x44	15	65
30	W24x76	30	W18x35	10	44
30	W24x67	30	W16x31	7.5	33
Bay Size 30-feet x 35-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
30	W27x84	35	W24x55	15	76
30	W27x84	35	W21x44	10	51
30	W24x76	35	W16x31	7.5	38
Bay Size 30-feet x 40-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
30	W30x90	40	W24x82	15	87
30	W30x90	40	W21x50	10	58
30	W27x84	40	W18x40	7.5	44
Bay Size 35-feet x 35-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
35	W30x99	35	W24x55	17.5	84
35	W30x99	35	W21x50	11.67	59
35	W30x90	35	W18x35	8.8	45
Bay Size 35-feet x 40-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
35	W33x118	40	W24x68	17.5	102

Table 3.1-Continued

Range of Girders and Beams for Typical Bay Framing Dimensions (cont.)					
Bay Size 35-feet x 40-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
35	W33x118	40	W24x55	11.67	68
35	W30x99	40	W21x44	8.8	51
Bay Size 40-feet x 40-feet					
Girder		Beam		Beam Spacing (ft)	Factored End Shear (kips)
Length (ft)	Section	Length (ft)	Section		
40	W33x130	40	W27x84	20	116
40	W33x130	40	W24x55	13.33	78
40	W33x130	40	W21x50	10	58
40	W33x118	40	W21x44	8	47

The range of factored end reactions range from 14 kips for a 20-foot x 20-foot bay with a 5-foot beam spacing to 116 kips for a 40-foot x 40-foot bay with a 20-foot beam spacing. The average factored end shear is 47 kips.

The wide flange sections in Table 3.1 are chosen because they are the least cost but not necessarily least weight. The cost of the bay includes the cost of the steel, the cost of the shear stud installation, and the cost of cambering. All of the defaults for cost are used and are described earlier in this chapter.

The information from Table 3.1 can be used to reduce the number of all-bolted extended angle and tee tables given in the appendices of this document, by removing the tables that can not be used for the wide flange sections given in Table 3.1.

CHAPTER 4
LIMIT STATES

4.1 Extended Double Angle Connection

Double angles or two-sided connections have certain advantages over one sided connections. Double angle connections can resist larger end reactions because the supported member bolts are in double shear and the eccentricity perpendicular to the beam axis need not be considered for workable gages. The pin in an extended and standard double angle connection is located at the girder web as shown in Figure 4.1.

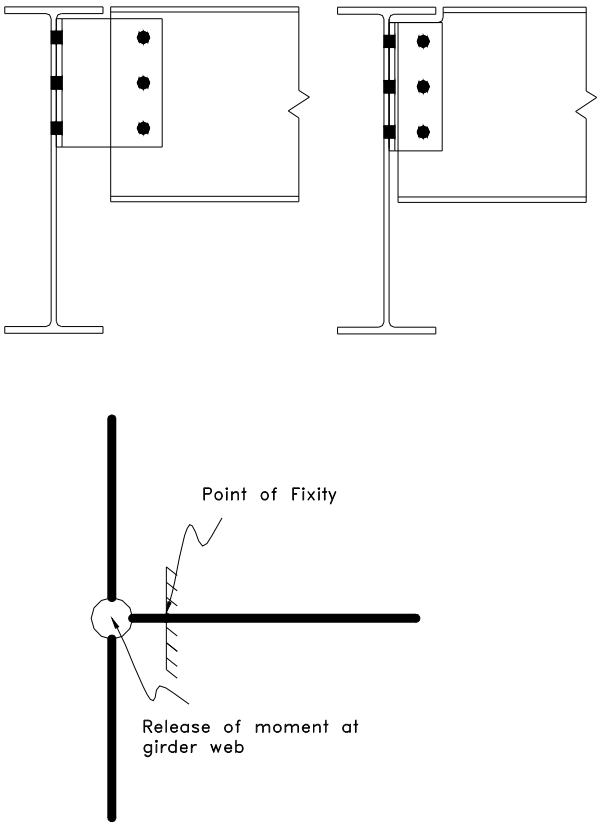

Figure 4.1 Pin and Point of Fixity

Double angle connections usually require that the supported member be coped in order to make the connection. A connection to a coped beam has three limit states at the cope that do not occur in a connection to an uncoped beam; lateral-torsional buckling, local web buckling, and fatigue cracking (Cheng 1993). These limit states are not considered in the analysis of extended double angle connections because there is no coping involved. The following limit states are considered in the design of an extended double angle connection:

1. Shear Yielding
2. Shear Rupture
3. Flexural Yielding
4. Flexural Rupture
5. Block Shear Rupture
6. Bolt Bearing
7. Bolt Slip
8. Bolt Shear

The bolt limit states include effects from the eccentricity of the loading. These limit states are discussed in more detail in Section 4.4 of this chapter.

4.2 Extended Single Angle Connection

A single angle connection uses one angle to make the connection. Single angle connections have the following advantages:

4. Shop attachment of the connection elements to the support, simplifying shop fabrication and erection

5. Reduced material and shop labor requirements

6. Ample erection clearance is provided

7. Excellent safety during erection since double connections often can be eliminated (AISC 1999)

Single angles also have several disadvantages:

8. The supporting member bolts must be designed as eccentrically loaded

9. Single angles have less capacity because the outstanding leg bolts are in single shear and only one angle is used in the connection.

As with the double angle connection the supported beam must typically be coped in order to construct the connection. An extended single angle connection does not require coping of the supported beam; therefore, limit states for coping the beam are no longer applicable. An extended single angle connection includes all of the limit states that were stated previously for extended double angle connections. The point of fixity for a single angle connection is the same as a double angle connection. Single angle connections also require that the bolts perpendicular to the beam are designed for shear and moment due to the eccentricity on these bolts. Therefore, both the supporting and supported bolt lines must be designed with eccentricity considered.

4.3 Extended Tee Connection

Extended tee connections are very similar to extended single angle connections in that the supported member bolts are in single shear. Therefore, these two types of connections have less capacity than an extended double angle connection.

As in the previous types of connections, the line of force in a tee connection acts through the centerline of the supporting member which is the pin of the connection as shown in Figure 4.1. Therefore, prying action is not considered in the design of any of the extended connections. Also, tee connections have two lines of bolts on the supporting member that are symmetrical, so eccentricity on these bolts is not a consideration. Tees are available with a wide range of stem lengths making them the most versatile extended connection type.

4.4 Limit State Calculations

4.4.1 Shear Yielding

Shear yielding is a ductile limit state that is a function of the gross shear area of the element (Green et al. 2001). For single angles and tees, the shear area is equal to the following equation:

$$A_v = h_a t_a \quad \text{(Eq. 4.1)}$$

h_a = the length of the angle or tee

t_a = the thickness of the outstanding angle leg or stem thickness

Double angles have twice the shear area of a single angle by virtue of having two legs in shear. The shear area is used to calculate the shear yielding capacity of the connection. This equation is shown below:

$$\phi R_n = \phi 0.6 A_v F_y \quad \text{(Eq. 4.2)}$$

F_y = yield stress of the detail material

ϕ = 0.90

The equation given above is Equation J5-3 from the AISC-LRFD Specification (AISC 1999). The ϕ term is a resistance factor that is dependent on the limit state. For yielding limit states, ϕ is 0.90. The yield stress, F_y, is either 36 ksi or 50 ksi for A36 or A992 steels, respectively (AISC 2001). Angles used in the study are designed using both A36 and A992 steel while tees are designed with only A992 steel. This limit state is calculated for a range of angles and tees from 5.50 inches to 35.50 inches in length.

4.4.2 Shear Rupture

Shear rupture is also a limit state for the connection. The failure plane is located along the line of the bolts in the supported angle leg/s or tee stem; therefore, a reduced or

net area is used for calculating the shear rupture strength of the connection. The net shear area is calculated using the following equation:

$$A_{nv} = \left[h_a - n(d_h + \frac{1}{16}) \right] t_a \qquad \text{(Eq. 4.3)}$$

n = the number of bolts

d_h = the bolt hole diameter

For the calculation of A_{nv} the AISC-LRFD Specification requires that $1/16$ of an inch be added to the nominal bolt hole diameter when calculating net areas (AISC 1999). The net shear area is the sum of both angles for double angle connections. The shear rupture capacity is given by the equation below:

$$\phi R_n = \phi 0.6 A_{nv} F_u \qquad \text{(Eq. 4.4)}$$

F_u = the ultimate stress of the detail material

$\phi = 0.75$

This equation is also Equation J4-1 in the AISC-LRFD Specification. For rupture limit states, ϕ is 0.75. The ultimate stress, F_u, is either 58 ksi or 65 ksi for A36 and A992 steels, respectively (AISC 2001). The range of angle and tee lengths is the same as for shear yielding.

4.4.3 Flexural Yielding

Flexural yielding of the outstanding angle leg or tee stem is checked in determining the design capacity of the extended connections. In standard connections, flexural yielding need not be considered because the eccentricity of the load is within specified gage distances (AISC 2001). For most flexural limit states, the plastic section modulus, Z, is used to determine the flexural design strength. The AISC-LRFD Manual (2001)

allows the designer to use the elastic section modulus, S, as a conservative approximation when calculating the flexural limit states in connections. The elastic section modulus for the angles and tees is calculated using Equation 4.5:

$$S = \frac{t_a h_a^2}{6} \qquad \text{(Eq. 4.5)}$$

The flexural design strength is given by Equation 4.6:

$$\phi M_n = \phi S F_y \qquad \text{(Eq. 4.6)}$$

$\phi = 0.90$

In order to compare the flexural limit states to the others the moment is converted to a load that acts at an eccentricity. The eccentricity, e, varies depending upon the supported leg or stem length. The eccentricity is assumed to be the distance from the centerline of the supported bolts to the face of the supported web as shown in Figure 4.2.

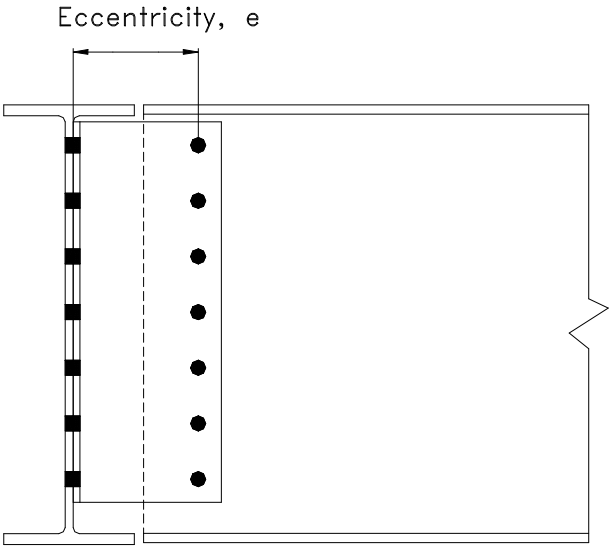

Figure 4.2 Moment Eccentricity

The figure shows the dimension that is used to determine the eccentricity. Therefore, the flexural capacity of the connection is dependent upon the eccentricity

unlike for shear limit states. As the eccentricity increases; the flexural strength decreases. The connection capacity, ϕR_n, is therefore:

$$\phi R_n = \frac{\phi M_n}{e} \qquad \text{(Eq. 4.7)}$$

e = eccentricity

4.4.4 Flexural Rupture

Flexural rupture is an ultimate strength limit state. The net elastic section modulus is conservatively used to determine the section capacity. In Section 15 of the AISC-LRFD Manual, an equation is provided for the net section modulus for bracket plates (AISC 2001). The AISC Manual permits this equation to be used to determine the net elastic section modulus for shear connections. This is a conservative approach because the equation is for the net elastic section modulus, S_{net}, not the net plastic modulus. The equation for S_{net} is given as Equation 4.8:

$$S_{net} = \frac{t_a}{6}\left[h_a{}^2 - \frac{s^2 n\left(n^2 - 1\right)\left(d_h + \frac{1}{16}\right)}{h_a} \right] \qquad \text{(Eq. 4.8)}$$

s = bolt spacing

The equation is found at the bottom of Table 15-2 in the AISC-LRFD Manual. The equation to determine the flexural rupture is below:

$$\phi M_n = \phi S_{net} F_u \qquad \text{(Eq.4.9)}$$

$\phi = 0.75$

The flexural rupture strength of a connection is given in terms of a moment, so the moment, M_n, must be divided by the load eccentricity shown in Figure 4.2 to calculate

the end reaction. As with flexural yielding, flexural rupture follows the same trend that is that as the eccentricity increases, the capacity decreases. Therefore the connection capacity is equal to Equation 4.7.

4.4.5 Block Shear Rupture

Block shear rupture is a limit state in which the failure path includes both an area subject to shear and an area subject to tension (Green et al. 2001). In standard connections there are two possible elements that can experience block shear rupture; the connection element (angle or tee) and the net coped section. Extended connections do not require the supported member to be coped, so block shear rupture will not occur. The only element that needs to be checked for block shear rupture is the angle or the tee. Block shear rupture also has the possibility of occurring across more than one failure plane, but there is only one possible failure plane for an extended connection. Figure 4.2 shows both the shear and tension failure planes.

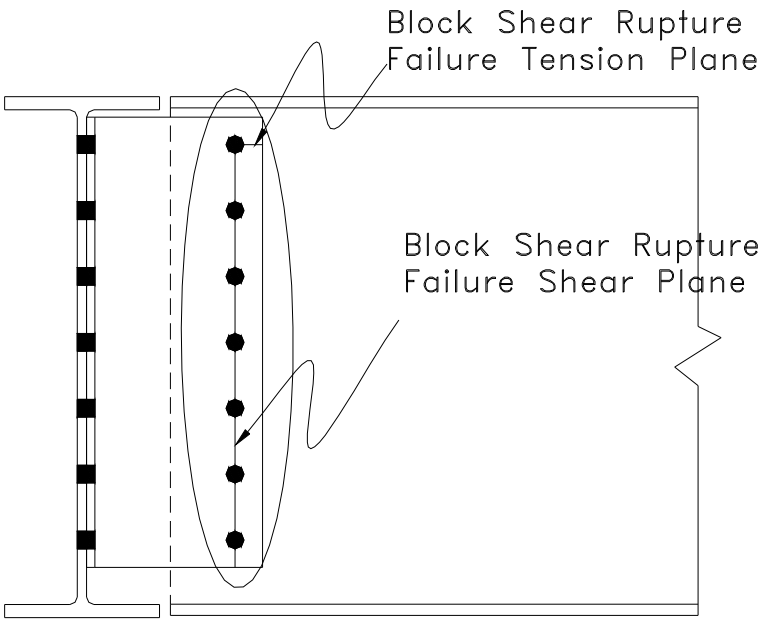

Figure 4.3 Block Shear Rupture Failure Planes

There are two equations that are used to determine the block shear rupture strength of a connection. The equation that controls is dependant on values of tension rupture and shear rupture, and which of the two is greater. All the connections in this research project are controlled by shear rupture, so Equation J4-3b in the AISC-LRFD Specification is used to determine the block shear rupture strength (1999). The equation is shown below:

$$\phi R_n = \phi[0.6F_uA_{nv} + F_yA_{gt}] \leq \phi[0.6F_uA_{nv} + F_uA_{nt}] \quad \text{(Eq. 4.10)}$$

A_{nv} = net area subject to shear

A_{gt} = gross area subject to tension

A_{nt} = net area subject to tension

ϕ = 0.75

Block shear rupture can be conservatively approximated as the shear rupture strength of the connection. The gross area in tension, A_{gt}, is very small, and the difference between the block shear, A_{nv}, and the net area for shear rupture is the value of L_c, which is the clear distance from the outlying bolt and the connection angle or tee edge.

4.4.6 Bolt Bearing

Bolt bearing is concerned with the deformation of material at the loaded edge of the bolt holes (Green et al. 2001). Bearing capacity of the connection is influenced by the proximity of the bolt to the loaded edge, as well as, the spacing between the bolts.

The bolt edge distance is assumed to be 1-1/4 inches. This edge distance is the same as the one given in the double angle tables of Part 10 in the AISC Manual. This edge distance is the minimum for connections using 3/4-inch diameter through 1-inch diameter bolts. This makes the connection as small as possible which widens its range of applicability. Extended connections do not have the same carrying capacity as

equivalent-number-of-bolt standard connections. Therefore, an extra bolt is required in an extended connection to make up for this loss in strength, which requires more space. Lengthening the edge distance would add more capacity to an extended connection, but not enough to overcome the requirement for an additional bolt.

Bolt bearing for the beam and girder are not explicitly checked in the extended connection tables. These two limit states must be checked separately in order to verify the design strength of the connection. For both the girder and the beam the bolt hole deformation will be the limiting factor because there is no chance of the bolt tearing out. Part 10 of the AISC Manual has numbers for these limit states given in a kips per inch of web thickness format.

All bolt limit states are treated as eccentrically loaded. Eccentricity produces both a rotation and a translation of one connection element with respect to the other. The combined effect of this rotation and translation is equivalent to a rotation about a point defined as the instantaneous center of rotation (IC). In order to determine the bolt bearing capacity the instantaneous center (IC) method is utilized. This method includes the nonlinearity of the bolt deformation. The AISC-LRFD Manual has tables with IC method coefficients in Chapter 7 (2001). These tables are designed for a bolt group containing 2 to 12 bolts and eccentricities up to 36 inches. These coefficients are multiplied by the bearing capacity of a single bolt.

The bolt bearing equation given in the AISC-LRFD Specification as Equation J3-2a is given below:

$$\phi R_n = \phi 1.2 L_c t_a F_u \leq \phi 2.4 d_h t_a F_u \qquad \text{(Eq. 4.11)}$$

$\phi = 0.75$

L_c = clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material.

The Equation 4.11 considers bolt hole deformation at service loads, a conservative assumption. The equation above does not include effects from load eccentricity. The value from the equation above for one bolt is determined and multiplied by the appropriate C coefficient for the IC method. The equation is Equation 4.12:

$$\phi R_n = \phi C r_n \qquad \text{(Eq. 4.12)}$$

ϕ = 0.75

C = IC coefficient

r_n = the bearing design strength for one bolt

4.4.7 Bolt Slip

Bolt slip is considered in slip critical connections. In the design tables in the appendices of this document, slip critical connections for three different hole types are considered. Equations for bolt slip do not include effects of bolt eccentricity. The slip critical value for one bolt is determined and multiplied by the C coefficient from the IC method. The equation for bolt slip is given below:

$$\phi R_n = \phi 1.13 \mu T_b N_s N_b \qquad \text{(Eq. 4.13)}$$

ϕ = resistance factor ranging from 1.0 to 0.85

μ = mean slip coefficient (Class A μ = 0.33, Class B μ = 0.5)

T_b = minimum fastener tension given in AISC LRFD Specification Table J3.1

N_s = number of slip planes

N_b = number of bolts

The ϕ-factor for standard holes is 1.0, while the ϕ-factor for oversized and short-slotted holes is 0.85. The minimum fastener tension is a function of bolt diameter. The slip capacity of the connection is the slip capacity of one bolt multiplied by the C coefficient.

4.4.8 Bolt Shear

Bolt shear is applicable to each bolted ply of a connection that is subjected to shear (Green et al. 2001). The shear strength of a bolt is directly proportional to the number of interfaces (shear planes) between the plies within the grip of the bolt that a single shear force is transmitted through. The outstanding legs of double angle connections have two shear planes, while the outstanding leg or stem for single angle and tee connections have one shear plane. The equation for bolt shear is shown below:

$$\phi R_n = \phi F_v A_b N_s N_b \qquad \text{(Eq. 4.14)}$$

$\phi = 0.75$

F_v = bolt ultimate shear stress

A_b = nominal cross-sectional area of bolt

N_s = number of shear planes

N_b = number of bolts

As with the other bolt limit states, the bolt shear equation does not include the effects of load eccentricity. The shear strength of one bolt is calculated and multiplied by the C coefficient. This is equivalent to Equation 4.12 except the ϕ-factor is not applied because it is applied in Equation 4.14.

CHAPTER 5
EXTENDED DESIGN TABLE CONSTRUCTION

5.1 Extended Single and Double Angle Table Construction

The process that has been used to develop the design tables for single and double angles is divided into three phases:

10. Determine the applicable limit states for these connections;
11. Calculate the connection strength based on the limit states previously determined; and,
12. Reduce the data and compile into a series of connection design aid tables.

The first and second phases have been discussed in Chapter 3.

Tables have been developed for six, seven, eight, and nine-inch leg angles; 3/4, 7/8 and, 1-inch diameter ASTM A325/F1852 and ASTM A490 bolts, and ASTM A36 and ASTM A992 angle material. Currently, 9-inch angles are not available from steel mills, but are included because of the possible future demand for longer angle legs if the use of extended connections is shown to be cost effective. All supporting and supported members are assumed to be A992 wide flange structural shapes. All edge distances are assumed to be 1¼-inch. The controlling limit state is highlighted in the extended angle connection tables. All the design tables are located in the Appendix section of this document. The single and double angle tables are categorized by angle material (either A36 or A992) and bolt diameter (3/4-inch, 7/8-inch, 1-inch).

All connections that appear in the tables have controlling limit states that involve the bolts or the material around the bolts in the case of bolt bearing. The connection

angles never reach their yield or fracture limit states before a bolt limit state is reached. For many of the longer outstanding leg connections, the minimum connection strength (10 kips) specified in Section J1.7 of the AISC-LRFD Specification (AISC 1999) is not reached before the connection fails. Also, not all wide flange structural shapes allow for extended angle connections when used as girders. Many heavier wide flange sections have flanges whose flange width, b_f, will not allow for any practical extended connection to be used. In the tables, all design strength values are provided even though any connection with a strength less than 10 kips cannot be used.

The third phase of constructing the tables consists of compiling all of the strengths from each limit state and determining the controlling limit state. All of these calculations were computed via an Excel Spreadsheet. The tables are categorized by the following criteria:

- Length of outstanding angle leg
- Number of bolts in a single row
- Bolt type (A325/F1852, A490)
- Connection type (Threads excluded (X), included (N), or slip critical (SC))
- Angle thickness
- Bolt diameter
- Type of bolt hole (STD, OVS, SSLT)

The tables display the overall design strength of the connections, ϕR_n and the appropriate limit state. Bolt bearing on the beam and girder webs is not considered in the extended angle design strength tables, and must be checked separately by the designer.

5.2 Extended Tee Table Construction

The extended tee tables are developed using the same methodology as the single and double angle tables with some exceptions. Tees and angles are similar in that they both have the same limit states, and that the controlling limit states always involve the

bolts or the material around the bolts in the case of bolt bearing. The load is assumed to have a line of action through the girder web which would eccentrically load the outlying or stem bolts. The supporting member bolts are in a state of direct shear. The tee stem must also be checked for flexural yielding and flexural rupture.

Extended tees pose the challenge of determining what eccentricity to use because there are such a wide variety of tee sections. Two approaches are used to calculate the design capacity of an extended tee connection:

1. Specify a rational number of eccentricities that cover most cases of extended tee connections, i.e. eccentricities that will extend beyond a majority of girder flanges;

2. Formulate an equation that is a function of eccentricity and the number of bolts. The equation gives the appropriate eccentricity coefficient that is used to determine the strength of the connection.

5.2.1 Extended Tee Tables

The extended tee design tables are given in Appendices M through O of this document. The tee tables have a similar format to the angle tables, with some differences. Due to the wide range of tees available, any eccentricity is possible. Using the data from the parametric bay study, a practical range of eccentricities was determined. The range of eccentricities for the tables ranges from 5 inches to 12 inches. This range covers numerous beam-to-girder connections found in commercial steel building design. The designer may also linearly interpolate between the values of eccentricity.

The wide variety of tees also allows for a wide range of stem thicknesses. The stem thickness is one of the limiting factors in the design of extended tee connections. The controlling limit state changes depending on the stem thickness. After a certain limiting thickness is reached, the limit state changes from a bearing limit state to either a bolt shear or slip critical limit state. The limiting thickness is equal to the shear or slip

capacity divided by the bearing capacity for a one inch thick tee stem. Therefore, the values given in the tables are in units of either kips per inch of tee stem thickness or in kips, depending on the controlling limit state. The highlighted rows are in units of kips and have either bolt shear or bolt slip as the controlling limit state depending on the connection type. The unhighlighted rows are in units of kips per inch of tee stem thickness for the bolt bearing limit state.

The AISC Specification requires that tees are configured so that flexing of the tee accommodates the simple-beam end rotation (AISC 1999). The AISC Manual gives an equation in Part 9 for maximum tee stem thickness.

$$t_{s\,max} = \frac{d_b}{2} + 1/16 \text{ in.} \qquad \text{(Eq. 5.1)}$$

d_b = bolt diameter (in.)

The tables for extended tees do not check this requirement for ductility. There is the possibility that because of the extended stem length that this requirement is not applicable.

5.2.2 Extended Tee Equation

In order to have a more general solution than the one presented by the extended tee tables, Equation 5.1 has been formulated to determine the design capacity of an extended tee connection. The limit states for an extended tee connection always involve the bolts connecting the tee to the supported member. Therefore, a similar approach to the C-coefficients given in Chapter 7 in the AISC Manual (2001) has been developed.

The formulation involved plotting the IC coefficients for each bolt group (from 2 bolts to 12 bolts). The plots for each group were than curve-fit to determine a general relationship.

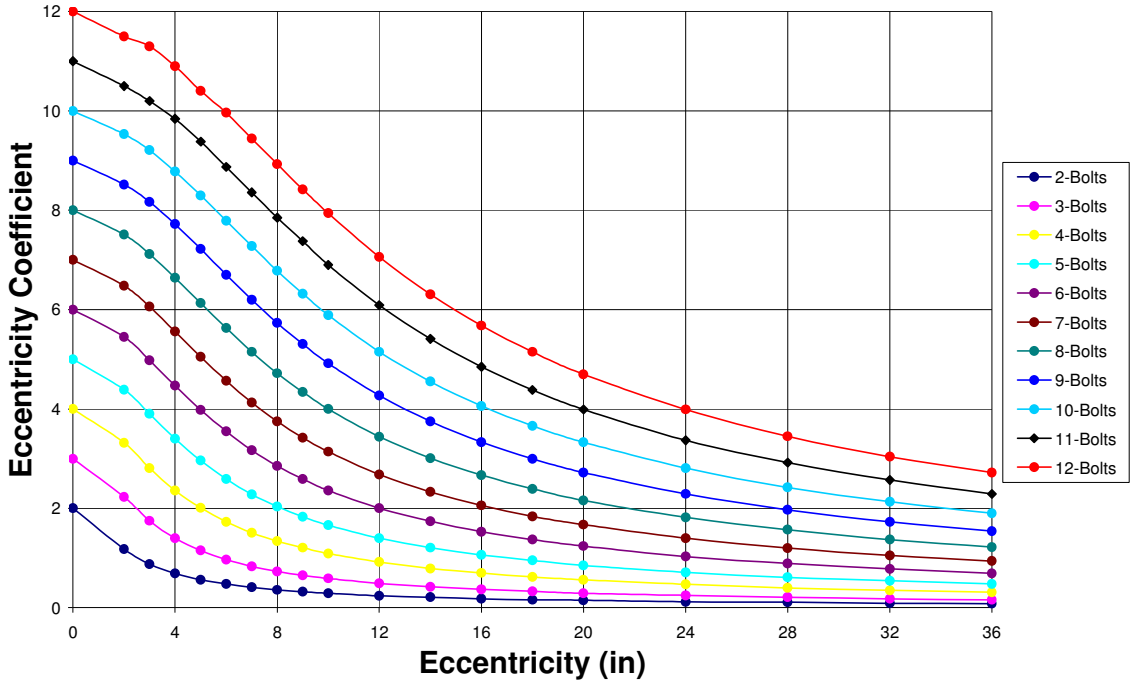

Figure 5.1 Eccentricity Coefficients for Tees

The curves are logarithmic in nature, but a governing equation could not be determined using all twelve curves. Using the parametric bay study to determine the highest practical shear reaction, the number of curves was reduced from 11 to 7. The excluded curves include those using 9 bolts or above, therefore; the retained curves include only those using between 2 and 8 bolts. The retained curves were bounded between an eccentricity of 5 and 16 inches because this was deemed the practical range for extended connections.

The reduced set of curves was fit with logarithmic curves and from that a general equation was derived:

$$IC = C_1 \ln(e_x) + C_2 \qquad \text{(Eq. 5.2)}$$

Where:

IC = instant center coefficient

C_1 = first coefficient of number of bolts

C_2 = second coefficient of number of bolts

e_x = bolt eccentricity

The coefficients were determined by curve fitting the reduced results shown in Figure 5.1. Those results are given in Figure 5.2 shows the new plot with the fitted curves.

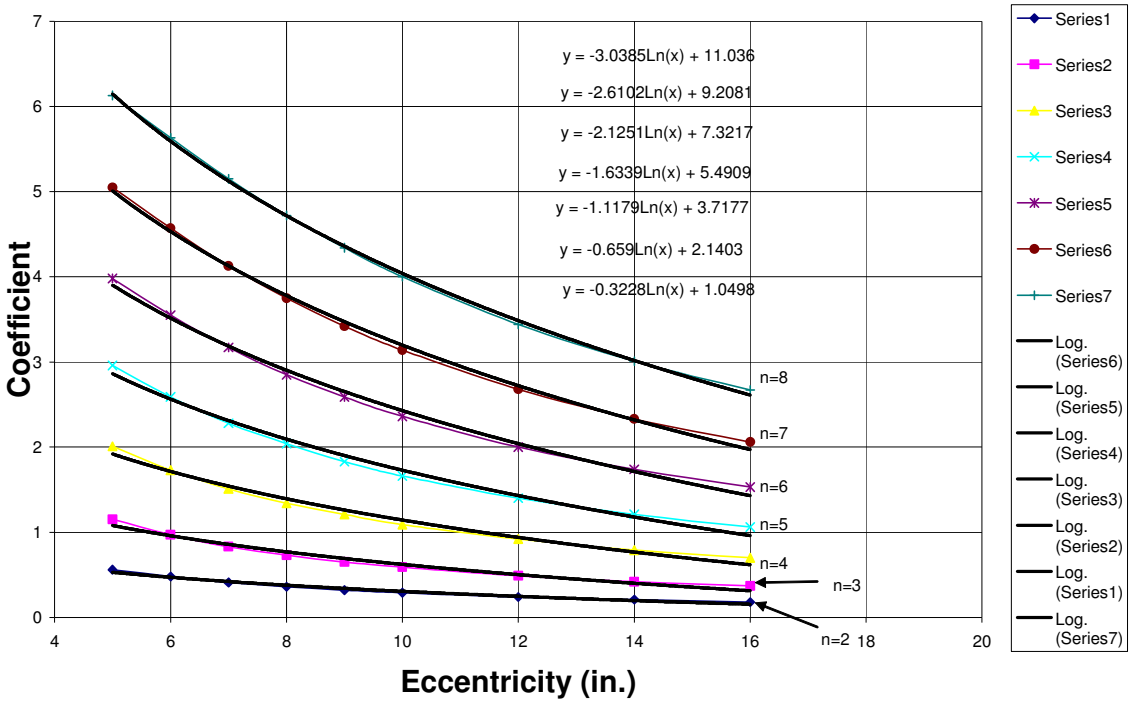

Figure 5.2 Retained Eccentricity Curves

The coefficients for the fitted curves from Figure 5.2 are plotted with respect to number of bolts. Figures 5.3 and 5.4 show the coefficient curves with the fit equations for coefficients C_1 and C_2. Equations 5.2 and 5.3 give the final expression for coeffiecents C_1 and C_2, respectively. The coefficients are a function of the number of bolts in the tee stem. Both equations are second order equations and are used to calculate the IC coefficient necessary for a particular connection.

$$C_1 = -0.0065n^2 - 0.4018n + 0.5521 \quad \text{(Eq. 5.3)}$$

Where:

n = number of bolts in the tee stem

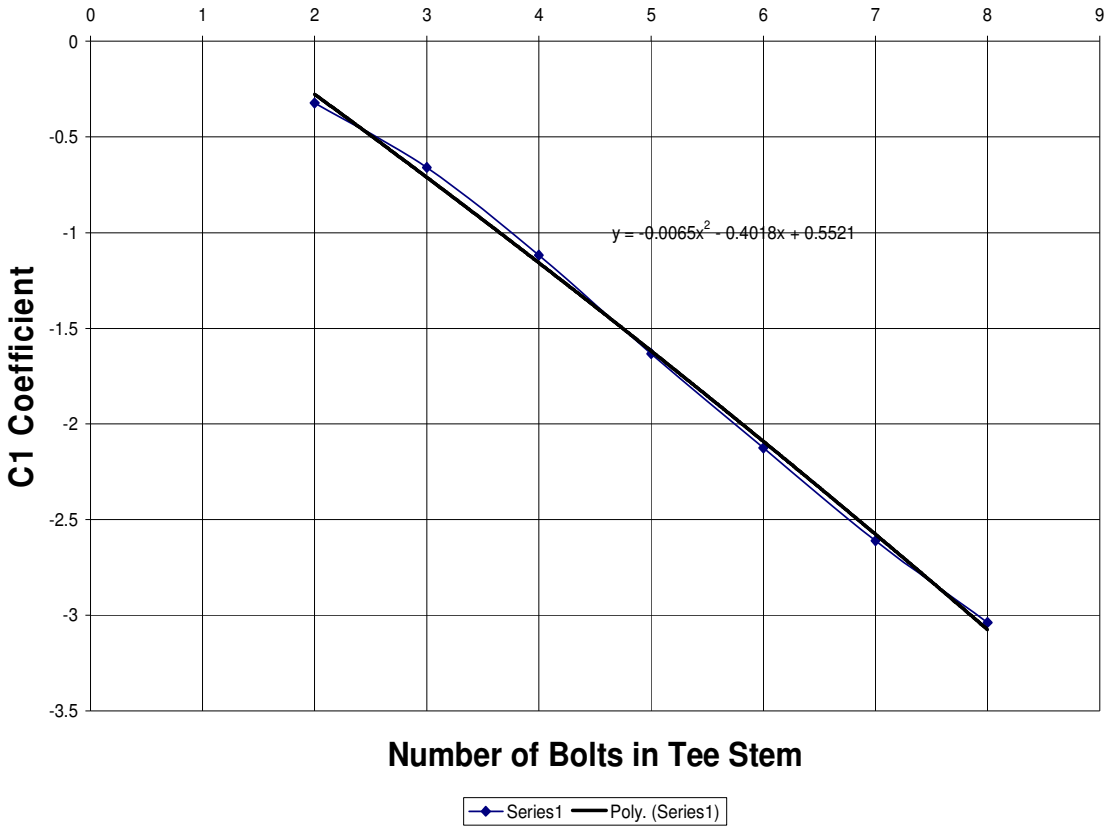

Figure 5.3 Coefficient C_1 Curve

$$C_2 = 0.0637n^2 - 1.0669n - 1.4715 \quad \text{(Eq. 5.4)}$$

Using Equations 5.1 through 5.3, an instantaneous center coefficient can be calculated. The IC coefficient is multiplied by the least design strength of one bolt; determined by the limit states of either bolt shear strength, bearing strength at the bolt holes, or slip resistance (if the connection is to be slip critical). The design strength is given as Equation 5.5:

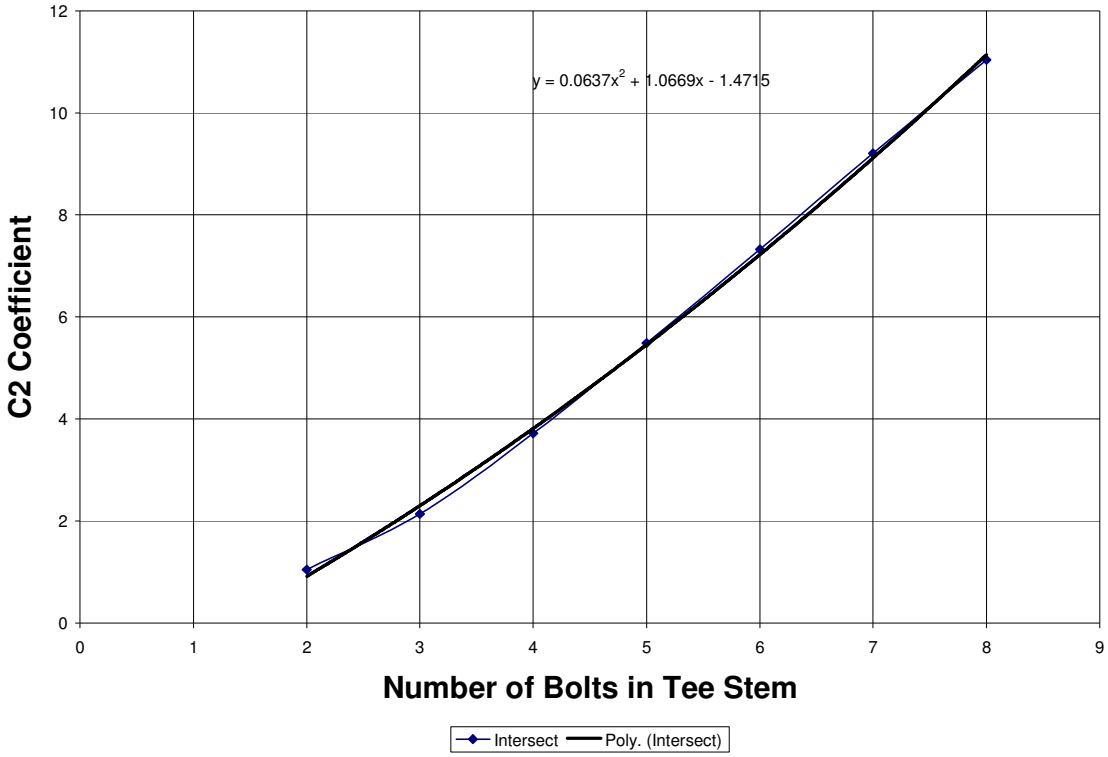

Figure 5.4 Coefficient C_2 Curve

$$\phi R_n = [C_1 \ln(e_x) + C_2] \times \phi r_n \qquad \text{(Eq. 5.5)}$$

ϕ = resistance factor (varies depending on limit state)

R_n = nominal strength of connection

r_n = nominal strength of one bolt

The equation method of determining the design strength for extended tee connection is slightly limited. The equations only apply for the number of bolts in the tee stem ranging from 2 to 8, and the eccentricity of the load must be between 5 and 16 inches.

CHAPTER 6
DESIGN EXAMPLES

6.1 Extended Double Angle Design Example

The following example is intended to show the use of the design tables in the appendices to design an all-bolted extended double angle connection. The connection to be designed is taken from the results of the parametric bay study. The problem statement is given in the following paragraph.

Design the all-bolted double-angle shear connection shown in Figure 6.1. The connection should be designed as an extended connection. Use A36 material for the connection angles and 3/4 inch diameter A325 bolts. The connection is carrying a factored load of 19 kips which was determined using the parametric bay study spreadsheet provided by AISC (AISC 2003). Lastly, draw a detail of the designed connection.

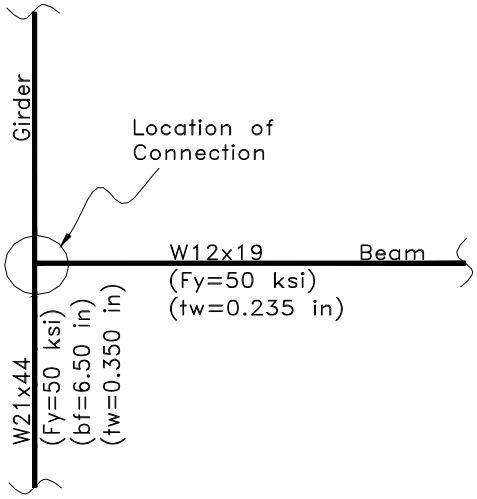

Figure 6.1 Plan View of Extended Double Angle Connection Location

Step 1- Design Bolts and Angles

Calculate the required length of the outstanding angle leg. Equation 6.1 can be used to determine the necessary outstanding angle length.

$$e_a = \frac{b_f}{2} + 3.5 \qquad \text{(Eq. 6.1)}$$

b_f = girder flange width (inches)

$$e_a = \frac{6.50}{2} + 3.5 = 6.75 \text{ in.}$$

For this example, e_a is equal to 6.75 inches which requires a 7-inch outstanding angle leg in order to clear the girder and beam flanges.

Step 2- Select Extended Connection

Use the all-bolted extended double angle design tables and choose an appropriate connection. Using the tables in Appendix A, a connection can be chosen. A 3-bolt connection using 5/16-inch thick A36 angles will work.

$$\phi R_n = 27.9 \text{ kips} \geq 19 \text{ kips} \qquad \text{(Eq. 6.2)}$$

The values given in the tables are for the design strength, therefore; they are compared to the factored loads directly. The controlling limit state is bolt bearing on the outstanding angle legs which can be seen by the color coding in Appendix A.

Step 3-Check supported beam web

From Table 10-1 in the AISC Manual, for three rows of bolts, beam material of F_y = 50 ksi and F_u = 65 ksi, and L_{ev} = 1.25 in. and L_{eh} = 1.25 in., and the beam is uncoped (AISC 2001). This is a bolt bearing limit state check on the supported beam web.

$$\phi R_n = (263 \text{ kips/in.})(0.235 \text{ in.}) \qquad \text{(Eq. 6.3)}$$

$$= 61.8 \text{ kips} \geq 19 \text{ kips}$$

The supported beam web has sufficient strength and because the beam is uncoped that is the only limit state for the beam that needs to be checked.

Step 4-Check supporting girder web

From Table 10-1 in the AISC Manual, for three rows of bolts and girder material of F_u = 65 ksi (AISC 2001). This is a bolt bearing limit state check on the supporting girder web.

$$\phi R_n = (526 \text{ kips/in.})(0.350 \text{ in.}) \quad \text{(Eq. 6.4)}$$

$$= 184 \text{ kips} \geq 19 \text{ kips}$$

The detailed connection is summarized in Figure 6.2

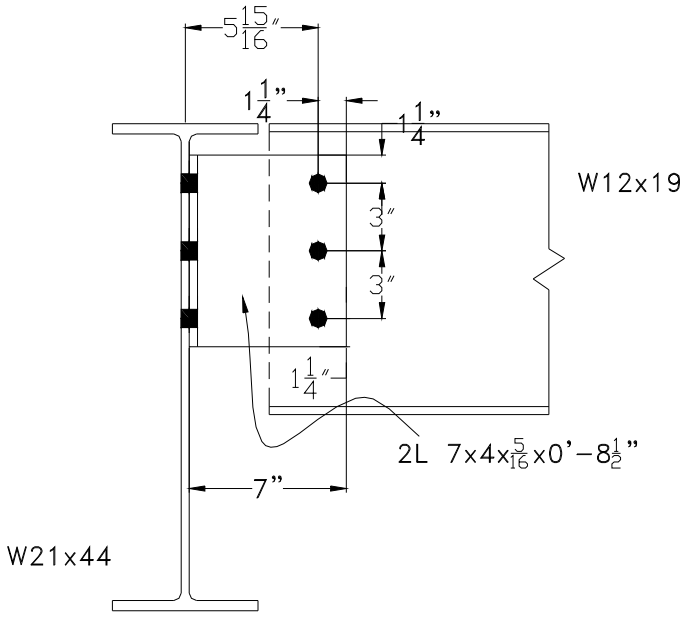

Figure 6.2 Extended Double Angle Detail

Step 5-Design Standard Connection

The design of the standard double angle connection is checked by MathCAD worksheets (Green et al. 2001). The connection requires three 3/4-inch diameter bolts, in order for the angle to be greater than half the T-depth of the beam.

$$\phi R_n = 42.8 \text{ kips} \geq 19 \text{ kips} \qquad \text{(Eq. 6.5)}$$

The controlling limit state is bolt bearing on the outstanding leg. The detail for the connection can be seen in Figure 6.3.

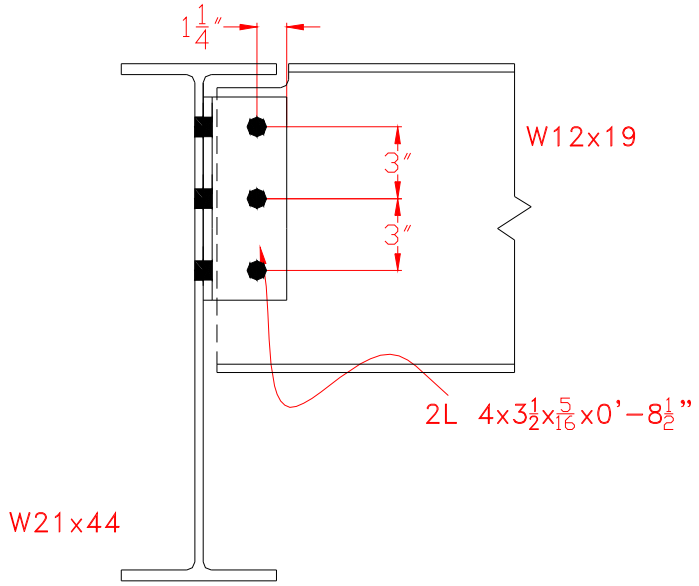

Figure 6.3 Standard Double Angle Detail

6.2 Extended Single Angle Design Example

The following example is intended to show the use of the design tables in the appendices to design an all-bolted extended single angle connection. The connection to be designed is taken from the results of the parametric bay study. The problem statement is given in the following paragraph.

Design the all-bolted single-angle shear connection shown in Figure 6.4. The connection should be designed as an extended connection. Use A36 material for the

connection angles and 3/4 inch diameter A325 bolts. The connection is carrying a factored load of 50 kips, which was determined using the parametric bay study spreadsheet provided by AISC (AISC 2003). Lastly, draw a detail of the designed connection.

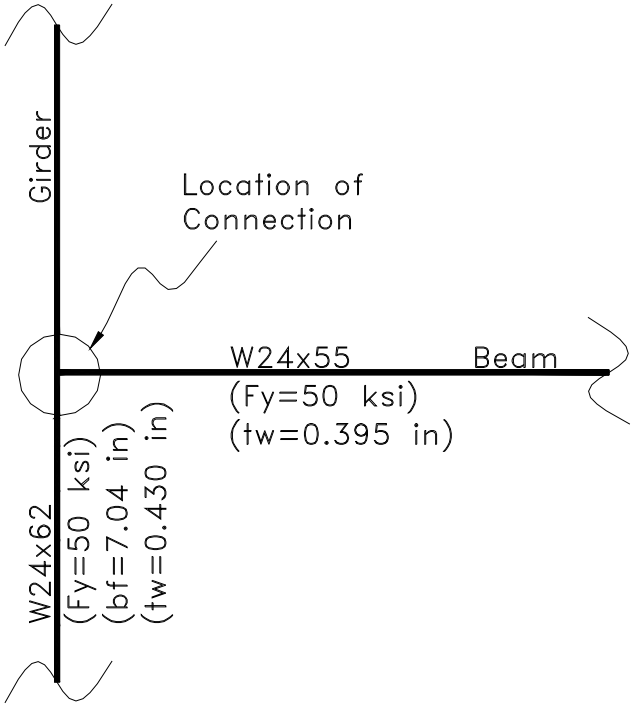

Figure 6.4 Plan View of Extended Single Angle Connection Location

Step 1-Design Bolts and Angle

First calculate the required length of the angle. Equation 6.1 can be used to determine the necessary outstanding angle length.

$$e_a = \frac{7.04}{2} + 3.5 = 7.02 \text{ in.} \qquad \text{(Eq. 6.6)}$$

For this example, e_a is equal to 7.02 inches which requires a 7-inch outstanding angle leg in order to clear the girder and beam flanges.

Step 2-Select Extended Connection

Use the all-bolted extended single angle design tables and choose an appropriate connection. Using the tables in Appendix G, a connection can be chosen. A 6-bolt connection using a 3/8-inch thick A36 angle will work.

$$\phi R_n = 58.2 \text{ kips} \geq 50 \text{ kips} \qquad \text{(Eq. 6.7)}$$

Step 3-Check supported beam web

From Table 10-1 in the AISC Manual, for six rows of bolts, beam material of F_y = 50 ksi and F_u = 65 ksi, and L_{ev} = 1.25 in. and L_{eh} = 1.25 in., and the beam is uncoped (AISC 2001).

$$\phi R_n = (526 \text{ kips/in.})(0.395 \text{in.}) \qquad \text{(Eq. 6.8)}$$

$$= 208 \text{ kips} \geq 50 \text{ kips}$$

The supported beam web has sufficient strength and because the beam is uncoped that is the only limit state for the beam that needs to be checked.

Step 4-Check supporting girder web

From Table 10-1 in the AISC Manual, for six rows of bolts and girder material of F_y = 50 ksi and F_u = 65 ksi , using half the value because this is a single angle connection (AISC 2001)

$$\phi R_n = \tfrac{1}{2}(1050 \text{ kips/in.})(0.430 \text{ in.}) \qquad \text{(Eq. 6.9)}$$

$$= 226 \text{ kips} \geq 50 \text{ kips}$$

The detailed connection is summarized in Figure 6.5

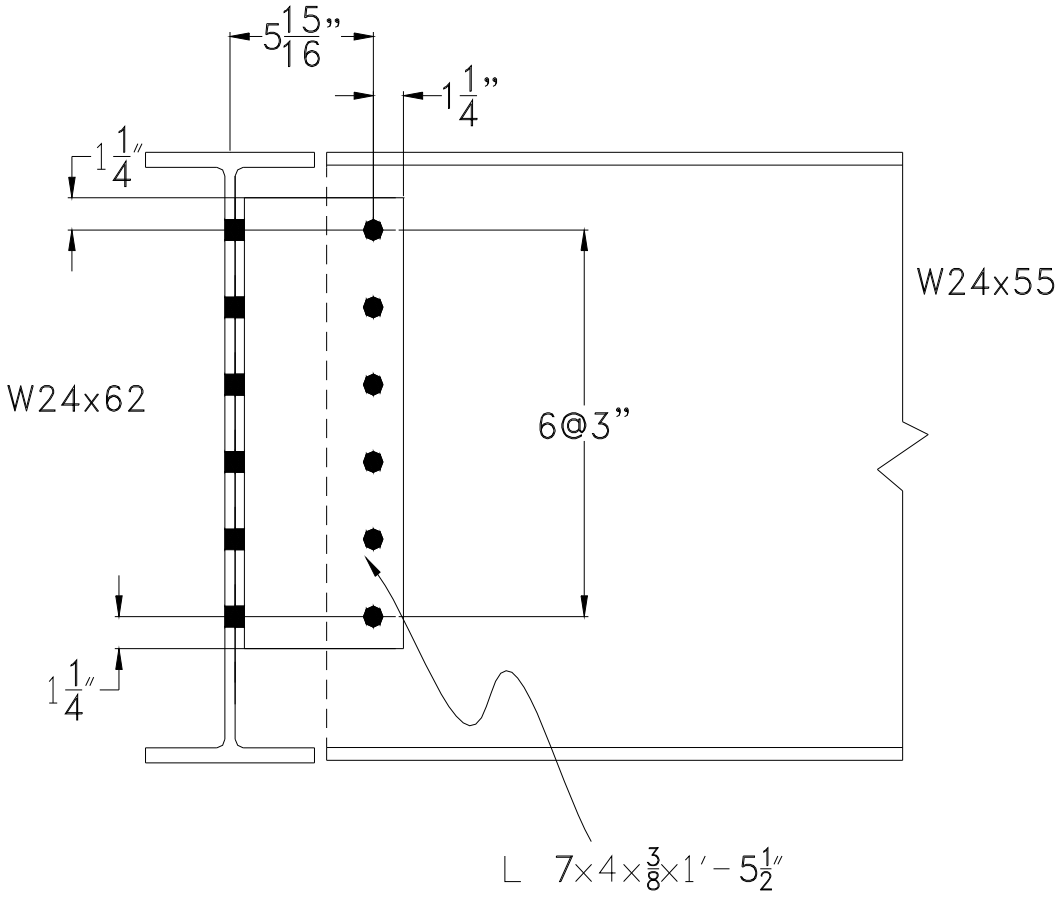

Figure 6.5 Extended Single Angle Detail

Step 5-Design Standard Connection

The design of the standard single angle connection is checked by MathCAD worksheets (Green et al. 2001). The connection requires only four 3/4-inch diameter bolts, but the beam must be coped top and bottom in order to fit within the girder T-dimension.

$$\phi R_n = 63.6 \text{ kips} \geq 50 \text{ kips} \qquad \text{(Eq. 6.10)}$$

The controlling limit state is bolt shear on the outstanding leg. The detail for the connection can be seen in Figure 6.6.

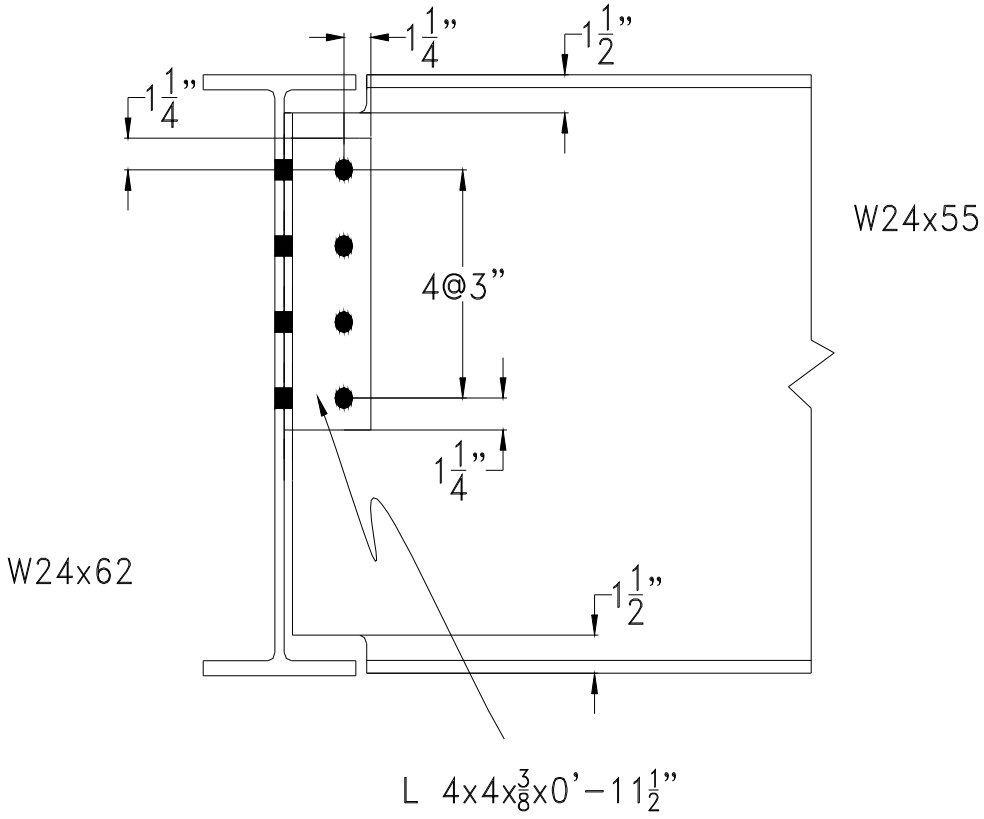

Figure 6.6 Standard Single Angle Detail

6.3 Extended Tee Design Example

The following example is intended to show the use of the design tables in the appendices to design an all-bolted extended tee connection. The connection to be designed is taken from the results of the parametric bay study. The problem statement is given in the following paragraph.

Design the all-bolted tee shear connection shown in Figure 6.7. The connection should be designed as an extended connection. Use A992 material for the tee and 3/4 inch diameter A325 bolts. The connection is carrying a factored load of 19 kips which was determined using the parametric bay study spreadsheet provided by AISC (AISC 2003). Lastly, draw a detail of the designed connection

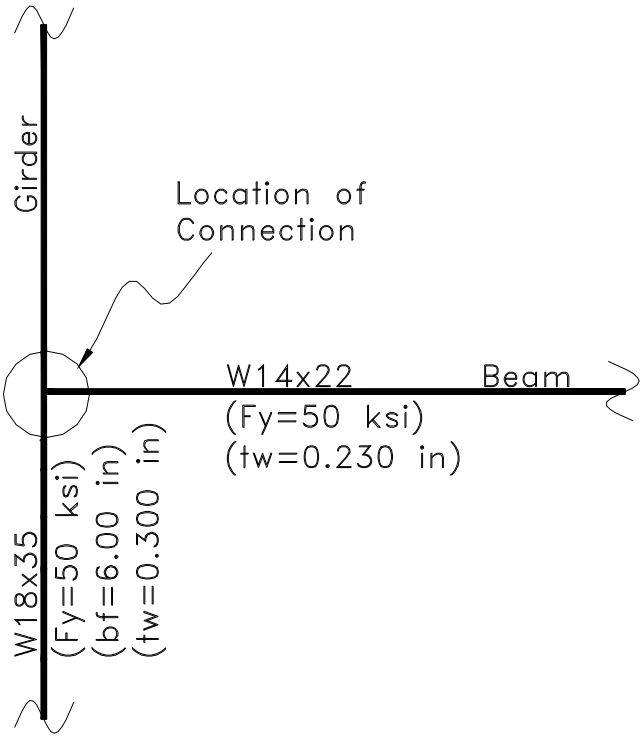

Figure 6.7 Plan View of Extended Tee Connection Location

Step 1-Design Bolts and Tee

Calculate the required depth of the tee. Equation 6.1 can be used to determine the necessary outstanding tee depth.

$$e_a = \frac{6.00}{2} + 3.5 = 6.50 \text{ in.} \qquad \text{(Eq. 6.11)}$$

For this example, e_a is equal to 6.5 inches which requires a 7-inch deep tee in order to clear the girder and beam flanges.

Step 2-Select Extended Connection

Use the all-bolted extended tee design tables and choose an appropriate connection. Using the tables in Appendix M, a connection can be chosen. Choose a WT6x25, for this connection. Now the stem thickness needs to be checked in order to determine which row on the design table to use. The stem thickness for a WT6x25 is 0.37 inches,

therefore; use the highlighted row because the stem thickness is greater than the limiting thickness of 0.36 inches. Assume the eccentricity to be 7 inches to be conservative.

$$\phi R_n = 24.0 \text{ kips} \geq 19 \text{ kips} \quad \text{(Eq. 6.12)}$$

Step 3-Check supported beam web

From Table 10-1 in the AISC Manual, for four rows of bolts, beam material of $F_y = 50$ ksi and $F_u = 65$ ksi, and $L_{ev} = 1.25$ in. and $L_{eh} = 1.25$ in., and the beam is uncoped (AISC 2001).

$$\phi R_n = (409 \text{ kips/in.})(0.230 \text{ in.}) \quad \text{(Eq. 6.13)}$$

$$= 94.0 \text{ kips} \geq 19 \text{ kips}$$

The supported beam web has sufficient strength and because the beam is uncoped that is the only limit state for the beam that needs to be checked.

Step 4-Check supporting girder web

From Table 10-1 in the AISC Manual, for four rows of bolts and girder material of $F_y = 50$ and $F_u = 65$ ksi , (AISC 2001)

$$\phi R_n = (819 \text{ kips/in.})(0.300 \text{ in.}) \quad \text{(Eq. 6.14)}$$

$$= 246 \text{ kips} \geq 19 \text{ kips}$$

The connection is summarized in Figure 6.8

Step 5-Design Standard Connection

The design of the standard tee connection is checked by MathCAD worksheets (Green et al. 2001). The connection requires only three 3/4-inch diameter bolts, but the beam must be coped

$$\phi R_n = 39.1 \text{ kips} \geq 19 \text{ kips} \quad \text{(Eq. 6.15)}$$

The controlling limit state is bolt bearing on the tee stem. The detail for the connection can be seen in Figure 6.9.

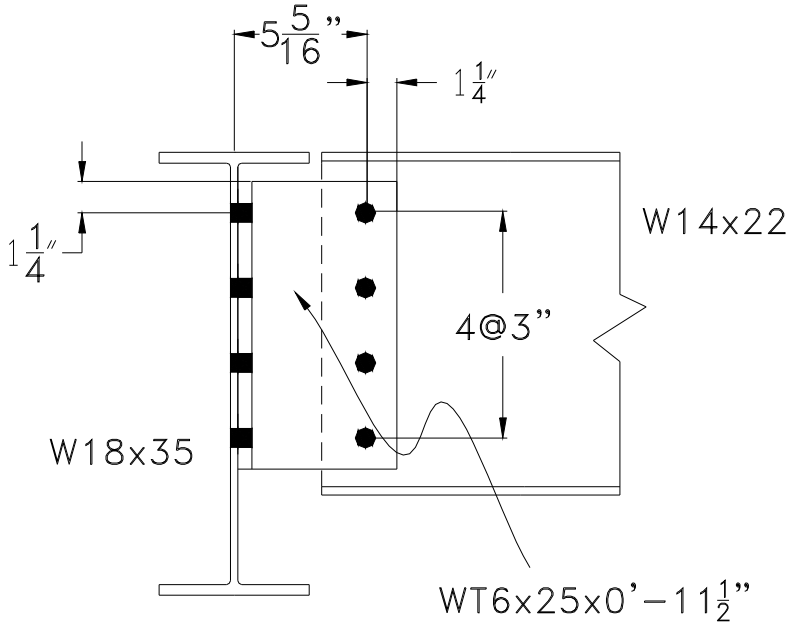

Figure 6.8 Extended Tee Detail

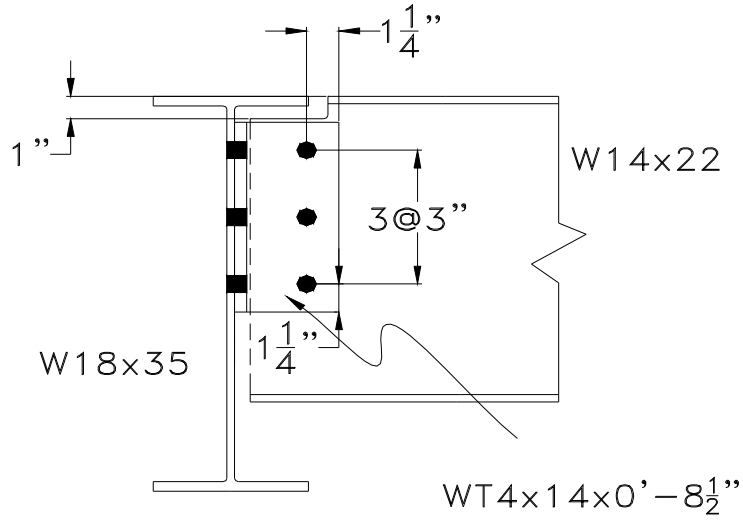

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Figure 6.9 Standard Tee Connection

CHAPTER 7
FINITE ELEMENT ANALYSIS

7.1 Introduction

This chapter presents the results of a finite element study that was conducted on a single angle bolted connection where the protruded leg of the angle extended beyond the flange of the supporting girder. The behavior of the extended connection was compared to that of a standard equal leg angle connection that would be used in a coped beam to girder connection. The finite element model consisted of three main parts: the connection angle, bolts and a portion of the supporting girder web. Each of these parts was modeled with three-dimensional (3D) solid elements. Additionally, the contact surface between connected elements, e.g. angle and girder web were modeled. The finite element model incorporated the effects of material and geometric nonlinearity as well as including the effect of initial bolt pretension on the overall connection behavior.

The finite element analysis was carried out using the latest commercially available ADINA finite element software package, Version 8.1 (ADINA 2003). This finite element package has the capability to model complex phenomena such as contact problems, initial stresses, non-linear material and geometric behavior as well as dynamic analysis. The user inputs the geometry as a 3D model drawn in a Computer Aided Design (CAD) environment. Then, after specifying the desired type of element(s) and mesh density, the program automatically generates an optimal finite element mesh.

Once the analytical model is generated the analysis results can be presented in numerous graphs and plots showing critical behaviors that are identified such as the

applied load-vertical tip displacement behavior and the effective stresses occurring throughout the model. The basic finite element model was created where the position of the bolt line in the in-plane angle leg corresponded to that of a standard coped beam to girder connection. The finite element model was then modified by adding additional elements to the in-plane angle leg to account for the bolt line being located further away from the girder web. This model represented the protruded angle leg of an extended connection where the supported beam would not need to be coped prior to being connected to the supporting girder. The material strengths used in the models for the structural shapes consisted of both A36 and A572 Gr. 50 steel. Therefore, the material steel strength was considered a model parameter. The finite element analysis results for the various models are compared as well as to the current design procedures that are in the AISC *Manual of Steel Construction* (AISC 2001).

7.2 Finite Element Model Development

7.2.1 FE Discretization for Angle

Three-dimensional (3D) solid elements were utilized to model the angle section. These elements are 8-node elements as described in the ADINA Theory and Modeling Guide (ADINA 2003). Each node in the solid element has three master degrees of freedom: X-translation, Y-translation, and Z-translation. The basic finite element mesh for the angle contained 5830 solid elements and 6320 nodes. The angle mesh detail is shown in Figure 7.1. The angle section used in the basic model represented a L3½ x 3½ x $^{5}/_{16}$ and was 9 inches long. This length was chosen since it is representative of a standard three-bolt shear connection with 1½ in. edge spacing and 3 in. center-to-center spacing of the bolts. The 3½ inch protruded leg in the basic model was extended to 5 inches in the modified finite element model.

The basic and modified models were developed for a three-bolt connection. A standard bolt hole diameter was used in each of the models and consisted of holes that had a 0.8125 inch diameter for ¾ inch diameter bolts.

Following a convergence study of the contact problem between the bolts and the bolt holes, it was determined that four elements would be necessary through the thickness of the angle leg (Wheeler et al. 2000). Since there were no bolt holes modeled in the protruded leg, only two elements were used through the thickness in order to decrease the number of elements used in the finite element mesh of the angle (Mao et al. 2001). A convergence study was also carried out to determine the required element size to be used to model the angle section. Three mesh sizes, a coarse, fine, and extra fine mesh were created with average element sizes of 0.4, 0.3, and 0.2 inches, respectively, along the top and bottom edges of the angle. It was determined, from the convergence study, that it would be necessary to use the extra fine mesh in modeling the angle section. Therefore, with this mesh size thirty elements were generated around the circumference of each of the bolt holes.

7.2.2 FE Discretization for Girder

Modeling of the supporting girder was simplified to that of modeling its web in order to decrease the number elements used in the overall finite element model. Three-dimensional (3D) solid elements were utilized to model the web of the girder, the same type of elements used to model the angle section. The basic finite element mesh for the girder web contained 5296 solid elements and 5834 nodes. The girder web was constructed as a plate with a width of 5½ inches, height of 11 inches and a thickness of $^{5}/_{16}$ inches. The mesh detail is shown in Figure 7.1.

Three bolt holes were modeled in the web of girder to correspond with the three bolt holes in the angle. The diameter of these bolt holes was also 0.8125 inches. Following the same convergence study of the contact problem between the bolts and the bolt holes, it was determined that four elements would be required through the thickness of the girder web.

Similar to the angle mesh convergence study, three different element sizes were considered for the girder web mesh. The average element sizes that were evaluated had dimensions of 0.4, 0.3 and 0.25 inches. Based on the results of the study, the 0.25 inch element size was chosen for the girder web mesh. Also, in order to match the mesh of the angle section that was connected to the web of the girder, thirty elements were generated around the circumference of each of the bolt holes.

7.2.3 FE Discretization for Bolts

High strength structural ASTM A325 and A490 bolts were included as part of the finite element model. The two types of bolts were each modeled in a similar fashion, the only difference being their material behavior. Depending on the type of bolt used in the model, a minimum pretension could be applied to the bolt in accordance with the AISC-LRFD Specification (AISC 1999). Three-dimensional (3D) solid elements were utilized to model each of the three bolts. These elements were 8-node elements as described in the ADINA Theory and Modeling Guide (ADINA 2003) with three master displacement degrees of freedom per node. The basic finite element mesh for the three bolts included 10251 elements and 11685 nodes. The bolt mesh detail is shown in Figure 7.1.

The diameter of each bolt that was modeled was ¾ inch while the diameter of each bolt head was 1¼ inch. In addition to the bolt and the bolt head being modeled, the nut was also included as part of the finite element model. Along the body of the bolt, eight

elements were modeled in order to match the four elements through the thickness of the angle leg and the other four elements through the thickness of the girder web. Four elements were generated through the thickness of the bolt head and the nut. In order to match the angle and girder web mesh, thirty elements were constructed around the body of the bolt, the bolt head and the nut.

7.3 FE Model Contact Conditions

A contact condition can be specified in ADINA to model the contact behavior between solid elements and other structural elements such as the truss, beam, shell, plate and pile elements. Since only 3D solid elements were utilized in the model, the contact group that was used in the model was the 3D contact group. In this type of contact group, one of the two contact surfaces that formed is called the contactor surface and the other is called the target surface. During the loading of the finite element model the two contact surfaces are expected to come into contact and become a contact pair.

All parts of the bolted-bolted shear connection are connected to each other through the contact condition. When the applied load from the beam is imparted to the angle, the angle begins to displace which then causes it to come into contact with the bolts. The displacement of the outstanding leg of the angle in turn then causes the bolts to come into contact with the girder. When the bolts are also pretensioned, the bolt heads are brought into contact with the in-plane leg of the angle, the nuts are brought into contact with the girder web and the facing elements of the in-plane angle leg and the girder web are brought into contact prior to the load being applied to the model.

The contact surfaces as described above were defined as surfaces that were initially in contact or were anticipated to come into contact by the pretensioning of the bolts or during the application of the load. In order to avoid an overconstrained analysis problem

that is caused when a contactor node belongs to more than one contact surface in a contact group, a total of 36 surfaces, divided to 8 contact groups, and 20 contact pairs were constructed as part of the overall finite element model. These contact groups and contact conditions are described in Tables 7.1 and 7.2 as follows:

Table 7.1-Finite Element Model Contact Group Descriptions

Contact Group No.	Contact Description
1	Contact surface between the in-plane angle leg and the girder web[(a)]
2	Contact surface between the bolt heads and the in-plane angle leg
3	Contact surface between the nuts and the girder web
4	Contact surface between the shank of the bolts and the holes in the in-plane leg of the angle[(a)]
5	Contact surface between the shank of the bolts and the holes in the web of the girder[(c)]
6	Contact surface between the in-plane angle leg and the girder web
7	Contact surface between the shank of the bolts and the holes in the in-plane leg of angle[(b)]
8	Contact surface between the shank of the bolts and the holes in the web of the girder[(b)]

Notes:

[(a)]The contact surface between the in-plane leg and the girder web was divided into group numbers 1 and 6

[(b)]Contact surface between the shank of the bolts and the holes in the in-plane leg of the angle was divided into group numbers 4 and 7

[(c)]Contact surface between the shank of the bolts and the holes in the web of the girder was divided into group numbers 5 and 8

Table 7.2- Finite Element Model Contact Surface, Pair, and Group Interactions

	Contact Surface Number		Contact pair		
Contact Groups	Number	Position of Faces	Number	Target Surface	Contactor Surface
Group 1	1	Face #12 on Body #4	1	2	1
	2	Face #12 on Body #6			
Group 2	1	Face #11 on Body #4	1	2	1
	2	Face #6 on Body #8	2	3	1
	3	Face #6 on Body #7	3	4	1
	4	Face #6 on Body #9			
Group 3	1	Face #11 on Body #6	1	1	2
	2	Face #5 on Body #8	2	1	3
	3	Face #5 on Body #7	3	1	4
	4	Face #5 on Body #9			
Group 4	1	Face #1 on Body #4	1	4	1
	2	Face #2 on Body #4	2	5	2
	3	Face #6 on Body #4	3	6	3
	4	Face #7 on Body #8			
	5	Face #7 on Body #7			
	6	Face #7 on Body #9			
Group 5	1	Face #9 on Body #6	1	1	4
	2	Face #7 on Body #6	2	2	5
	3	Face #10 on Body #6	3	3	6
	4	Face #4 on Body #8			
	5	Face #4 on Body #7			
	6	Face #4 on Body #9			
Group 6	1	Face #12 on Body #6	1	1	2
	2	Face #6 on Body #2			
Group 7	1	Face #10 on Body #4	1	4	1
	2	Face #7 on Body #4	2	5	2
	3	Face #9 on Body #4	3	6	3
	4	Face #4 on Body #8			
	5	Face #4 on Body #7			
	6	Face #4 on Body #9			
Group 8	1	Face #6 on Body #6	1	1	4
	2	Face #2 on Body #6	2	2	5
	3	Face #1 on Body #6	3	3	6
	4	Face #7 on Body #8			
	5	Face #7 on Body #7			
	6	Face #7 on Body #9			

Tables 7.1 and 7.2 describe the detailed interactions that occurred in the finite element analysis. Table 7.1 gives the general description of the eight contact groups that were included in the model. Table 7.2 gives the detailed interactions between the three main components that were included in the model and are called Bodies. The girder web included two Bodies that were numbered 3 and 6. The angle included five Bodies that were numbered 1, 2, 4, 5 and 10. The bolts included three Bodies that corresponded to the three bolts that numbered 7, 8 and 9. If no contact pair numbers given in the table that means that these two surfaces did not come into contact during the analysis.

ADINA has a library of simple Bodies contained within ADINA-M that can be specified for contact problems. If the Body is of a complex nature it needs to be modeled by the user. In the bolted-bolted beam-to-girder finite element model that was created only Body numbers 1 and 3 were taken from the ADINA-M library. The other Body numbers were more complex and had to be developed from the simple Body definitions provided in the software. For these remaining complex Bodies, ADINA assigned Face numbers to each Body (e.g. the simple block Body has six Faces that are assigned Face numbers 1 through 6). ADINA automatically assigned Face numbers to each complex Body that was modeled such as the bolt shanks or the in-plane leg of the angle having three bolt holes. Only through direct observation of the graphical ADINA output could the automatically assigned Face numbers be identified.

An important distinction between a contactor surface and a target surface is that in the converged finite element solution, the material overlap at the contactor nodes is zero while the target nodes can overlap the contactor body (Bathe and Chaudhary 2000). Therefore, the surfaces in the angle holes were formed as a contactor surface while the

surfaces on the bolts that are in contact with the angle holes were formed as the target surface. On the other hand, the surfaces on the bolts that are in contact with the girder web were assigned as the contactor surfaces while the surfaces in the girder web holes were denoted as the target surface.

The model of the connection with pretensioned bolts meant that there was friction between the in-plane leg of angle and the girder web. This friction along the contact surface was handled in the model by assigning a compression force that acts on each contactor node and that node is allowed to kinematically slide along the target segments generating a tangential force that is equal to the Coulomb friction force (ADINA 2003). In ADINA, the user only has to input a Coulomb friction coefficient in the model definition of the contact group where it is to be considered and then the program automatically determines the tangential force from the compression force based on the following equation:

$$T_t = \mu T_n \qquad \text{(Eq. 7.1)}$$

Where:

T_t = Tangential force

T_n = Normal force

μ = Coulomb friction coefficient

In the finite element model that was created only the friction between the in-plane leg of angle and the girder web was considered. The Coulomb friction coefficient that was assumed for this frictional contact was $\mu = 0.2$. The frictional contact between the bolt heads to the in-plane angle leg as well as the nuts to the girder web was not considered. This modeling assumption was made since these contact surfaces had a

much smaller surface area than that of the in-plane angle leg being in contact with the girder web. This assumption also helped to decrease the analysis run time and the number of iterations that necessary for each time step to converge.

7.4 FE Model Initial Conditions

The three-bolt connection was pretensioned to assure that the leg of the angle was brought into firm contact with the web of the girder before the vertical load was applied. In order to accomplish this in the finite element model, an initial stress was applied to the bolts to create the pretension. Following the ADINA-Theory and Modeling Guide (ADINA 2003), the initial stress could be done by three different methods: nodal initial strain, element initial strain or directly applying a pressure load. The direct pressure load application method was selected because it was easy to apply and the magnitude of the specified pressure load could be changed. Furthermore, the method accurately reflected the behavior of the bolts when they are pretensioned, i.e. only the body of the bolt had a pretension load, not the bolt heads or nuts.

In order to generate the bolt pretension, a pressure load was simultaneously applied at each bolt head and nut. The pressure load that was applied to the ¾ inch diameter bolts in the finite element model was 10 ksi. This initial condition was established in the first step of the analysis. After that, in the second step, the pretension load was omitted and the external vertical load was incrementally applied.

7.5 FE Model Applied Loading

A static analysis solution scheme was performed using ADINA on the finite element model. This type of solution does not include time dependent effects, so the specified time step increment in the program was used to define the increment or intensity of each load step increment. In order to ensure convergence was achieved in the

solution, the number of time steps needed to be small and it was typical for the analysis runs to use more than 350 time steps in each case.

The finite element model loading was carried out in two steps: Step 1 was described in Section 7.4 where a pretension load was generated in the bolts, and Step 2 is described in this section where the external vertical load was applied to the model. The vertical shear load was applied incrementally from zero until a maximum value was reached. This maximum load indicated that the bolted-bolted connection had reached its ultimate load-carrying capacity.

The vertical shear load was transmitted from the beam into the connection angle through the three bolts attaching it to the protruded leg. These three bolts were modeled as three load groups and each group consisted of six single loads as shown in Figure 7.2. The locations of where the vertical loads were applied were determined from the usual geometry of where the bolt holes would have been if they had been modeled. These locations in the protruded leg were at a horizontal distance of 2 inches from the heel of the 3½ inch angle leg and 3½ inches from the heel of the 5 inch angle leg.

7.6 FE Model Boundary Conditions

There were two types of boundary conditions utilized in the model. The first type of boundary condition was placed on the vertical edges of the girder web. Recall that its model definition consisted of 8-node, 3D solid elements with three master degrees of freedom at each node (X-, Y- and Z-translation). To simulate a fixed type boundary condition, all the nodal translational degrees of freedom were fixed along these edges which were away from the portion of the web where the angle was attached. This boundary condition was generated along the two edges of the girder web that are parallel to the Z-axis as shown in Figure 7.3.

The second boundary condition was placed on the protruded angle leg. In a real bolted-bolted connection this protruded leg would be connected to the web of a beam, but since this web was not modeled, a boundary condition was imposed to simulate this part of the connection. The inherent stiffness in the connection between the web of the beam and the protruded angle leg would restrain this part of the connection from twisting or moving in the X-direction. Therefore, the X-direction movement of the angle was fixed through the use of a boundary condition imposed on every node that made up the exterior face of the protruded angle leg. This boundary condition can be seen in Figure 7.3.

7.7 FE Model Material Behavior

The inelastic material behavior of the angle, girder web and bolts were considered in the finite element model development. Two steel material types, A36 (ASTM 2003?) and A572 Gr. 50 (ASTM 2003?) were assigned to the angle while only one type of steel material, A572 Gr. 50 was assigned to the girder web. Again, there were two steel material types assigned to the bolts – either A325 (ASTM 2003?) or A490 (ASTM 2003?). No material coupon tests or bolt tests were conducted for this project so it was decided that a reasonable way to incorporate the inelastic behavior of the steel materials was to treat each type as having a bi-linear stress-strain curve (Salmon and Johnson 1996). Regardless of the type of steel material, the Modulus of Elasticity, E, was defined as having a value of 29,000 ksi. The stress-strain relationships provided in the ADINA FE models for the A36 steel, A572 Gr. 50 steel, A325 bolt steel and A490 bolt steel are given in Figures 7.4 through7.7. All of the material bi-linear curves are comprised of two straight line segments. The first portion represents the elastic behavior and goes from zero to a point defined by the yield strain and the corresponding yield stress of the material, (ε_y , σ_y). The second portion represents the inelastic behavior of the material.

This part of the stress-strain curve starts at (ε_y , σ_y) and is terminated at a point defined by the ultimate strain and the corresponding ultimate tensile strength of the material, (ε_u , σ_u). It was felt that this level of strain would not be exceeded in any of the analyses so the stress-strain curves did not need to be extended any further than that provided.

Table 7.3 FE Model Steel Material Properties

ASTM Designation	Yield Stress, σ_y (ksi)	Ultimate Tensile Strength, σ_u (ksi)
A36	36	58
A572 Gr. 50	50	65
A325	80	100
A490	100	120

Finally, the steel materials for the angle and girder web along with the different bolt types were arranged into groups and analyzed as shown in the Table 7.4.

Table 7.4 FE Model Material Groups

	Angle	Girder Web	Bolt
Group I	A36	A572	A490
Group II	A36	A572	A325
Group III	A572	A572	A490

7.8 FE Analysis Results

The results from each FE model were post-processed through ADINA-Plot, a branch of the ADINA finite element software package, Version 8.1 (ADINA 2003). In order to compare the analysis results from different model configurations a consistent approach to the data would need to be taken. It was decided that the best way to do this would be to either: 1) Plot the incremental applied load versus the tip deflection of the protruded angle leg from different FE models; or 2) Plot the incremental applied load versus the end rotation of the protruded angle leg from different FE models. The end rotation of the leg was calculated from the displacement results taken at two nodes on the

toe of the protruded leg. The first node was located at the top corner and the second node was located at the bottom corner of the protruded leg. The node numbers from the two different geometric models that were used to determine the end rotation of the angle leg are shown in the Table 7.5.

Table 7.5 Corner Node Numbering

Model Description	Top Corner Node	Bottom Corner Node
3½ in. Protruded Leg Model	24703	22556
5 in. Protruded Leg Model	27719	22591

The end rotation, θ, of the protruded leg from each analysis result was calculated using the following the equation:

$$\theta = \frac{\left(Y_{top} - Y_{bottom}\right)}{\left(9\text{ in} + Z_{bottom} - Z_{top}\right)} \qquad \text{(Eq. 7.2)}$$

Where:

Y_{top} = Displacement of the top corner node in the Y-axis

Y_{bottom} = Displacement of the bottom corner node in the Y-axis

Z_{top} = Displacement of the top corner node in the Z-axis

Z_{bottom} = Displacement of the bottom corner node in the Z-axis

9 in. = Length of the angle

It was necessary to take into account both the Y-axis displacement as well as the Z-axis displacement in the calculation of end rotation since the protruded angle leg did not deform solely in its own plane. Figure 7.8 shows the load vs. displacement results of the Material Group I finite element model with a 5 inch protruded leg where the maximum displacements reached 0.36 and 0.23 inches in the Y- and Z-axis, respectively when the maximum applied load reached 34.8 kips. This occurred at time step = 193.

The applied load vs. end rotation was compared for two Material Group I models that only differed in the length of the protruded angle leg (see Figure 7.9). The model with the 3½ inch protruded leg converged at time step = 277, corresponding to a maximum applied load of 49.9 kips and an end rotation of 0.054 rad. The model with the 5 inch protruded leg converged at time step = 193, corresponding to a maximum applied load of 34.8 kips and an end rotation of 0.053 rad.

The next applied load vs. end rotation comparison that was made evaluated the results from the Material Group I (A490 bolts) and II (A325 bolts) models. The length of the protruded angle leg in each model was 5 inches. The model with the A325 bolts reached a convergence limit when time step = 194, corresponding to a maximum applied load of 35.0 kips and an end rotation of 0.058 rad. In comparison, the model with the A490 bolts converged at time step = 193, corresponding to a maximum applied load of 34.8 kips and an end rotation of 0.053 rad. The results of this comparison are shown in Figure 7.10.

The last applied load vs. end rotation comparison that was made evaluated the results from the Material Group I (A36 angle) and III (A572 Gr. 50 angle) models. The length of the protruded angle leg in each model was 5 inches. The model with the A36 steel angle reached a convergence limit when time step = 193, corresponding to a maximum applied load of 34.8 kips and an end rotation of 0.053 rad. In comparison, the model with the A572 Gr. 50 steel angle converged at time step = 240, corresponding to a maximum applied load of 43.2 kips and an end rotation of 0.066 rad. Figure 7.11 shows the comparison between these two analysis results.

Figures 7.12 and 7.13 are smoothed effective stress plots showing the change in model behavior from the initial time step to the final time step, respectively of the analysis run with Material Group I and a 3½ inch protruded angle leg. At time step = 1.000 there was no externally applied load, only the pretension in the bolts. The maximum smoothed effective stress was approximately 14 ksi and that was fairly uniform between the angle, girder web and the bolts. At time step = 193, the maximum smoothed effective stresses were 65.78 ksi in the angle, 88.14 ksi in the girder web and 132.6 ksi on the bolt shank. The critical stress occurred at the location of the top hole in the angle leg. This would correspond to reaching a limit state of bolt bearing on the angle material which is the same limit state that would have been found if using the design tables in the Appendices.

Figures 7.14 and 7.15 show the maximum smoothed effective stress plots for analysis runs with Material Groups II and III, respectively and a 3½ inch protruded angle leg. For Material Group II (time step = 194) these stresses were 70.05 ksi in the angle, 88.11 in the girder web and 98.30 ksi on the bolt shank. For Material Group III (time step = 240) these stresses were 78.91 ksi in the angle, 99.95 ksi in the girder web and 136.8 ksi on the bolt shank. In each case the maximum stress occurred at one of the bolt hole locations indicating that a limit state of bolt bearing was reached.

One more comparison was made between all the models previously discussed and a new model where the boundary condition along the vertical edges of the girder web was changed from being fixed to that of being pinned. Figure 7.16 shows the applied load vs. end rotation behavior of the new model compared to all the previous results. The pinned boundary condition has a marked influence on the rotational behavior of the connection

whereas the strength of the connection only changed slightly. A convergence limit was reached in the analysis of this model at time step = 207, corresponding to an applied load of 37.2 kips and a maximum end rotation of 0.129 rad. Again, the maximum stresses occurred at the top bolt hole location, but now it was bolt bearing on the girder web.

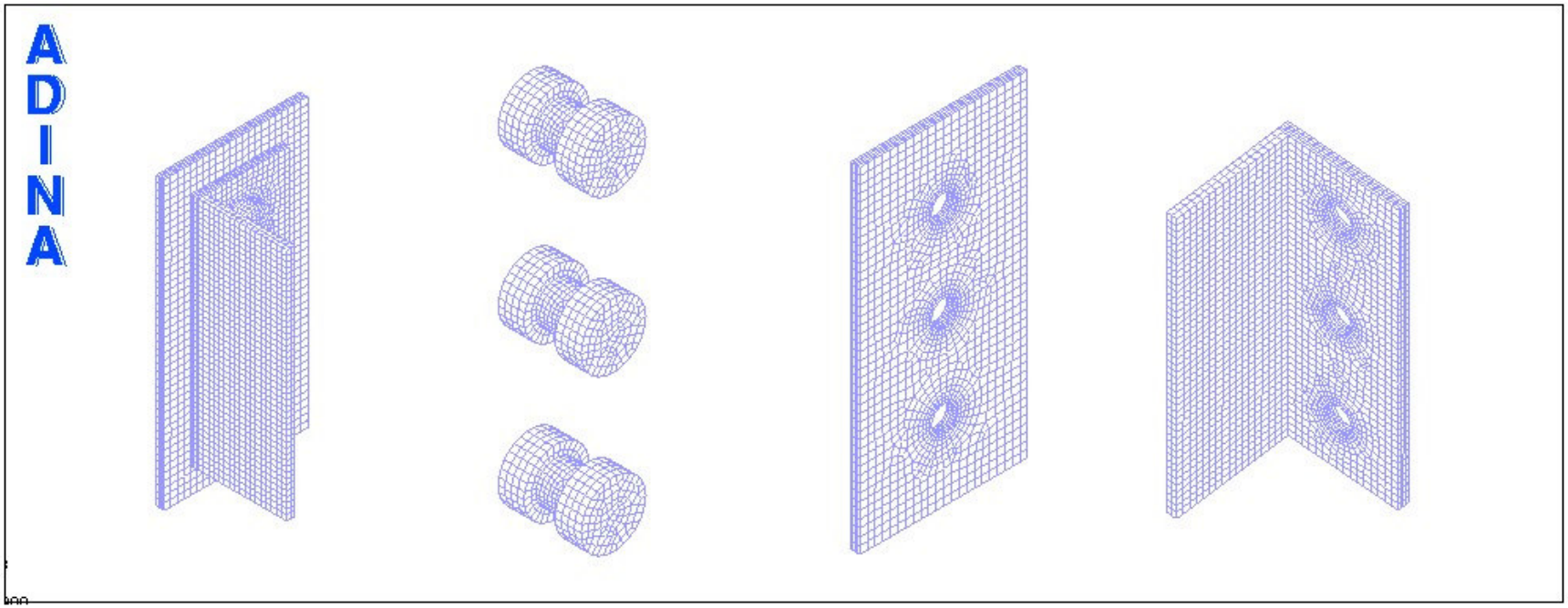

Figure 7.1 FE Model Element Meshing

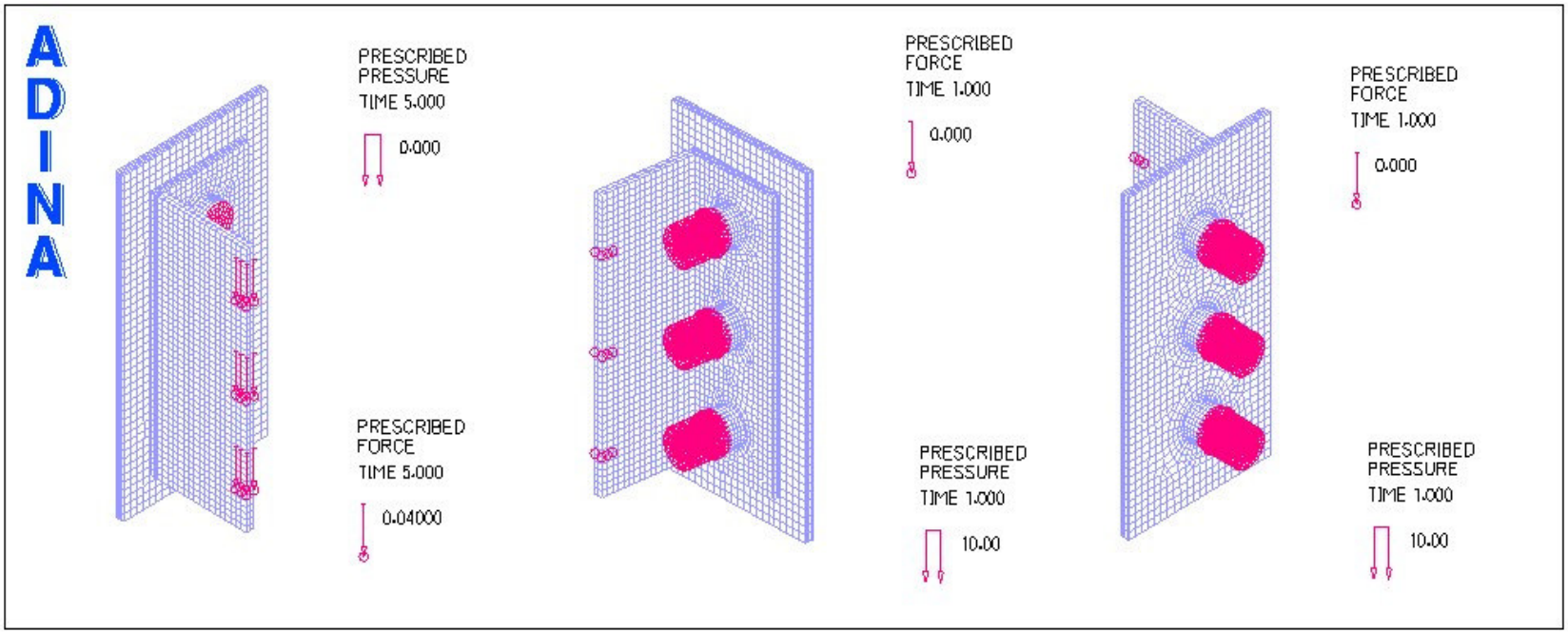

Figure 7.2 FE Model Applied Loading

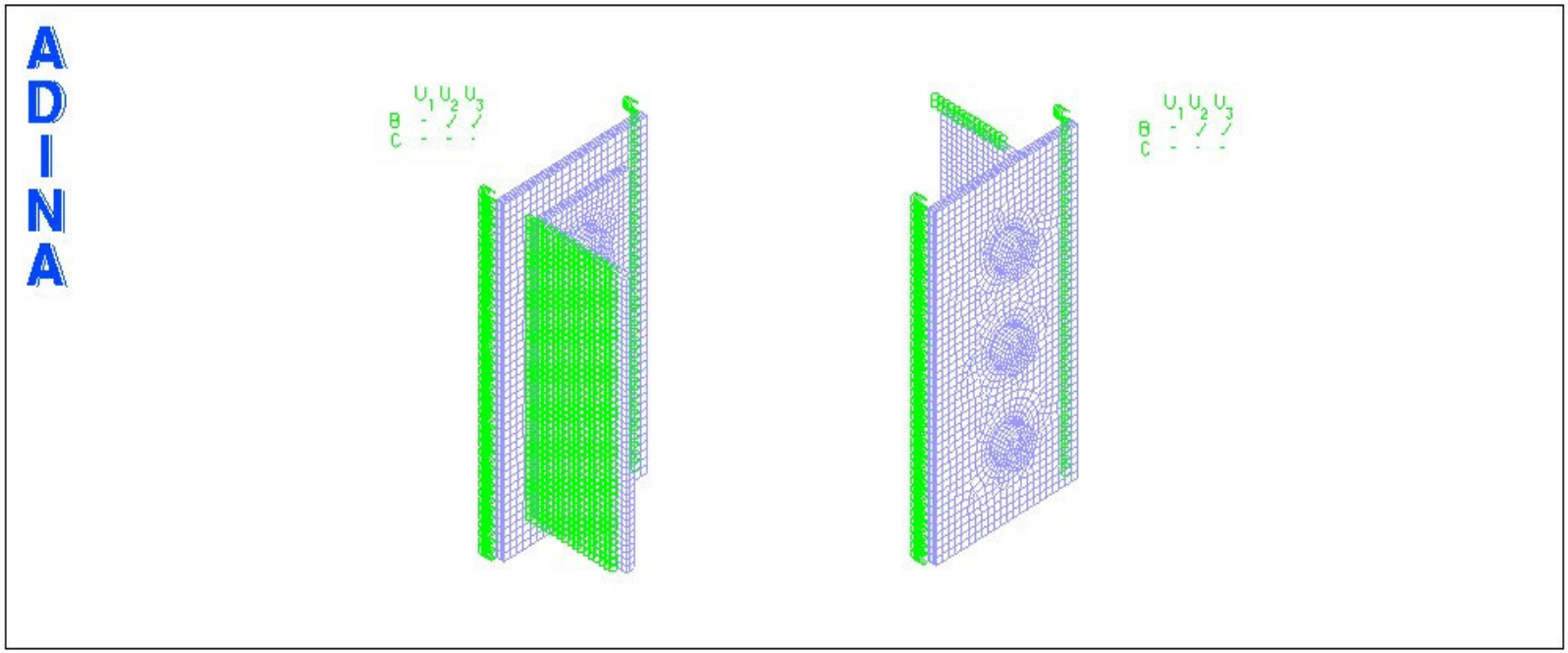

Figure 7.3 FE Model Boundary Conditions

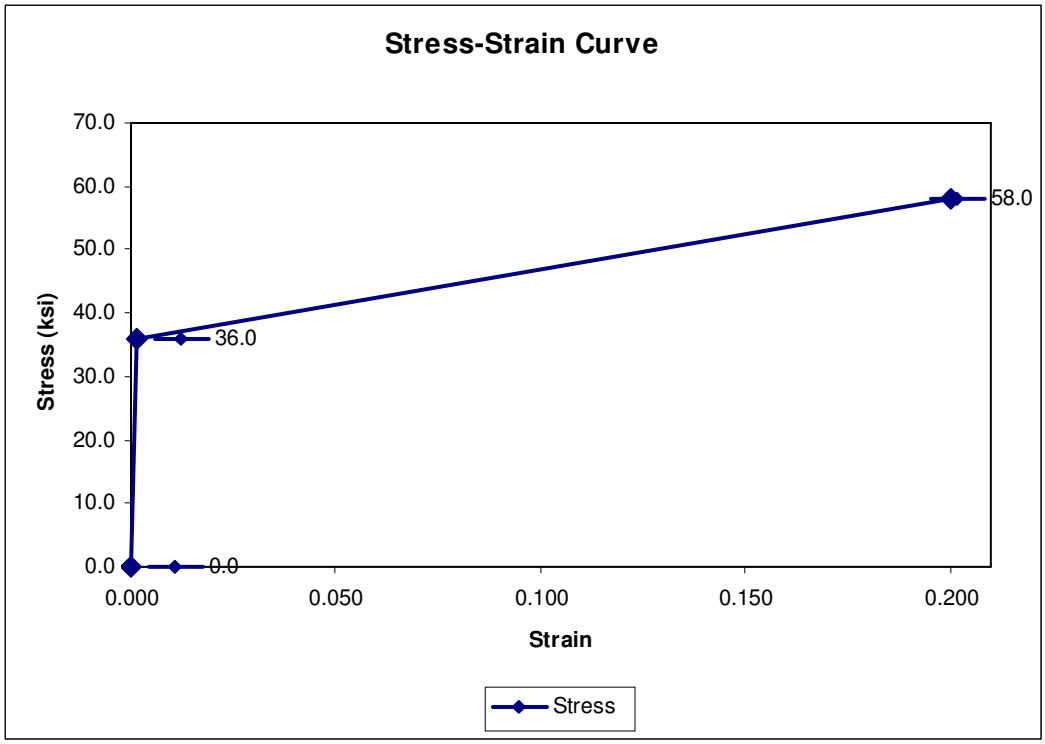

Figure 7.4 Bi-linear Stress-Strain Curve for A36 Steel Material

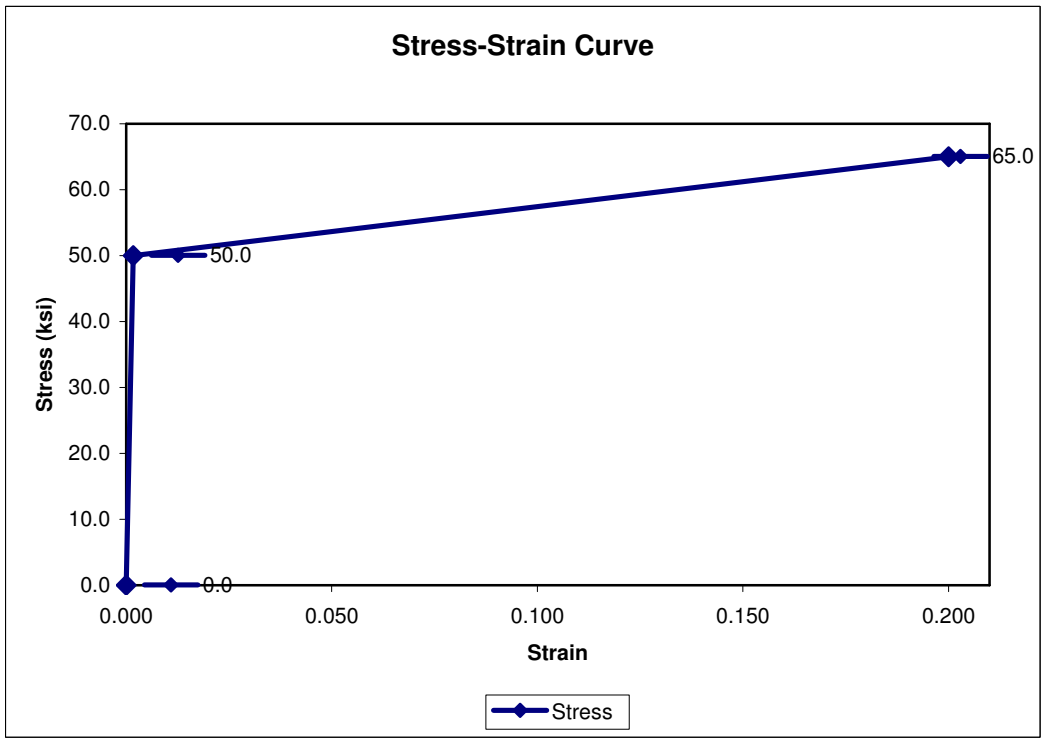

Figure 7.5 Bi-linear Stress-Strain Curve for A572 Gr. 50 Steel Material

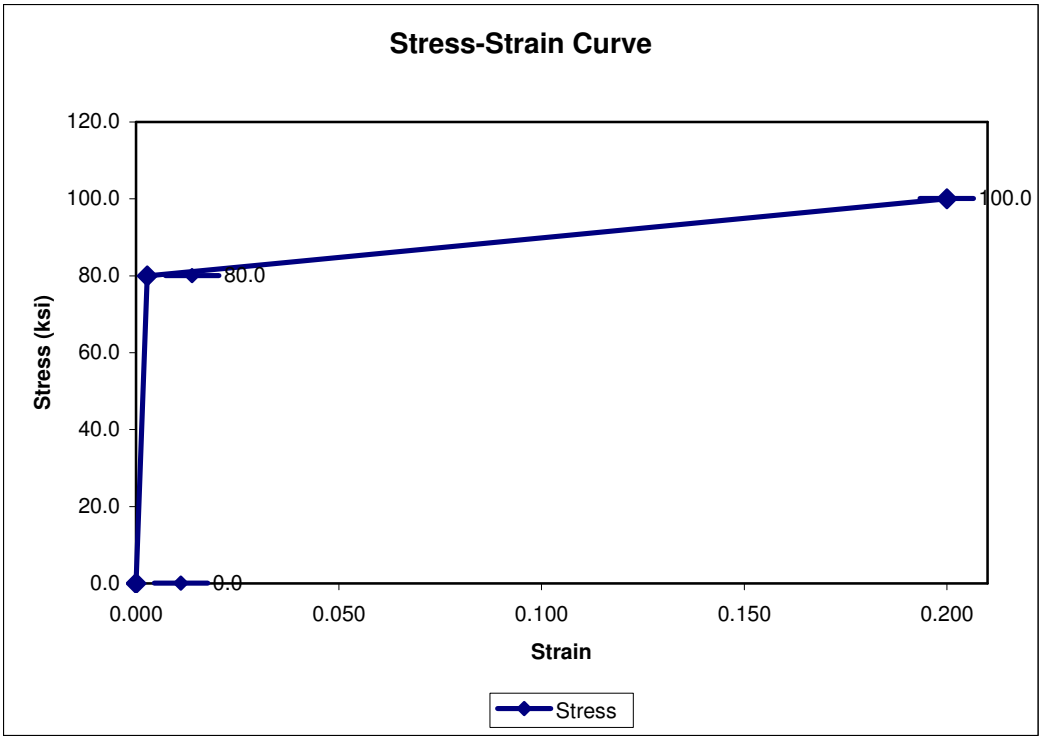

Figure 7.6 Bi-linear Stress-Strain Curve for A325 Bolt Material

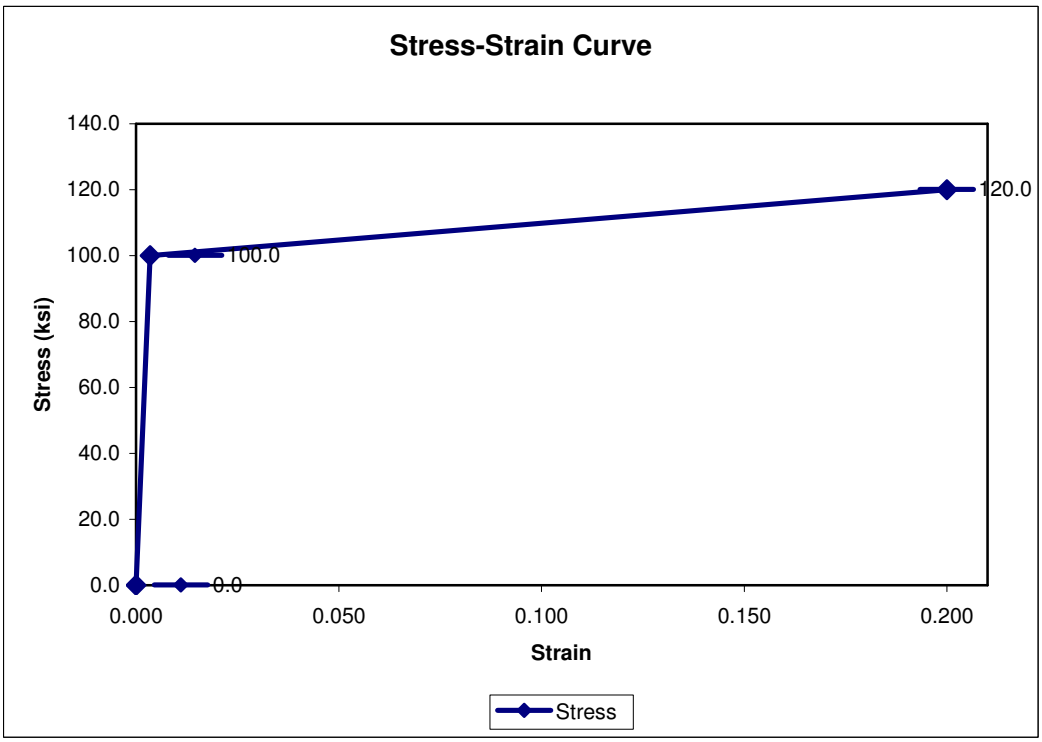

Figure 7.7 Bi-linear Stress-Strain Curve for A490 Bolt Material

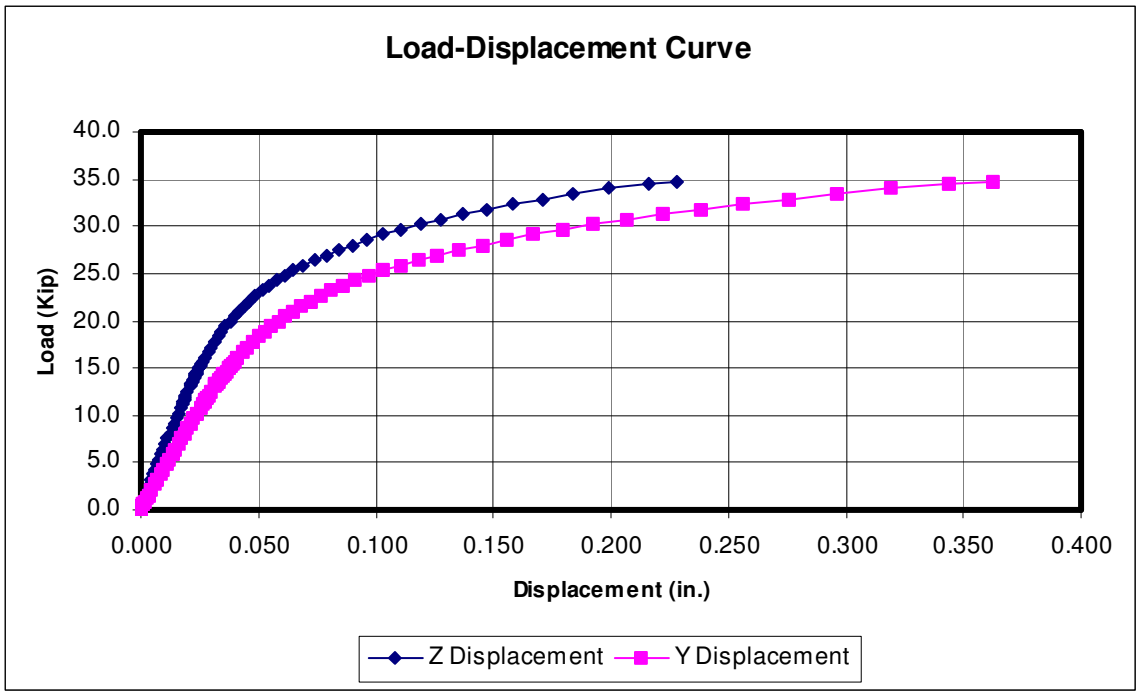

Figure 7.8 Applied Load vs. Horizontal Z- and Vertical Y- Tip Displacement of FE Model with 5 in. Protruded Angle Leg and Material Group I

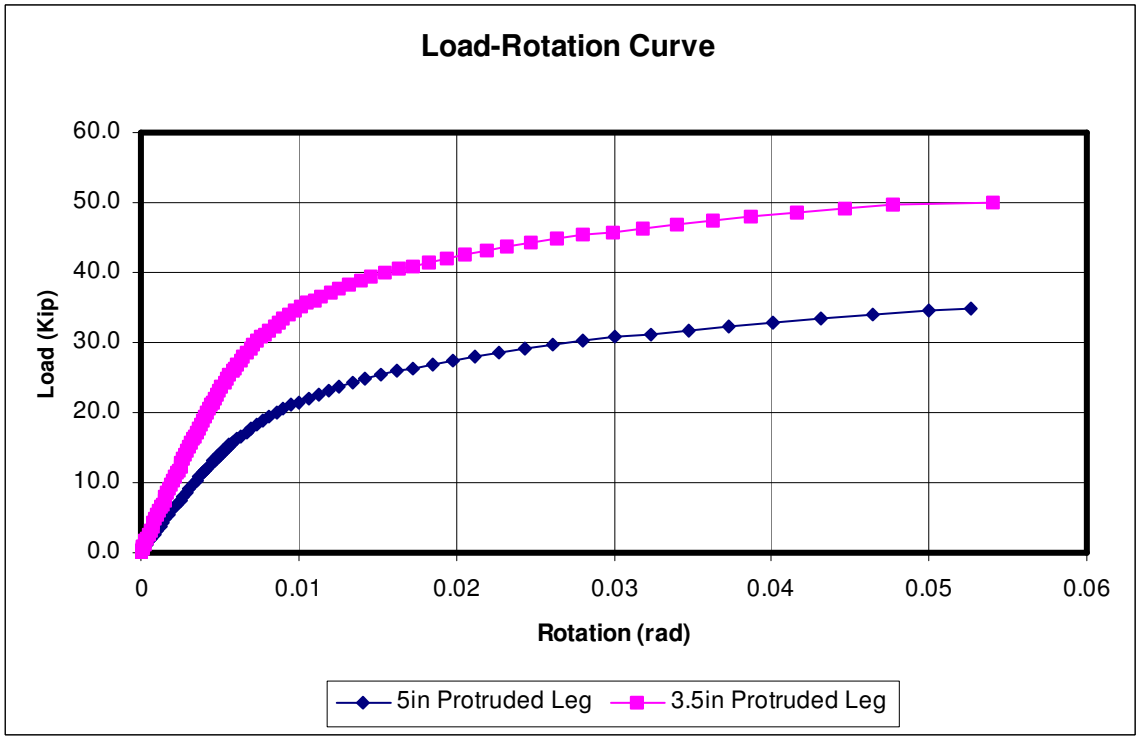

Figure 7.9 Comparison of Applied Load vs. End Rotation Curves for FE Models with 3.5 and 5 in. Protruded Legs and Material Group I

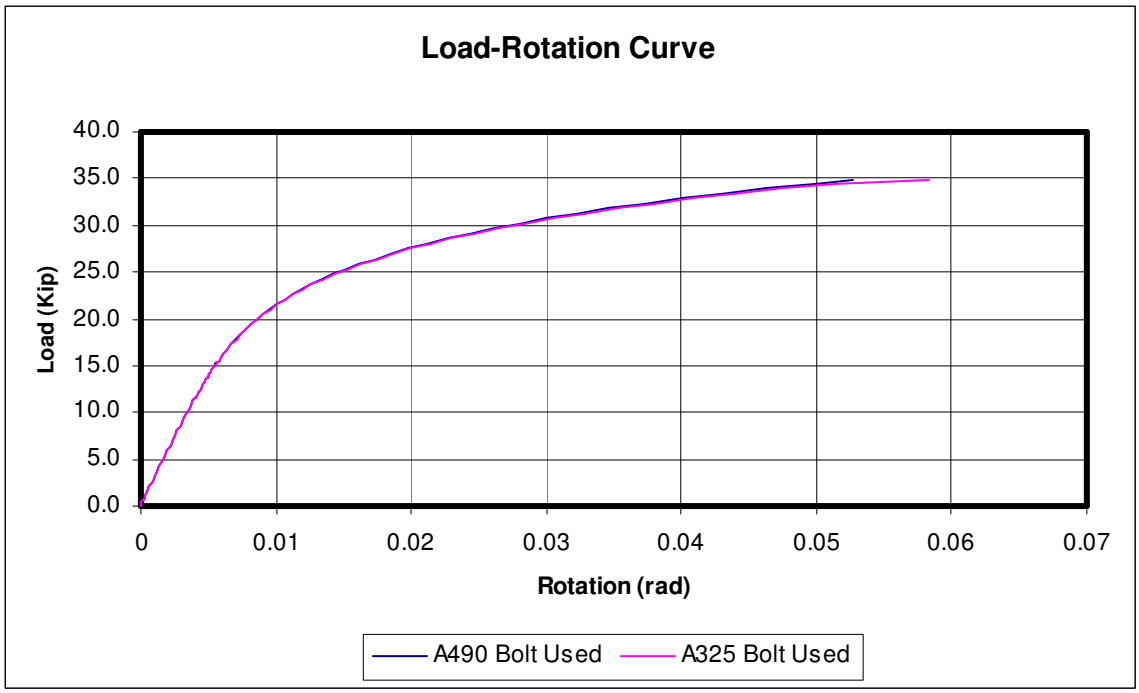

Figure 7.10 Comparison of Applied Load vs. End Rotation Curves for FE Models with A325 and A490 Bolts and 5 in. Protruded Leg

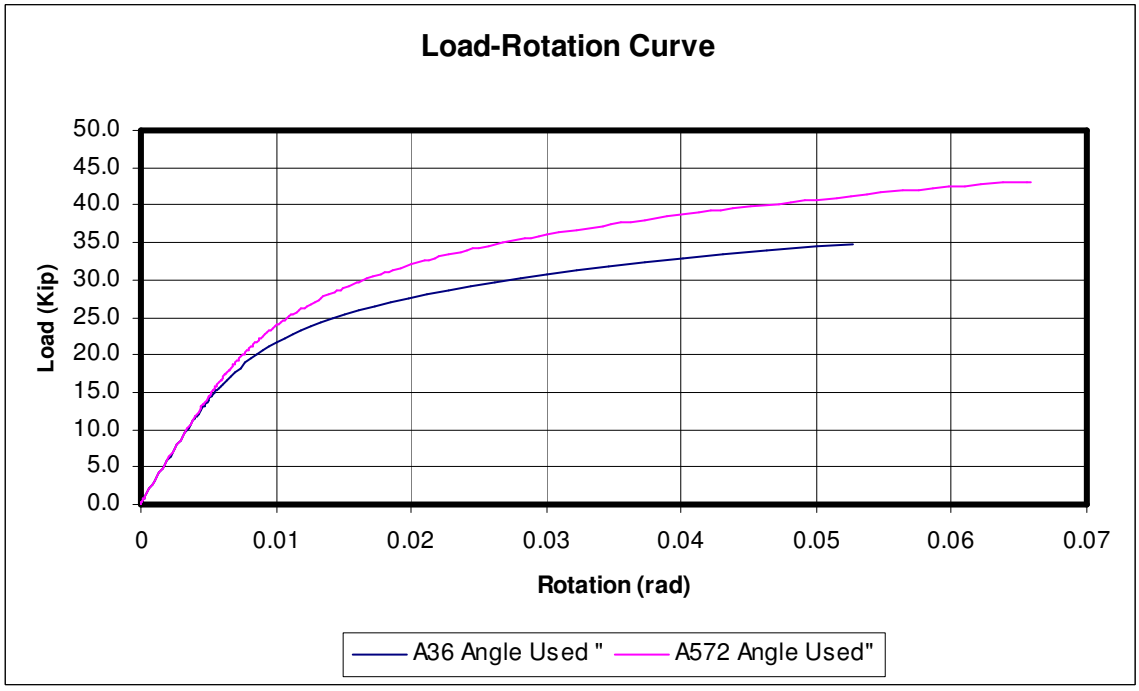

Figure 7.11 Comparison of Applied Load vs. End Rotation Curves for FE Models with A36 and A572 Gr. 50 Angles and 5 in. Protruded Leg

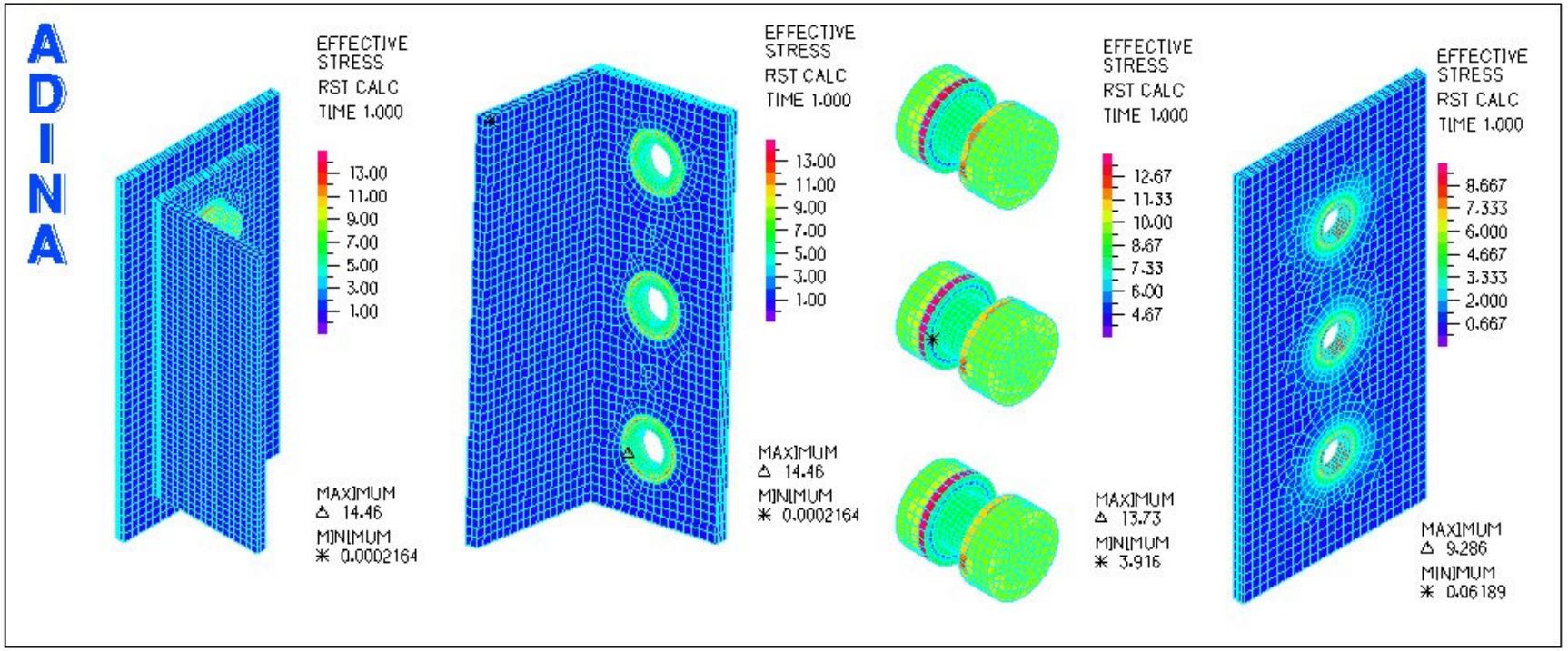

Figure 7.12 Effective Stress Plots of the Single Angle, Bolts and Girder Web for the FE Model with 3.5 in. Protruded Leg and Material Group I, Time Step = 1.000

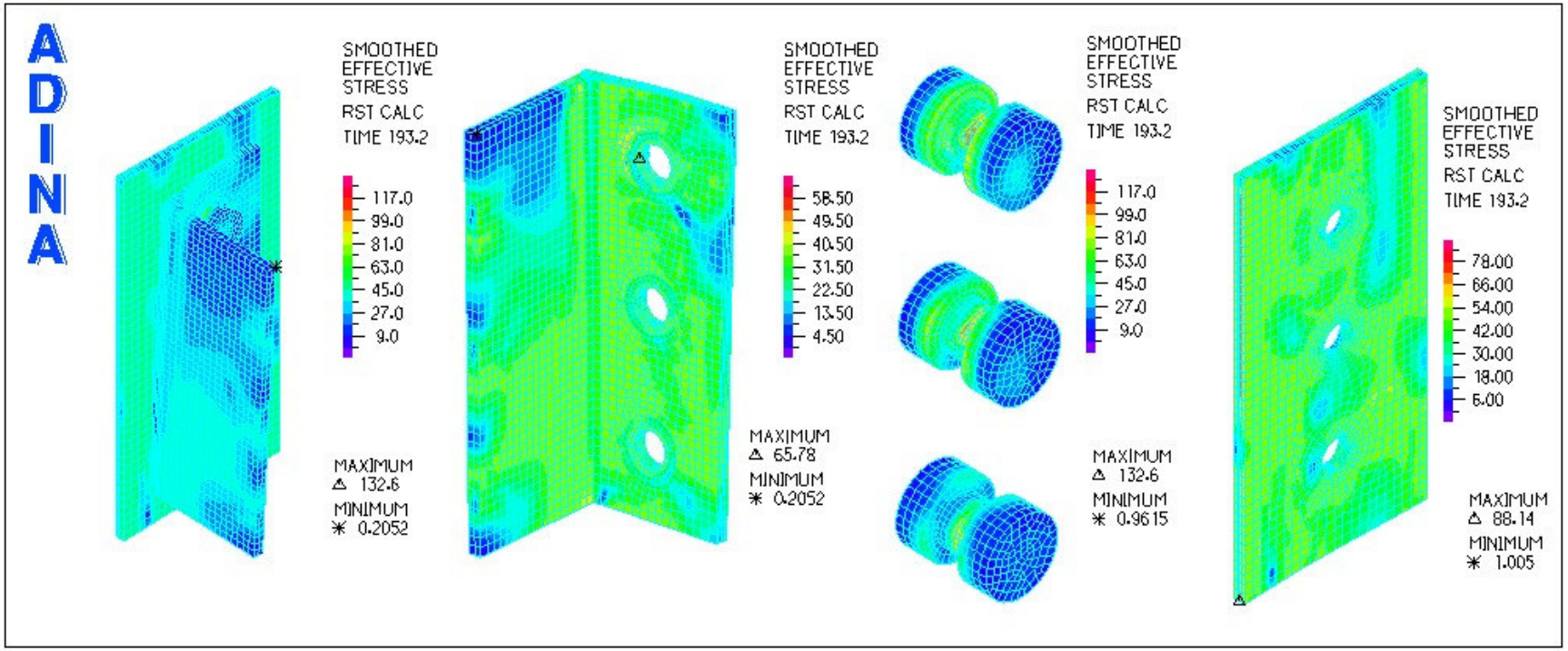

Figure 7.13 Effective Stress Plots of the Single Angle, Bolts and Girder Web for the FE Model with 3.5 in. Protruded Leg and Material Group I, Time Step = 193.2 (Maximum Applied Load)

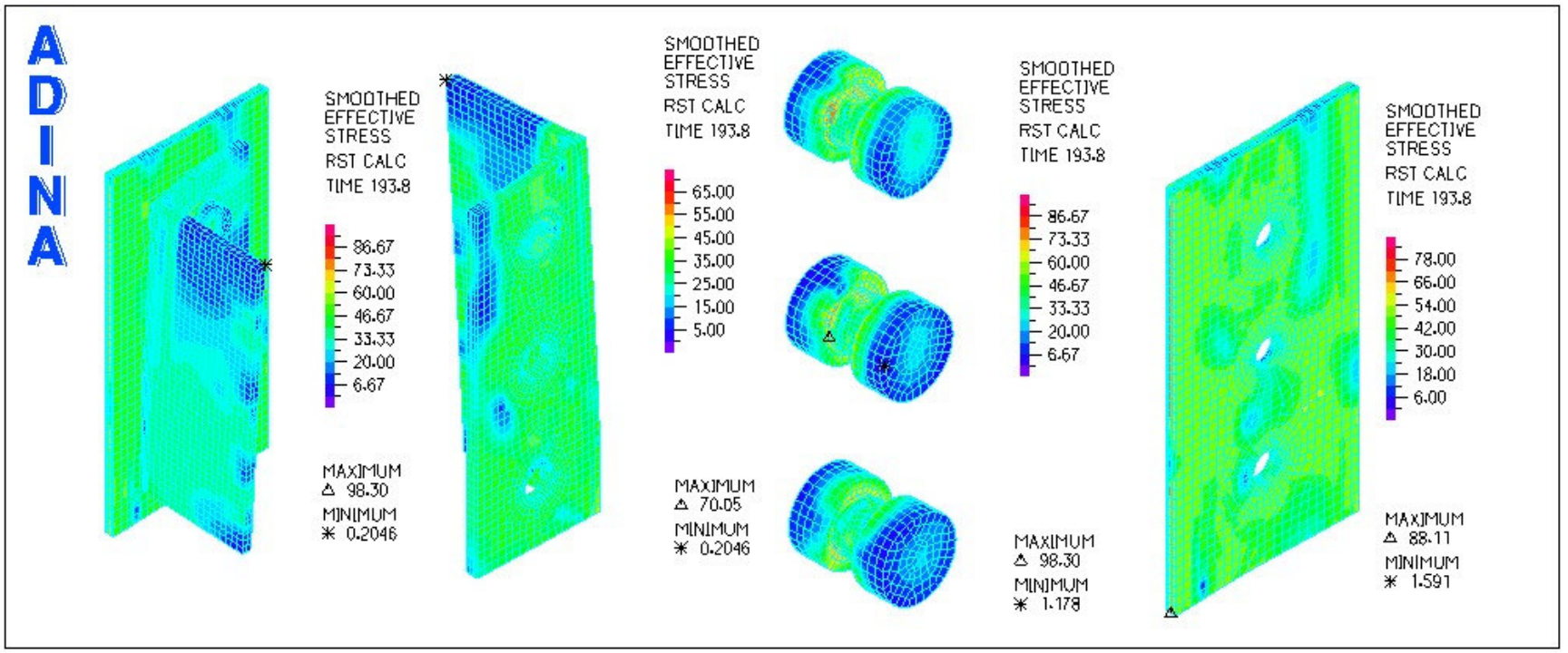

Figure 7.14 Effective Stress Plots of the Single Angle, Bolts and Girder Web for the FE Model with 3.5 in. Protruded Leg and Material Group II, Time Step = 193.8 9 (Maximum Applied Load)

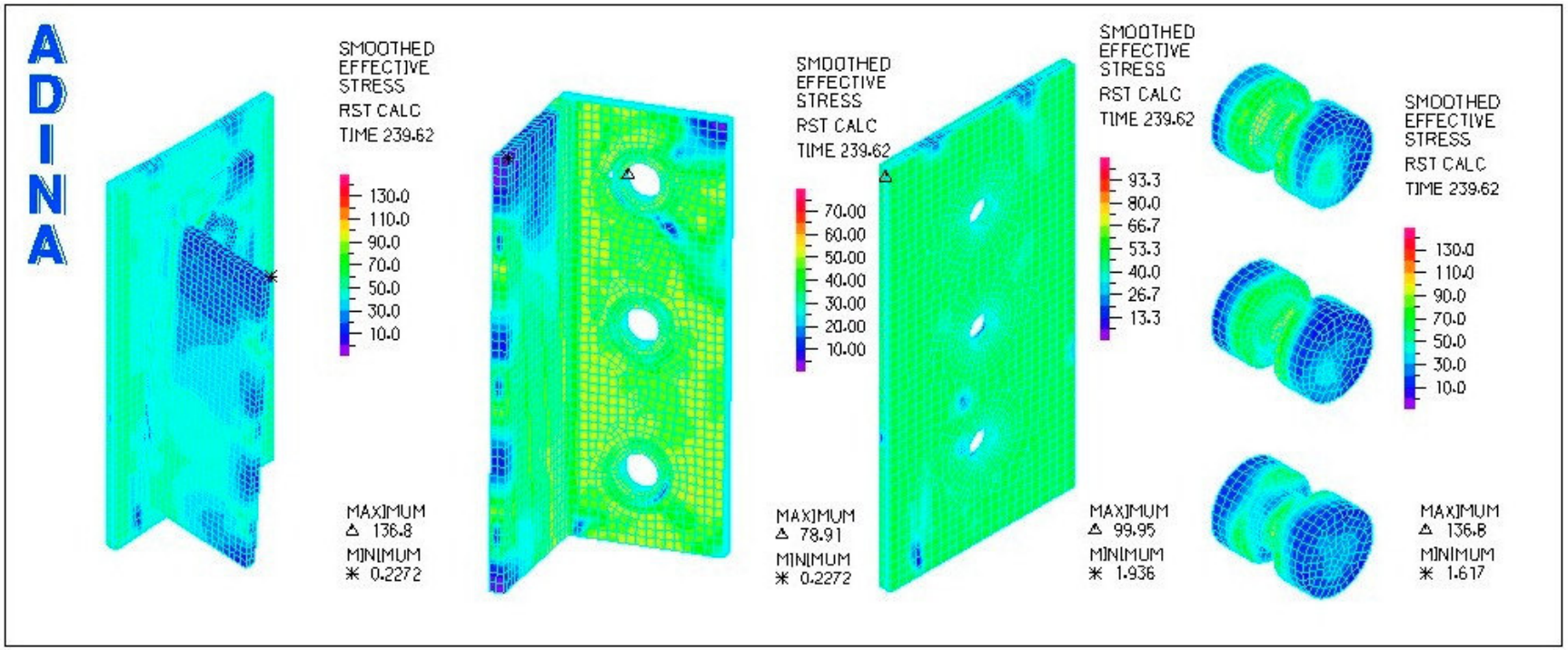

Figure 7.15 Effective Stress Plots of the Single Angle, Bolts and Girder Web for the FE Model with 3.5 in. Protruded Leg and Material Group III, Time Step = 239.62 (Maximum Applied Load)

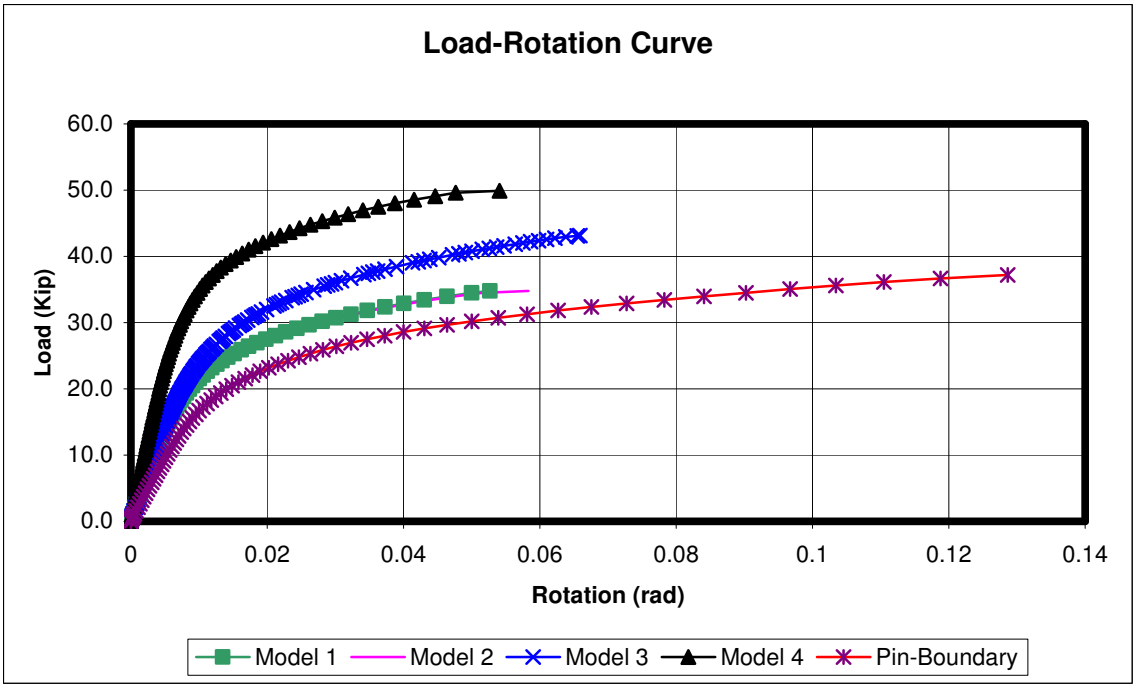

Figure 7.16 Comparison of Applied Load vs. End Rotation Curves for Material Groups I, II and III with Fixed Girder Web Boundary Conditions and Material Group III with Pinned Girder Web Boundary Conditions

CHAPTER 8
SUMMARY AND CONCLUSIONS

Extended all-bolted double angle, single angle, and tee connections are a viable alternative to standard shear connections with coped beams. The connections have a limited range of applicability, but in low-rise commercial buildings with lightly loaded bays, an extended connection will be economical. The connections require no new construction methods or material, so they can be put to use immediately. The introduction of longer leg or higher yield strength will increase the range where extended all-bolted connections can be used.

The tables located in the appendices of this document are considered reliable for design use. The methods that are used to tabulate them are all based on sound theory and mechanics. It is recommended that before extended all-bolted connections are introduced into common practice that some confirmatory laboratory testing be conducted. The results from this testing may require modifications to the assumptions made in the calculation of the design tables.

Also, more testing is recommended in the area of beam-to-girder connections. Almost all previous research is oriented towards beam-to-column connections. The behavior of a beam-to-girder connection will almost certainly vary somewhat from that of a beam-to-column connection. Beam-to-girder connections are usually made to the web of the girder and the web of the beam while beam-to column connections connect the column flange to the beam girder. The stiffnesses between the girder web and the column flange vary. This may affect the overall connection behavior. This insight may

help with the design of extended connections. Also, the differences between two-sided connections as with interior girders where there is one connection on either side of the girder web, and one-sided connections to spandrel girders should be considered during the testing of beam-to-girder connections.

The design of extended all-bolted double angle, single angle, and tee connections must be carefully considered. The designer should understand the theory and mechanics that are involved in the design of these connections. The tables located in the appendices section are only tools and designers should use their best judgment when selecting the type of connection to be specified..

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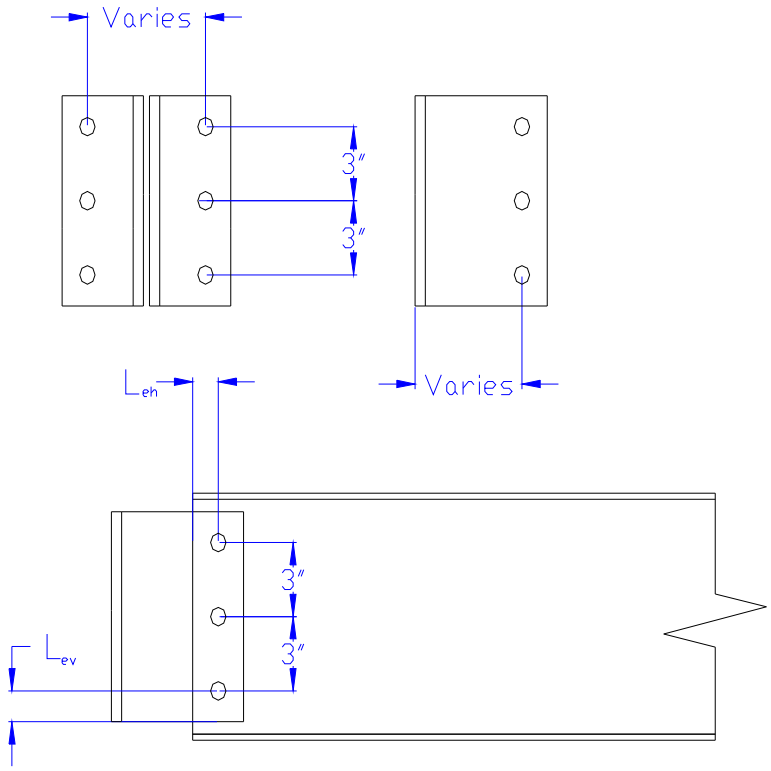
APPENDIX A
3/4-INCH DIAMETER ALL-BOLTED A36 STEEL DOUBLE ANGLE CONNECTIONS

The tables given in Appendix A are all-bolted double angle connections. The angles are A36 angles using either A325/F1852 or A490 3/4-inch diameter bolts.



Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	6	A325/ F1852	N		14.9	17.3	17.3
				X		14.9	17.9	21.6
				SC Class A	STD	11.3	11.3	11.3
					OVS	9.7	9.7	9.7
					SSLT	9.7	9.7	9.7
				SC Class B	STD	14.9	17.2	17.2
					OVS	13.8	14.6	14.6
					SSLT	14.6	14.6	14.6
			A490	N		14.9	17.9	21.6
				X		14.9	17.9	23.9
				SC Class A	STD	14.2	14.2	14.2
					OVS	12.0	12.0	12.0
					SSLT	12.0	12.0	12.0
				SC Class B	STD	14.9	17.9	21.5
					OVS	13.8	16.6	18.2
					SSLT	14.9	17.9	18.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	6	A325/ F1852	N		33.3	38.6	38.6
				X		33.3	40.0	48.3
				SC Class A	STD	25.3	25.3	25.3
					OVS	21.6	21.6	21.6
					SSLT	21.6	21.6	21.6
				SC Class B	STD	33.3	38.4	38.4
					OVS	30.9	32.6	32.6
					SSLT	32.6	32.6	32.6
			A490	N		33.3	40.0	48.3
				X		33.3	40.0	53.4
				SC Class A	STD	31.6	31.6	31.6
					OVS	26.9	26.9	26.9
					SSLT	26.9	26.9	26.9
				SC Class B	STD	33.3	40.0	48.0
					OVS	30.9	37.1	40.7
					SSLT	33.3	40.0	40.7

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	6	A325/ F1852	N		57.7	66.7	66.7
				X		57.7	69.2	83.5
				SC Class A	STD	43.8	43.8	43.8
					OVS	37.3	37.3	37.3
					SSLT	37.3	37.3	37.3
				SC Class B	STD	57.7	66.4	66.4
					OVS	53.5	56.4	56.4
					SSLT	56.4	56.4	56.4
			A490	N		57.7	69.2	83.5
				X		57.7	69.2	92.3
				SC Class A	STD	54.7	54.7	54.7
					OVS	46.6	46.6	46.6
					SSLT	46.6	46.6	46.6
				SC Class B	STD	57.7	69.2	83.0
					OVS	53.5	64.2	70.5
					SSLT	57.7	69.2	70.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	6	A325/ F1852	N		84.4	97.6	97.6
				X		84.4	101.3	122.2
				SC Class A	STD	64.2	64.2	64.2
					OVS	54.6	54.6	54.6
					SSLT	54.6	54.6	54.6
				SC Class B	STD	84.4	97.1	97.1
					OVS	78.3	82.6	82.6
					SSLT	82.6	82.6	82.6
			A490	N		84.4	101.3	122.2
				X		84.4	101.3	135.1
				SC Class A	STD	80.1	80.1	80.1
					OVS	68.2	68.2	68.2
					SSLT	68.2	68.2	68.2
				SC Class B	STD	84.4	101.3	121.4
					OVS	78.3	93.9	103.2
					SSLT	84.4	101.3	103.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	6	A325/ F1852	N		112.8	130.5	130.5
				X		112.8	135.4	163.3
				SC Class A	STD	85.7	85.7	85.7
					OVS	73.0	73.0	73.0
					SSLT	73.0	73.0	73.0
				SC Class B	STD	112.8	129.8	129.8
					OVS	104.6	110.3	110.3
					SSLT	110.3	110.3	110.3
			A490	N		112.8	135.4	163.3
				X		112.8	135.4	180.5
				SC Class A	STD	107.1	107.1	107.1
					OVS	91.1	91.1	91.1
					SSLT	91.1	91.1	91.1
				SC Class B	STD	112.8	135.4	162.3
					OVS	104.6	125.5	137.8
					SSLT	112.8	135.4	137.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	6	A325/ F1852	N		142.6	164.9	164.9
				X		142.6	171.1	206.4
				SC Class A	STD	108.4	108.4	108.4
					OVS	92.3	92.3	92.3
					SSLT	92.3	92.3	92.3
				SC Class B	STD	142.6	164.1	164.1
					OVS	132.2	139.4	139.4
					SSLT	139.4	139.4	139.4
			A490	N		142.6	171.1	206.4
				X		142.6	171.1	228.1
				SC Class A	STD	135.3	135.3	135.3
					OVS	115.1	115.1	115.1
					SSLT	115.1	115.1	115.1
				SC Class B	STD	142.6	171.1	205.1
					OVS	132.2	158.7	174.2
					SSLT	142.6	171.1	174.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	6	A325/ F1852	N		172.1	199.0	199.0
				X		172.1	206.5	249.0
				SC Class A	STD	130.8	130.8	130.8
					OVS	111.4	111.4	111.4
					SSLT	111.4	111.4	111.4
				SC Class B	STD	172.1	198.0	198.0
					OVS	159.6	168.3	168.3
					SSLT	168.3	168.3	168.3
			A490	N		172.1	206.5	249.0
				X		172.1	206.5	275.3
				SC Class A	STD	163.3	163.3	163.3
					OVS	138.9	138.9	138.9
					SSLT	138.9	138.9	138.9
				SC Class B	STD	172.1	206.5	247.5
					OVS	159.6	191.5	210.3
					SSLT	172.1	206.5	210.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	6	A325/ F1852	N		202.0	233.6	233.6
				X		202.0	242.4	292.3
				SC Class A	STD	153.5	153.5	153.5
					OVS	130.7	130.7	130.7
					SSLT	130.7	130.7	130.7
				SC Class B	STD	202.0	232.4	232.4
					OVS	187.3	197.5	197.5
					SSLT	197.5	197.5	197.5
			A490	N		202.0	242.4	292.3
				X		202.0	242.4	323.2
				SC Class A	STD	191.7	191.7	191.7
					OVS	163.1	163.1	163.1
					SSLT	163.1	163.1	163.1
				SC Class B	STD	202.0	242.4	290.5
					OVS	187.3	224.8	246.8
					SSLT	202.0	242.4	246.8

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	6	A325/ F1852	N		231.6	267.8	267.8
				X		231.6	277.9	335.1
				SC Class A	STD	176.0	176.0	176.0
					OVS	149.9	149.9	149.9
					SSLT	149.9	149.9	149.9
				SC Class B	STD	231.6	266.4	266.4
					OVS	214.7	226.4	226.4
					SSLT	226.4	226.4	226.4
			A490	N		231.6	277.9	335.1
				X		231.6	277.9	370.5
				SC Class A	STD	219.8	219.8	219.8
					OVS	186.9	186.9	186.9
					SSLT	186.9	186.9	186.9
				SC Class B	STD	231.6	277.9	333.0
					OVS	214.7	257.7	282.9
					SSLT	231.6	277.9	282.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	6	A325/ F1852	N		261.1	301.9	301.9
				X		261.1	313.3	377.9
				SC Class A	STD	198.4	198.4	198.4
					OVS	169.0	169.0	169.0
					SSLT	169.0	169.0	169.0
				SC Class B	STD	261.1	300.4	300.4
					OVS	242.1	255.4	255.4
					SSLT	255.4	255.4	255.4
			A490	N		261.1	313.3	377.9
				X		261.1	313.3	417.8
				SC Class A	STD	247.8	247.8	247.8
					OVS	210.8	210.8	210.8
					SSLT	210.8	210.8	210.8
				SC Class B	STD	261.1	313.3	375.5
					OVS	242.1	290.5	319.0
					SSLT	261.1	313.3	319.0

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	6	A325/ F1852	N		289.4	334.7	334.7
				X		289.4	347.3	418.9
				SC Class A	STD	220.0	220.0	220.0
					OVS	187.3	187.3	187.3
					SSLT	187.3	187.3	187.3
				SC Class B	STD	289.4	333.0	333.0
					OVS	268.4	283.1	283.1
					SSLT	283.1	283.1	283.1
			A490	N		289.4	347.3	418.9
				X		289.4	347.3	463.1
				SC Class A	STD	274.7	274.7	274.7
					OVS	233.7	233.7	233.7
					SSLT	233.7	233.7	233.7
				SC Class B	STD	289.4	347.3	416.3
					OVS	268.4	322.1	353.6
					SSLT	289.4	347.3	353.6

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	7	A325/ F1852	N		13.8	15.9	15.9
				X		13.8	16.5	19.9
				SC Class A	STD	10.5	10.5	10.5
					OVS	8.9	8.9	8.9
					SSLT	8.9	8.9	8.9
				SC Class B	STD	13.8	15.8	15.8
					OVS	12.8	13.4	13.4
					SSLT	13.4	13.4	13.4
			A490	N		13.8	16.5	19.9
				X		13.8	16.5	22.0
				SC Class A	STD	13.1	13.1	13.1
					OVS	11.1	11.1	11.1
					SSLT	11.1	11.1	11.1
				SC Class B	STD	13.8	16.5	19.8
					OVS	12.8	15.3	16.8
					SSLT	13.8	16.5	16.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	7	A325/ F1852	N		27.9	32.3	32.3
				X		27.9	33.5	40.4
				SC Class A	STD	21.2	21.2	21.2
					OVS	18.1	18.1	18.1
					SSLT	18.1	18.1	18.1
				SC Class B	STD	27.9	32.1	32.1
					OVS	25.9	27.3	27.3
					SSLT	27.3	27.3	27.3
			A490	N		27.9	33.5	40.4
				X		27.9	33.5	44.7
				SC Class A	STD	26.5	26.5	26.5
					OVS	22.5	22.5	22.5
					SSLT	22.5	22.5	22.5
				SC Class B	STD	27.9	33.5	40.1
					OVS	25.9	31.1	34.1
					SSLT	27.9	33.5	34.1

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	7	A325/ F1852	N		50.1	58.0	58.0
				X		50.1	60.1	72.5
				SC Class A	STD	38.1	38.1	38.1
					OVS	32.4	32.4	32.4
					SSLT	32.4	32.4	32.4
				SC Class B	STD	50.1	57.7	57.7
					OVS	46.5	49.0	49.0
					SSLT	49.0	49.0	49.0
			A490	N		50.1	60.1	72.5
				X		50.1	60.1	80.2
				SC Class A	STD	47.6	47.6	47.6
					OVS	40.5	40.5	40.5
					SSLT	40.5	40.5	40.5
				SC Class B	STD	50.1	60.1	72.1
					OVS	46.5	55.8	61.2
					SSLT	50.1	60.1	61.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	7	A325/ F1852	N		73.8	85.3	85.3
				X		73.8	88.5	106.8
				SC Class A	STD	56.1	56.1	56.1
					OVS	47.7	47.7	47.7
					SSLT	47.7	47.7	47.7
				SC Class B	STD	73.8	84.9	84.9
					OVS	68.4	72.1	72.1
					SSLT	72.1	72.1	72.1
			A490	N		73.8	88.5	106.8
				X		73.8	88.5	118.0
				SC Class A	STD	70.0	70.0	70.0
					OVS	59.6	59.6	59.6
					SSLT	59.6	59.6	59.6
				SC Class B	STD	73.8	88.5	106.1
					OVS	68.4	82.1	90.1
					SSLT	73.8	88.5	90.1

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	7	A325/ F1852	N		100.6	116.3	116.3
				X		100.6	120.7	145.6
				SC Class A	STD	76.4	76.4	76.4
					OVS	65.1	65.1	65.1
					SSLT	65.1	65.1	65.1
				SC Class B	STD	100.6	115.7	115.7
					OVS	93.3	98.4	98.4
					SSLT	98.4	98.4	98.4
			A490	N		100.6	120.7	145.6
				X		100.6	120.7	160.9
				SC Class A	STD	95.5	95.5	95.5
					OVS	81.2	81.2	81.2
					SSLT	81.2	81.2	81.2
				SC Class B	STD	100.6	120.7	144.7
					OVS	93.3	111.9	122.9
					SSLT	100.6	120.7	122.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	7	A325/ F1852	N		129.0	149.1	149.1
				X		129.0	154.8	186.7
				SC Class A	STD	98.0	98.0	98.0
					OVS	83.5	83.5	83.5
					SSLT	83.5	83.5	83.5
				SC Class B	STD	129.0	148.4	148.4
					OVS	119.6	126.1	126.1
					SSLT	126.1	126.1	126.1
			A490	N		129.0	154.8	186.7
				X		129.0	154.8	206.4
				SC Class A	STD	122.4	122.4	122.4
					OVS	104.1	104.1	104.1
					SSLT	104.1	104.1	104.1
				SC Class B	STD	129.0	154.8	185.5
					OVS	119.6	143.5	157.6
					SSLT	129.0	154.8	157.6

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	7	A325/ F1852	N		158.3	183.0	183.0
				X		158.3	189.9	229.0
				SC Class A	STD	120.3	120.3	120.3
					OVS	102.4	102.4	102.4
					SSLT	102.4	102.4	102.4
				SC Class B	STD	158.3	182.1	182.1
					OVS	146.8	154.8	154.8
					SSLT	154.8	154.8	154.8
			A490	N		158.3	189.9	229.0
				X		158.3	189.9	253.2
				SC Class A	STD	150.2	150.2	150.2
					OVS	127.8	127.8	127.8
					SSLT	127.8	127.8	127.8
				SC Class B	STD	158.3	189.9	227.6
					OVS	146.8	176.1	193.4
					SSLT	158.3	189.9	193.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	7	A325/ F1852	N		187.8	217.2	217.2
				X		187.8	225.4	271.8
				SC Class A	STD	142.7	142.7	142.7
					OVS	121.6	121.6	121.6
					SSLT	121.6	121.6	121.6
				SC Class B	STD	187.8	216.1	216.1
					OVS	174.2	183.7	183.7
					SSLT	183.7	183.7	183.7
			A490	N		187.8	225.4	271.8
				X		187.8	225.4	300.5
				SC Class A	STD	178.3	178.3	178.3
					OVS	151.6	151.6	151.6
					SSLT	151.6	151.6	151.6
				SC Class B	STD	187.8	225.4	270.1
					OVS	174.2	209.0	229.5
					SSLT	187.8	225.4	229.5

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	7	A325/ F1852	N		217.7	251.8	251.8
				X		217.7	261.3	315.1
				SC Class A	STD	165.5	165.5	165.5
					OVS	140.9	140.9	140.9
					SSLT	140.9	140.9	140.9
				SC Class B	STD	217.7	250.5	250.5
					OVS	201.9	212.9	212.9
					SSLT	212.9	212.9	212.9
			A490	N		217.7	261.3	315.1
				X		217.7	261.3	348.4
				SC Class A	STD	206.6	206.6	206.6
					OVS	175.8	175.8	175.8
					SSLT	175.8	175.8	175.8
				SC Class B	STD	217.7	261.3	313.1
					OVS	201.9	242.3	266.0
					SSLT	217.7	261.3	266.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	7	A325/ F1852	N		249.5	288.5	288.5
				X		249.5	299.4	361.1
				SC Class A	STD	189.6	189.6	189.6
					OVS	161.5	161.5	161.5
					SSLT	161.5	161.5	161.5
				SC Class B	STD	249.5	287.1	287.1
					OVS	231.3	244.0	244.0
					SSLT	244.0	244.0	244.0
			A490	N		249.5	299.4	361.1
				X		249.5	299.4	399.2
				SC Class A	STD	236.8	236.8	236.8
					OVS	201.4	201.4	201.4
					SSLT	201.4	201.4	201.4
				SC Class B	STD	249.5	299.4	358.8
					OVS	231.3	277.6	304.8
					SSLT	249.5	299.4	304.8

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	7	A325/ F1852	N		276.9	320.2	320.2
				X		276.9	332.3	400.8
				SC Class A	STD	210.5	210.5	210.5
					OVS	179.2	179.2	179.2
					SSLT	179.2	179.2	179.2
				SC Class B	STD	276.9	318.6	318.6
					OVS	256.8	270.8	270.8
					SSLT	270.8	270.8	270.8
			A490	N		276.9	332.3	400.8
				X		276.9	332.3	443.1
				SC Class A	STD	262.8	262.8	262.8
					OVS	223.6	223.6	223.6
					SSLT	223.6	223.6	223.6
				SC Class B	STD	276.9	332.3	398.3
					OVS	256.8	308.1	338.4
					SSLT	276.9	332.3	338.4

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	Represents a bolt bearing limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	8	A325/ F1852	N		11.9	13.8	13.8
				X		11.9	14.3	17.2
				SC Class A	STD	9.1	9.1	9.1
					OVS	7.7	7.7	7.7
					SSLT	7.7	7.7	7.7
				SC Class B	STD	11.9	13.7	13.7
					OVS	11.0	11.6	11.6
					SSLT	11.6	11.6	11.6
			A490	N		11.9	14.3	17.2
				X		11.9	14.3	19.1
				SC Class A	STD	11.3	11.3	11.3
					OVS	9.6	9.6	9.6
					SSLT	9.6	9.6	9.6
				SC Class B	STD	11.9	14.3	17.1
					OVS	11.0	13.3	14.6
					SSLT	11.9	14.3	14.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	8	A325/ F1852	N		24.1	27.9	27.9
				X		24.1	28.9	34.9
				SC Class A	STD	18.3	18.3	18.3
					OVS	15.6	15.6	15.6
					SSLT	15.6	15.6	15.6
				SC Class B	STD	24.1	27.7	27.7
					OVS	22.3	23.6	23.6
					SSLT	23.6	23.6	23.6
			A490	N		24.1	28.9	34.9
				X		24.1	28.9	38.6
				SC Class A	STD	22.9	22.9	22.9
					OVS	19.5	19.5	19.5
					SSLT	19.5	19.5	19.5
				SC Class B	STD	24.1	28.9	34.7
					OVS	22.3	26.8	29.4
					SSLT	24.1	28.9	29.4

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	8	A325/ F1852	N		43.5	50.3	50.3
				X		43.5	52.2	63.0
				SC Class A	STD	33.1	33.1	33.1
					OVS	28.2	28.2	28.2
					SSLT	28.2	28.2	28.2
				SC Class B	STD	43.5	50.1	50.1
					OVS	40.4	42.6	42.6
					SSLT	42.6	42.6	42.6
			A490	N		43.5	52.2	63.0
				X		43.5	52.2	69.6
				SC Class A	STD	41.3	41.3	41.3
					OVS	35.1	35.1	35.1
					SSLT	35.1	35.1	35.1
				SC Class B	STD	43.5	52.2	62.6
					OVS	40.4	48.4	53.2
					SSLT	43.5	52.2	53.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	8	A325/ F1852	N		65.5	75.8	75.8
				X		65.5	78.6	94.8
				SC Class A	STD	49.8	49.8	49.8
					OVS	42.4	42.4	42.4
					SSLT	42.4	42.4	42.4
				SC Class B	STD	65.5	75.4	75.4
					OVS	60.7	64.1	64.1
					SSLT	64.1	64.1	64.1
			A490	N		65.5	78.6	94.8
				X		65.5	78.6	104.8
				SC Class A	STD	62.2	62.2	62.2
					OVS	52.9	52.9	52.9
					SSLT	52.9	52.9	52.9
				SC Class B	STD	65.5	78.6	94.2
					OVS	60.7	72.9	80.0
					SSLT	65.5	78.6	80.0

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	8	A325/ F1852	N		90.6	104.8	104.8
				X		90.6	108.7	131.2
				SC Class A	STD	68.9	68.9	68.9
					OVS	58.7	58.7	58.7
					SSLT	58.7	58.7	58.7
				SC Class B	STD	90.6	104.3	104.3
					OVS	84.0	88.6	88.6
					SSLT	88.6	88.6	88.6
			A490	N		90.6	108.7	131.2
				X		90.6	108.7	145.0
				SC Class A	STD	86.0	86.0	86.0
					OVS	73.2	73.2	73.2
					SSLT	73.2	73.2	73.2
				SC Class B	STD	90.6	108.7	130.3
					OVS	84.0	100.8	110.7
					SSLT	90.6	108.7	110.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	8	A325/ F1852	N		117.6	136.0	136.0
				X		117.6	141.1	170.2
				SC Class A	STD	89.4	89.4	89.4
					OVS	76.1	76.1	76.1
					SSLT	76.1	76.1	76.1
				SC Class B	STD	117.6	135.3	135.3
					OVS	109.0	115.0	115.0
					SSLT	115.0	115.0	115.0
			A490	N		117.6	141.1	170.2
				X		117.6	141.1	188.1
				SC Class A	STD	111.6	111.6	111.6
					OVS	94.9	94.9	94.9
					SSLT	94.9	94.9	94.9
				SC Class B	STD	117.6	141.1	169.1
					OVS	109.0	130.8	143.6
					SSLT	117.6	141.1	143.6

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	8	A325/ F1852	N		146.0	168.8	168.8
				X		146.0	175.2	211.3
				SC Class A	STD	110.9	110.9	110.9
					OVS	94.5	94.5	94.5
					SSLT	94.5	94.5	94.5
				SC Class B	STD	146.0	168.0	168.0
					OVS	135.4	142.8	142.8
					SSLT	142.8	142.8	142.8
			A490	N		146.0	175.2	211.3
				X		146.0	175.2	233.6
				SC Class A	STD	138.5	138.5	138.5
					OVS	117.8	117.8	117.8
					SSLT	117.8	117.8	117.8
				SC Class B	STD	146.0	175.2	209.9
					OVS	135.4	162.4	178.4
					SSLT	146.0	175.2	178.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	8	A325/ F1852	N		175.0	202.4	202.4
				X		175.0	210.0	253.3
				SC Class A	STD	133.0	133.0	133.0
					OVS	113.3	113.3	113.3
					SSLT	113.3	113.3	113.3
				SC Class B	STD	175.0	201.4	201.4
					OVS	162.3	171.2	171.2
					SSLT	171.2	171.2	171.2
			A490	N		175.0	210.0	253.3
				X		175.0	210.0	280.1
				SC Class A	STD	166.1	166.1	166.1
					OVS	141.3	141.3	141.3
					SSLT	141.3	141.3	141.3
				SC Class B	STD	175.0	210.0	251.7
					OVS	162.3	194.8	213.9
					SSLT	175.0	210.0	213.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	8	A325/ F1852	N		204.8	236.9	236.9
				X		204.8	245.8	296.4
				SC Class A	STD	155.7	155.7	155.7
					OVS	132.6	132.6	132.6
					SSLT	132.6	132.6	132.6
				SC Class B	STD	204.8	235.7	235.7
					OVS	189.9	200.3	200.3
					SSLT	200.3	200.3	200.3
			A490	N		204.8	245.8	296.4
				X		204.8	245.8	327.7
				SC Class A	STD	194.4	194.4	194.4
					OVS	165.4	165.4	165.4
					SSLT	165.4	165.4	165.4
				SC Class B	STD	204.8	245.8	294.6
					OVS	189.9	227.9	250.3
					SSLT	204.8	245.8	250.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	8	A325/ F1852	N		234.5	271.2	271.2
				X		234.5	281.4	339.4
				SC Class A	STD	178.2	178.2	178.2
					OVS	151.8	151.8	151.8
					SSLT	151.8	151.8	151.8
				SC Class B	STD	234.5	269.8	269.8
					OVS	217.5	229.4	229.4
					SSLT	229.4	229.4	229.4
			A490	N		234.5	281.4	339.4
				X		234.5	281.4	375.2
				SC Class A	STD	222.6	222.6	222.6
					OVS	189.3	189.3	189.3
					SSLT	189.3	189.3	189.3
				SC Class B	STD	234.5	281.4	337.3
					OVS	217.5	261.0	286.6
					SSLT	234.5	281.4	286.6

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	8	A325/ F1852	N		264.3	305.6	305.6
				X		264.3	317.2	382.5
				SC Class A	STD	200.9	200.9	200.9
					OVS	171.1	171.1	171.1
					SSLT	171.1	171.1	171.1
				SC Class B	STD	264.3	304.1	304.1
					OVS	245.1	258.5	258.5
					SSLT	258.5	258.5	258.5
			A490	N		264.3	317.2	382.5
				X		264.3	317.2	422.9
				SC Class A	STD	250.9	250.9	250.9
					OVS	213.4	213.4	213.4
					SSLT	213.4	213.4	213.4
				SC Class B	STD	264.3	317.2	380.1
					OVS	245.1	294.1	322.9
					SSLT	264.3	317.2	322.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	9	A325/ F1852	N		8.9	10.3	10.3
				X		8.9	10.7	12.9
				SC Class A	STD	6.8	6.8	6.8
					OVS	5.8	5.8	5.8
					SSLT	5.8	5.8	5.8
				SC Class B	STD	8.9	10.3	10.3
					OVS	8.3	8.7	8.7
					SSLT	8.7	8.7	8.7
			A490	N		8.9	10.7	12.9
				X		8.9	10.7	14.3
				SC Class A	STD	8.5	8.5	8.5
					OVS	7.2	7.2	7.2
					SSLT	7.2	7.2	7.2
				SC Class B	STD	8.9	10.7	12.9
					OVS	8.3	9.9	10.9
					SSLT	8.9	10.7	10.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	9	A325/ F1852	N		20.8	24.0	24.0
				X		20.8	24.9	30.0
				SC Class A	STD	15.8	15.8	15.8
					OVS	13.4	13.4	13.4
					SSLT	13.4	13.4	13.4
				SC Class B	STD	20.8	23.9	23.9
					OVS	19.3	20.3	20.3
					SSLT	20.3	20.3	20.3
			A490	N		20.8	24.9	30.0
				X		20.8	24.9	33.2
				SC Class A	STD	19.7	19.7	19.7
					OVS	16.8	16.8	16.8
					SSLT	16.8	16.8	16.8
				SC Class B	STD	20.8	24.9	29.9
					OVS	19.3	23.1	25.4
					SSLT	20.8	24.9	25.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	9	A325/ F1852	N		38.0	44.0	44.0
				X		38.0	45.6	55.0
				SC Class A	STD	28.9	28.9	28.9
					OVS	24.6	24.6	24.6
					SSLT	24.6	24.6	24.6
				SC Class B	STD	38.0	43.7	43.7
					OVS	35.3	37.2	37.2
					SSLT	37.2	37.2	37.2
			A490	N		38.0	45.6	55.0
				X		38.0	45.6	60.8
				SC Class A	STD	36.1	36.1	36.1
					OVS	30.7	30.7	30.7
					SSLT	30.7	30.7	30.7
				SC Class B	STD	38.0	45.6	54.7
					OVS	35.3	42.3	46.5
					SSLT	38.0	45.6	46.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	9	A325/ F1852	N		57.8	66.8	66.8
				X		57.8	69.3	83.6
				SC Class A	STD	43.9	43.9	43.9
					OVS	37.4	37.4	37.4
					SSLT	37.4	37.4	37.4
				SC Class B	STD	57.8	66.4	66.4
					OVS	53.6	56.5	56.5
					SSLT	56.5	56.5	56.5
			A490	N		57.8	69.3	83.6
				X		57.8	69.3	92.4
				SC Class A	STD	54.8	54.8	54.8
					OVS	46.6	46.6	46.6
					SSLT	46.6	46.6	46.6
				SC Class B	STD	57.8	69.3	83.1
					OVS	53.6	64.3	70.6
					SSLT	57.8	69.3	70.6

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	9	A325/ F1852	N		80.6	93.2	93.2
				X		80.6	96.7	116.6
				SC Class A	STD	61.2	61.2	61.2
					OVS	52.2	52.2	52.2
					SSLT	52.2	52.2	52.2
				SC Class B	STD	80.6	92.7	92.7
					OVS	74.7	78.8	78.8
					SSLT	78.8	78.8	78.8
			A490	N		80.6	96.7	116.6
				X		80.6	96.7	128.9
				SC Class A	STD	76.5	76.5	76.5
					OVS	65.0	65.0	65.0
					SSLT	65.0	65.0	65.0
				SC Class B	STD	80.6	96.7	115.9
					OVS	74.7	89.7	98.4
					SSLT	80.6	96.7	98.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	9	A325/ F1852	N		105.7	122.3	122.3
				X		105.7	126.9	153.0
				SC Class A	STD	80.4	80.4	80.4
					OVS	68.4	68.4	68.4
					SSLT	68.4	68.4	68.4
				SC Class B	STD	105.7	121.7	121.7
					OVS	98.0	103.4	103.4
					SSLT	103.4	103.4	103.4
			A490	N		105.7	126.9	153.0
				X		105.7	126.9	169.2
				SC Class A	STD	100.4	100.4	100.4
					OVS	85.4	85.4	85.4
					SSLT	85.4	85.4	85.4
				SC Class B	STD	105.7	126.9	152.1
					OVS	98.0	117.7	129.2
					SSLT	105.7	126.9	129.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	9	A325/ F1852	N		132.8	153.5	153.5
				X		132.8	159.3	192.1
				SC Class A	STD	100.9	100.9	100.9
					OVS	85.9	85.9	85.9
					SSLT	85.9	85.9	85.9
				SC Class B	STD	132.8	152.7	152.7
					OVS	123.1	129.8	129.8
					SSLT	129.8	129.8	129.8
			A490	N		132.8	159.3	192.1
				X		132.8	159.3	212.4
				SC Class A	STD	126.0	126.0	126.0
					OVS	107.2	107.2	107.2
					SSLT	107.2	107.2	107.2
				SC Class B	STD	132.8	159.3	190.9
					OVS	123.1	147.7	162.2
					SSLT	132.8	159.3	162.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	9	A325/ F1852	N		160.8	186.0	186.0
				X		160.8	193.0	232.7
				SC Class A	STD	122.2	122.2	122.2
					OVS	104.1	104.1	104.1
					SSLT	104.1	104.1	104.1
				SC Class B	STD	160.8	185.0	185.0
					OVS	149.1	157.3	157.3
					SSLT	157.3	157.3	157.3
			A490	N		160.8	193.0	232.7
				X		160.8	193.0	257.3
				SC Class A	STD	152.6	152.6	152.6
					OVS	129.8	129.8	129.8
					SSLT	129.8	129.8	129.8
				SC Class B	STD	160.8	193.0	231.3
					OVS	149.1	178.9	196.5
					SSLT	160.8	193.0	196.5

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	9	A325/ F1852	N		189.9	219.6	219.6
				X		189.9	227.9	274.8
				SC Class A	STD	144.3	144.3	144.3
					OVS	122.9	122.9	122.9
					SSLT	122.9	122.9	122.9
				SC Class B	STD	189.9	218.5	218.5
					OVS	176.1	185.7	185.7
					SSLT	185.7	185.7	185.7
			A490	N		189.9	227.9	274.8
				X		189.9	227.9	303.8
				SC Class A	STD	180.2	180.2	180.2
					OVS	153.3	153.3	153.3
					SSLT	153.3	153.3	153.3
				SC Class B	STD	189.9	227.9	273.1
					OVS	176.1	211.3	232.0
					SSLT	189.9	227.9	232.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	9	A325/ F1852	N		219.4	253.7	253.7
				X		219.4	263.3	317.5
				SC Class A	STD	166.7	166.7	166.7
					OVS	142.0	142.0	142.0
					SSLT	142.0	142.0	142.0
				SC Class B	STD	219.4	252.4	252.4
					OVS	203.4	214.5	214.5
					SSLT	214.5	214.5	214.5
			A490	N		219.4	263.3	317.5
				X		219.4	263.3	351.0
				SC Class A	STD	208.2	208.2	208.2
					OVS	177.1	177.1	177.1
					SSLT	177.1	177.1	177.1
				SC Class B	STD	219.4	263.3	315.5
					OVS	203.4	244.1	268.0
					SSLT	219.4	263.3	268.0

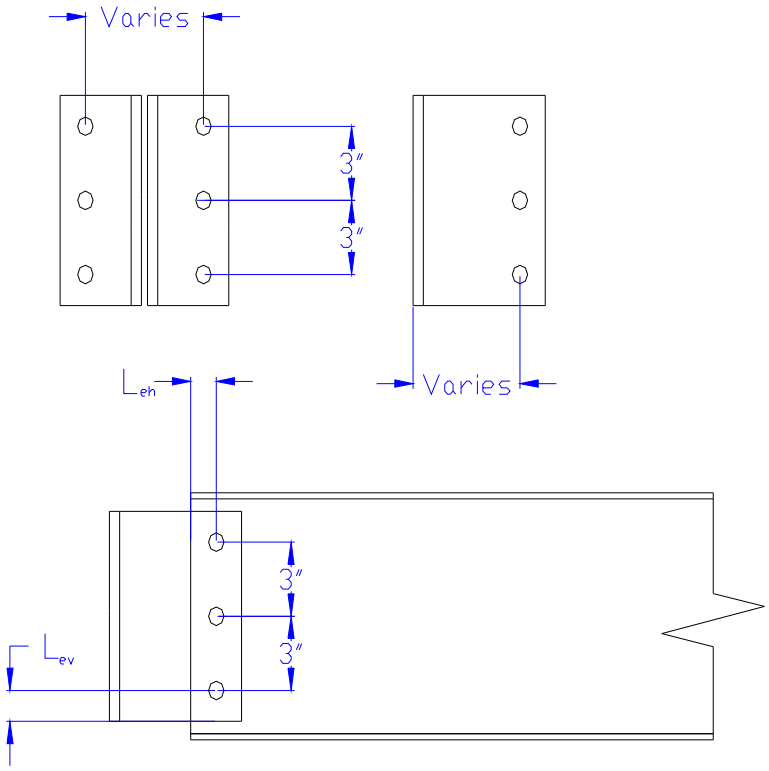
Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	9	A325/ F1852	N		249.1	288.0	288.0
				X		249.1	298.9	360.5
				SC Class A	STD	189.3	189.3	189.3
					OVS	161.2	161.2	161.2
					SSLT	161.2	161.2	161.2
				SC Class B	STD	249.1	286.6	286.6
					OVS	231.0	243.6	243.6
					SSLT	243.6	243.6	243.6
			A490	N		249.1	298.9	360.5
				X		249.1	298.9	398.5
				SC Class A	STD	236.4	236.4	236.4
					OVS	201.1	201.1	201.1
					SSLT	201.1	201.1	201.1
				SC Class B	STD	249.1	298.9	358.2
					OVS	231.0	277.2	304.3
					SSLT	249.1	298.9	304.3

APPENDIX B
7/8-INCH DIAMETER ALL-BOLTED A36 STEEL DOUBLE ANGLE CONNECTIONS

The tables given in Appendix B are all-bolted double angle connections. The angles are A36 angles using either A325/F1852 or A490 7/8-inch diameter bolts.



Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	6	A325/ F1852	N		13.8	16.6	22.1
				X		13.8	16.6	22.1
				SC Class A	STD	13.8	15.8	15.8
					OVS	12.7	13.4	13.4
					SSLT	13.4	13.4	13.4
				SC Class B	STD	13.8	16.6	22.1
					OVS	12.7	15.3	20.3
					SSLT	13.8	16.6	22.1
			A490	N		13.8	16.6	22.1
				X		13.8	16.6	22.1
				SC Class A	STD	13.8	16.6	19.8
					OVS	12.7	15.3	16.9
					SSLT	13.8	16.6	16.9
				SC Class B	STD	13.8	16.6	22.1
					OVS	12.7	15.3	20.3
					SSLT	13.8	16.6	22.1

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	6	A325/ F1852	N		30.9	37.1	49.5
				X		30.9	37.1	49.5
				SC Class A	STD	30.9	35.3	35.3
					OVS	28.4	29.9	29.9
					SSLT	29.9	29.9	29.9
				SC Class B	STD	30.9	37.1	49.5
					OVS	28.4	34.1	45.5
					SSLT	30.9	37.1	49.5
			A490	N		30.9	37.1	49.5
				X		30.9	37.1	49.5
				SC Class A	STD	30.9	37.1	44.3
					OVS	28.4	34.1	37.7
					SSLT	30.9	37.1	37.7
				SC Class B	STD	30.9	37.1	49.5
					OVS	28.4	34.1	45.5
					SSLT	30.9	37.1	49.5

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	6	A325/ F1852	N		53.5	64.2	85.6
				X		53.5	64.2	85.6
				SC Class A	STD	53.5	61.0	61.0
					OVS	49.2	51.8	51.8
					SSLT	51.8	51.8	51.8
				SC Class B	STD	53.5	64.2	85.6
					OVS	49.2	59.0	78.7
					SSLT	53.5	64.2	85.6
			A490	N		53.5	64.2	85.6
				X		53.5	64.2	85.6
				SC Class A	STD	53.5	64.2	76.6
					OVS	49.2	59.0	65.2
					SSLT	53.5	64.2	65.2
				SC Class B	STD	53.5	64.2	85.6
					OVS	49.2	59.0	78.7
					SSLT	53.5	64.2	85.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	6	A325/ F1852	N		78.3	93.9	125.3
				X		78.3	93.9	125.3
				SC Class A	STD	78.3	89.3	89.3
					OVS	72.0	75.8	75.8
					SSLT	75.8	75.8	75.8
				SC Class B	STD	78.3	93.9	125.3
					OVS	72.0	86.3	115.1
					SSLT	78.3	93.9	125.3
			A490	N		78.3	93.9	125.3
				X		78.3	93.9	125.3
				SC Class A	STD	78.3	93.9	112.1
					OVS	72.0	86.3	95.5
					SSLT	78.3	93.9	95.5
				SC Class B	STD	78.3	93.9	125.3
					OVS	72.0	86.3	115.1
					SSLT	78.3	93.9	125.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	6	A325/ F1852	N		104.6	125.5	167.4
				X		104.6	125.5	167.4
				SC Class A	STD	104.6	119.4	119.4
					OVS	96.2	101.3	101.3
					SSLT	101.3	101.3	101.3
				SC Class B	STD	104.6	125.5	167.4
					OVS	96.2	115.4	153.8
					SSLT	104.6	125.5	167.4
			A490	N		104.6	125.5	167.4
				X		104.6	125.5	167.4
				SC Class A	STD	104.6	125.5	149.7
					OVS	96.2	115.4	127.6
					SSLT	104.6	125.5	127.6
				SC Class B	STD	104.6	125.5	167.4
					OVS	96.2	115.4	153.8
					SSLT	104.6	125.5	167.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	6	A325/ F1852	N		132.2	158.7	211.5
				X		132.2	158.7	211.5
				SC Class A	STD	132.2	150.9	150.9
					OVS	121.5	128.1	128.1
					SSLT	128.1	128.1	128.1
				SC Class B	STD	132.2	158.7	211.5
					OVS	121.5	145.8	194.4
					SSLT	132.2	158.7	211.5
			A490	N		132.2	158.7	211.5
				X		132.2	158.7	211.5
				SC Class A	STD	132.2	158.7	189.3
					OVS	121.5	145.8	161.3
					SSLT	132.2	158.7	161.3
				SC Class B	STD	132.2	158.7	211.5
					OVS	121.5	145.8	194.4
					SSLT	132.2	158.7	211.5

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	6	A325/ F1852	N		159.6	191.5	255.3
				X		159.6	191.5	255.3
				SC Class A	STD	159.6	182.1	182.1
					OVS	146.7	154.6	154.6
					SSLT	154.6	154.6	154.6
				SC Class B	STD	159.6	191.5	255.3
					OVS	146.7	176.0	234.7
					SSLT	159.6	191.5	255.3
			A490	N		159.6	191.5	255.3
				X		159.6	191.5	255.3
				SC Class A	STD	159.6	191.5	228.4
					OVS	146.7	176.0	194.6
					SSLT	159.6	191.5	194.6
				SC Class B	STD	159.6	191.5	255.3
					OVS	146.7	176.0	234.7
					SSLT	159.6	191.5	255.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	6	A325/ F1852	N		187.3	224.8	299.7
				X		187.3	224.8	299.7
				SC Class A	STD	187.3	213.7	213.7
					OVS	172.1	181.4	181.4
					SSLT	181.4	181.4	181.4
				SC Class B	STD	187.3	224.8	299.7
					OVS	172.1	206.6	275.4
					SSLT	187.3	224.8	299.7
			A490	N		187.3	224.8	299.7
				X		187.3	224.8	299.7
				SC Class A	STD	187.3	224.8	268.1
					OVS	172.1	206.6	228.4
					SSLT	187.3	224.8	228.4
				SC Class B	STD	187.3	224.8	299.7
					OVS	172.1	206.6	275.4
					SSLT	187.3	224.8	299.7

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	6	A325/ F1852	N		214.7	257.7	343.5
				X		214.7	257.7	343.5
				SC Class A	STD	214.7	245.0	245.0
					OVS	197.3	208.0	208.0
					SSLT	208.0	208.0	208.0
				SC Class B	STD	214.7	257.7	343.5
					OVS	197.3	236.8	315.8
					SSLT	214.7	257.7	343.5
			A490	N		214.7	257.7	343.5
				X		214.7	257.7	343.5
				SC Class A	STD	214.7	257.7	307.3
					OVS	197.3	236.8	261.9
					SSLT	214.7	257.7	261.9
				SC Class B	STD	214.7	257.7	343.5
					OVS	197.3	236.8	315.8
					SSLT	214.7	257.7	343.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	6	A325/ F1852	N		242.1	290.5	387.4
				X		242.1	290.5	387.4
				SC Class A	STD	242.1	276.3	276.3
					OVS	222.5	234.5	234.5
					SSLT	234.5	234.5	234.5
				SC Class B	STD	242.1	290.5	387.4
					OVS	222.5	267.0	356.1
					SSLT	242.1	290.5	387.4
			A490	N		242.1	290.5	387.4
				X		242.1	290.5	387.4
				SC Class A	STD	242.1	290.5	346.6
					OVS	222.5	267.0	295.3
					SSLT	242.1	290.5	295.3
				SC Class B	STD	242.1	290.5	387.4
					OVS	222.5	267.0	356.1
					SSLT	242.1	290.5	387.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	6	A325/ F1852	N		268.4	322.1	429.4
				X		268.4	322.1	429.4
				SC Class A	STD	268.4	306.3	306.3
					OVS	246.7	260.0	260.0
					SSLT	260.0	260.0	260.0
				SC Class B	STD	268.4	322.1	429.4
					OVS	246.7	296.0	394.7
					SSLT	268.4	322.1	429.4
			A490	N		268.4	322.1	429.4
				X		268.4	322.1	429.4
				SC Class A	STD	268.4	322.1	384.2
					OVS	246.7	296.0	327.3
					SSLT	268.4	322.1	327.3
				SC Class B	STD	268.4	322.1	429.4
					OVS	246.7	296.0	394.7
					SSLT	268.4	322.1	429.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	7	A325/ F1852	N		12.8	15.3	20.4
				X		12.8	15.3	20.4
				SC Class A	STD	12.8	14.6	14.6
					OVS	11.7	12.4	12.4
					SSLT	12.4	12.4	12.4
				SC Class B	STD	12.8	15.3	20.4
					OVS	11.7	14.1	18.8
					SSLT	12.8	15.3	20.4
			A490	N		12.8	15.3	20.4
				X		12.8	15.3	20.4
				SC Class A	STD	12.8	15.3	18.3
					OVS	11.7	14.1	15.6
					SSLT	12.8	15.3	15.6
				SC Class B	STD	12.8	15.3	20.4
					OVS	11.7	14.1	18.8
					SSLT	12.8	15.3	20.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	7	A325/ F1852	N		25.9	31.1	41.4
				X		25.9	31.1	41.4
				SC Class A	STD	25.9	29.5	29.5
					OVS	23.8	25.1	25.1
					SSLT	25.1	25.1	25.1
				SC Class B	STD	25.9	31.1	41.4
					OVS	23.8	28.5	38.1
					SSLT	25.9	31.1	41.4
			A490	N		25.9	31.1	41.4
				X		25.9	31.1	41.4
				SC Class A	STD	25.9	31.1	37.0
					OVS	23.8	28.5	31.6
					SSLT	25.9	31.1	31.6
				SC Class B	STD	25.9	31.1	41.4
					OVS	23.8	28.5	38.1
					SSLT	25.9	31.1	41.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	7	A325/ F1852	N		46.5	55.8	74.4
				X		46.5	55.8	74.4
				SC Class A	STD	46.5	53.0	53.0
					OVS	42.7	45.0	45.0
					SSLT	45.0	45.0	45.0
				SC Class B	STD	46.5	55.8	74.4
					OVS	42.7	51.3	68.3
					SSLT	46.5	55.8	74.4
			A490	N		46.5	55.8	74.4
				X		46.5	55.8	74.4
				SC Class A	STD	46.5	55.8	66.5
					OVS	42.7	51.3	56.7
					SSLT	46.5	55.8	56.7
				SC Class B	STD	46.5	55.8	74.4
					OVS	42.7	51.3	68.3
					SSLT	46.5	55.8	74.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	7	A325/ F1852	N		68.4	82.1	109.4
				X		68.4	82.1	109.4
				SC Class A	STD	68.4	78.1	78.1
					OVS	62.9	66.3	66.3
					SSLT	66.3	66.3	66.3
				SC Class B	STD	68.4	82.1	109.4
					OVS	62.9	75.4	100.6
					SSLT	68.4	82.1	109.4
			A490	N		68.4	82.1	109.4
				X		68.4	82.1	109.4
				SC Class A	STD	68.4	82.1	97.9
					OVS	62.9	75.4	83.4
					SSLT	68.4	82.1	83.4
				SC Class B	STD	68.4	82.1	109.4
					OVS	62.9	75.4	100.6
					SSLT	68.4	82.1	109.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	7	A325/ F1852	N		93.3	111.9	149.2
				X		93.3	111.9	149.2
				SC Class A	STD	93.3	106.4	106.4
					OVS	85.7	90.3	90.3
					SSLT	90.3	90.3	90.3
				SC Class B	STD	93.3	111.9	149.2
					OVS	85.7	102.9	137.2
					SSLT	93.3	111.9	149.2
			A490	N		93.3	111.9	149.2
				X		93.3	111.9	149.2
				SC Class A	STD	93.3	111.9	133.5
					OVS	85.7	102.9	113.7
					SSLT	93.3	111.9	113.7
				SC Class B	STD	93.3	111.9	149.2
					OVS	85.7	102.9	137.2
					SSLT	93.3	111.9	149.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	7	A325/ F1852	N		119.6	143.5	191.4
				X		119.6	143.5	191.4
				SC Class A	STD	119.6	136.5	136.5
					OVS	109.9	115.8	115.8
					SSLT	115.8	115.8	115.8
				SC Class B	STD	119.6	143.5	191.4
					OVS	109.9	131.9	175.9
					SSLT	119.6	143.5	191.4
			A490	N		119.6	143.5	191.4
				X		119.6	143.5	191.4
				SC Class A	STD	119.6	143.5	171.2
					OVS	109.9	131.9	145.9
					SSLT	119.6	143.5	145.9
				SC Class B	STD	119.6	143.5	191.4
					OVS	109.9	131.9	175.9
					SSLT	119.6	143.5	191.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	7	A325/ F1852	N		146.8	176.1	234.8
				X		146.8	176.1	234.8
				SC Class A	STD	146.8	167.5	167.5
					OVS	134.9	142.1	142.1
					SSLT	142.1	142.1	142.1
				SC Class B	STD	146.8	176.1	234.8
					OVS	134.9	161.9	215.8
					SSLT	146.8	176.1	234.8
			A490	N		146.8	176.1	234.8
				X		146.8	176.1	234.8
				SC Class A	STD	146.8	176.1	210.1
					OVS	134.9	161.9	179.0
					SSLT	146.8	176.1	179.0
				SC Class B	STD	146.8	176.1	234.8
					OVS	134.9	161.9	215.8
					SSLT	146.8	176.1	234.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	7	A325/ F1852	N		174.2	209.0	278.7
				X		174.2	209.0	278.7
				SC Class A	STD	174.2	198.8	198.8
					OVS	160.1	168.7	168.7
					SSLT	168.7	168.7	168.7
				SC Class B	STD	174.2	209.0	278.7
					OVS	160.1	192.1	256.1
					SSLT	174.2	209.0	278.7
			A490	N		174.2	209.0	278.7
				X		174.2	209.0	278.7
				SC Class A	STD	174.2	209.0	249.3
					OVS	160.1	192.1	212.4
					SSLT	174.2	209.0	212.4
				SC Class B	STD	174.2	209.0	278.7
					OVS	160.1	192.1	256.1
					SSLT	174.2	209.0	278.7

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	7	A325/ F1852	N		201.9	242.3	323.0
				X		201.9	242.3	323.0
				SC Class A	STD	201.9	230.4	230.4
					OVS	185.6	195.6	195.6
					SSLT	195.6	195.6	195.6
				SC Class B	STD	201.9	242.3	323.0
					OVS	185.6	222.7	296.9
					SSLT	201.9	242.3	323.0
			A490	N		201.9	242.3	323.0
				X		201.9	242.3	323.0
				SC Class A	STD	201.9	242.3	289.0
					OVS	185.6	222.7	246.2
					SSLT	201.9	242.3	246.2
				SC Class B	STD	201.9	242.3	323.0
					OVS	185.6	222.7	296.9
					SSLT	201.9	242.3	323.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	7	A325/ F1852	N		231.3	277.6	370.2
				X		231.3	277.6	370.2
				SC Class A	STD	231.3	264.0	264.0
					OVS	212.6	224.1	224.1
					SSLT	224.1	224.1	224.1
				SC Class B	STD	231.3	277.6	370.2
					OVS	212.6	255.2	340.2
					SSLT	231.3	277.6	370.2
			A490	N		231.3	277.6	370.2
				X		231.3	277.6	370.2
				SC Class A	STD	231.3	277.6	331.1
					OVS	212.6	255.2	282.2
					SSLT	231.3	277.6	282.2
				SC Class B	STD	231.3	277.6	370.2
					OVS	212.6	255.2	340.2
					SSLT	231.3	277.6	370.2

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	7	A325/ F1852	N		256.8	308.1	410.9
				X		256.8	308.1	410.9
				SC Class A	STD	256.8	293.0	293.0
					OVS	236.0	248.7	248.7
					SSLT	248.7	248.7	248.7
				SC Class B	STD	256.8	308.1	410.9
					OVS	236.0	283.2	377.6
					SSLT	256.8	308.1	410.9
			A490	N		256.8	308.1	410.9
				X		256.8	308.1	410.9
				SC Class A	STD	256.8	308.1	367.6
					OVS	236.0	283.2	313.2
					SSLT	256.8	308.1	313.2
				SC Class B	STD	256.8	308.1	410.9
					OVS	236.0	283.2	377.6
					SSLT	256.8	308.1	410.9

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	8	A325/ F1852	N		11.0	13.3	17.7
				X		11.0	13.3	17.7
				SC Class A	STD	11.0	12.6	12.6
					OVS	10.2	10.7	10.7
					SSLT	10.7	10.7	10.7
				SC Class B	STD	11.0	13.3	17.7
					OVS	10.2	12.2	16.2
					SSLT	11.0	13.3	17.7
			A490	N		11.0	13.3	17.7
				X		11.0	13.3	17.7
				SC Class A	STD	11.0	13.3	15.8
					OVS	10.2	12.2	13.5
					SSLT	11.0	13.3	13.5
				SC Class B	STD	11.0	13.3	17.7
					OVS	10.2	12.2	16.2
					SSLT	11.0	13.3	17.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	8	A325/ F1852	N		22.3	26.8	35.7
				X		22.3	26.8	35.7
				SC Class A	STD	22.3	25.5	25.5
					OVS	20.5	21.6	21.6
					SSLT	21.6	21.6	21.6
				SC Class B	STD	22.3	26.8	35.7
					OVS	20.5	24.6	32.9
					SSLT	22.3	26.8	35.7
			A490	N		22.3	26.8	35.7
				X		22.3	26.8	35.7
				SC Class A	STD	22.3	26.8	32.0
					OVS	20.5	24.6	27.2
					SSLT	22.3	26.8	27.2
				SC Class B	STD	22.3	26.8	35.7
					OVS	20.5	24.6	32.9
					SSLT	22.3	26.8	35.7

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	8	A325/ F1852	N		40.4	48.4	64.6
				X		40.4	48.4	64.6
				SC Class A	STD	40.4	46.1	46.1
					OVS	37.1	39.1	39.1
					SSLT	39.1	39.1	39.1
				SC Class B	STD	40.4	48.4	64.6
					OVS	37.1	44.5	59.3
					SSLT	40.4	48.4	64.6
			A490	N		40.4	48.4	64.6
				X		40.4	48.4	64.6
				SC Class A	STD	40.4	48.4	57.8
					OVS	37.1	44.5	49.2
					SSLT	40.4	48.4	49.2
				SC Class B	STD	40.4	48.4	64.6
					OVS	37.1	44.5	59.3
					SSLT	40.4	48.4	64.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	8	A325/ F1852	N		60.7	72.9	97.2
				X		60.7	72.9	97.2
				SC Class A	STD	60.7	69.3	69.3
					OVS	55.8	58.8	58.8
					SSLT	58.8	58.8	58.8
				SC Class B	STD	60.7	72.9	97.2
					OVS	55.8	67.0	89.3
					SSLT	60.7	72.9	97.2
			A490	N		60.7	72.9	97.2
				X		60.7	72.9	97.2
				SC Class A	STD	60.7	72.9	87.0
					OVS	55.8	67.0	74.1
					SSLT	60.7	72.9	74.1
				SC Class B	STD	60.7	72.9	97.2
					OVS	55.8	67.0	89.3
					SSLT	60.7	72.9	97.2

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	8	A325/ F1852	N		84.0	100.8	134.5
				X		84.0	100.8	134.5
				SC Class A	STD	84.0	95.9	95.9
					OVS	77.2	81.4	81.4
					SSLT	81.4	81.4	81.4
				SC Class B	STD	84.0	100.8	134.5
					OVS	77.2	92.7	123.6
					SSLT	84.0	100.8	134.5
			A490	N		84.0	100.8	134.5
				X		84.0	100.8	134.5
				SC Class A	STD	84.0	100.8	120.3
					OVS	77.2	92.7	102.5
					SSLT	84.0	100.8	102.5
				SC Class B	STD	84.0	100.8	134.5
					OVS	77.2	92.7	123.6
					SSLT	84.0	100.8	134.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	8	A325/ F1852	N		109.0	130.8	174.4
				X		109.0	130.8	174.4
				SC Class A	STD	109.0	124.4	124.4
					OVS	100.2	105.6	105.6
					SSLT	105.6	105.6	105.6
				SC Class B	STD	109.0	130.8	174.4
					OVS	100.2	120.2	160.3
					SSLT	109.0	130.8	174.4
			A490	N		109.0	130.8	174.4
				X		109.0	130.8	174.4
				SC Class A	STD	109.0	130.8	156.0
					OVS	100.2	120.2	133.0
					SSLT	109.0	130.8	133.0
				SC Class B	STD	109.0	130.8	174.4
					OVS	100.2	120.2	160.3
					SSLT	109.0	130.8	174.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	8	A325/ F1852	N		135.4	162.4	216.6
				X		135.4	162.4	216.6
				SC Class A	STD	135.4	154.5	154.5
					OVS	124.4	131.1	131.1
					SSLT	131.1	131.1	131.1
				SC Class B	STD	135.4	162.4	216.6
					OVS	124.4	149.3	199.1
					SSLT	135.4	162.4	216.6
			A490	N		135.4	162.4	216.6
				X		135.4	162.4	216.6
				SC Class A	STD	135.4	162.4	193.8
					OVS	124.4	149.3	165.1
					SSLT	135.4	162.4	165.1
				SC Class B	STD	135.4	162.4	216.6
					OVS	124.4	149.3	199.1
					SSLT	135.4	162.4	216.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	8	A325/ F1852	N		162.3	194.8	259.7
				X		162.3	194.8	259.7
				SC Class A	STD	162.3	185.2	185.2
					OVS	149.2	157.2	157.2
					SSLT	157.2	157.2	157.2
				SC Class B	STD	162.3	194.8	259.7
					OVS	149.2	179.0	238.7
					SSLT	162.3	194.8	259.7
			A490	N		162.3	194.8	259.7
				X		162.3	194.8	259.7
				SC Class A	STD	162.3	194.8	232.3
					OVS	149.2	179.0	198.0
					SSLT	162.3	194.8	198.0
				SC Class B	STD	162.3	194.8	259.7
					OVS	149.2	179.0	238.7
					SSLT	162.3	194.8	259.7

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	8	A325/ F1852	N		189.9	227.9	303.9
				X		189.9	227.9	303.9
				SC Class A	STD	189.9	216.7	216.7
					OVS	174.6	184.0	184.0
					SSLT	184.0	184.0	184.0
				SC Class B	STD	189.9	227.9	303.9
					OVS	174.6	209.5	279.3
					SSLT	189.9	227.9	303.9
			A490	N		189.9	227.9	303.9
				X		189.9	227.9	303.9
				SC Class A	STD	189.9	227.9	271.9
					OVS	174.6	209.5	231.6
					SSLT	189.9	227.9	231.6
				SC Class B	STD	189.9	227.9	303.9
					OVS	174.6	209.5	279.3
					SSLT	189.9	227.9	303.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	8	A325/ F1852	N		217.5	261.0	348.0
				X		217.5	261.0	348.0
				SC Class A	STD	217.5	248.2	248.2
					OVS	199.9	210.6	210.6
					SSLT	210.6	210.6	210.6
				SC Class B	STD	217.5	261.0	348.0
					OVS	199.9	239.9	319.8
					SSLT	217.5	261.0	348.0
			A490	N		217.5	261.0	348.0
				X		217.5	261.0	348.0
				SC Class A	STD	217.5	261.0	311.3
					OVS	199.9	239.9	265.2
					SSLT	217.5	261.0	265.2
				SC Class B	STD	217.5	261.0	348.0
					OVS	199.9	239.9	319.8
					SSLT	217.5	261.0	348.0

Notes:
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L_{eh} is assumed to be 1.25 in.

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	8	A325/ F1852	N		245.1	294.1	392.2
				X		245.1	294.1	392.2
				SC Class A	STD	245.1	279.7	279.7
					OVS	225.3	237.4	237.4
					SSLT	237.4	237.4	237.4
				SC Class B	STD	245.1	294.1	392.2
					OVS	225.3	270.3	360.4
					SSLT	245.1	294.1	392.2
			A490	N		245.1	294.1	392.2
				X		245.1	294.1	392.2
				SC Class A	STD	245.1	294.1	350.8
					OVS	225.3	270.3	298.9
					SSLT	245.1	294.1	298.9
				SC Class B	STD	245.1	294.1	392.2
					OVS	225.3	270.3	360.4
					SSLT	245.1	294.1	392.2

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	9	A325/ F1852	N		8.3	9.9	13.3
				X		8.3	9.9	13.3
				SC Class A	STD	8.3	9.5	9.5
					OVS	7.6	8.0	8.0
					SSLT	8.0	8.0	8.0
				SC Class B	STD	8.3	9.9	13.3
					OVS	7.6	9.1	12.2
					SSLT	8.3	9.9	13.3
			A490	N		8.3	9.9	13.3
				X		8.3	9.9	13.3
				SC Class A	STD	8.3	9.9	11.9
					OVS	7.6	9.1	10.1
					SSLT	8.3	9.9	10.1
				SC Class B	STD	8.3	9.9	13.3
					OVS	7.6	9.1	12.2
					SSLT	8.3	9.9	13.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	9	A325/ F1852	N		19.3	23.1	30.8
				X		19.3	23.1	30.8
				SC Class A	STD	19.3	22.0	22.0
					OVS	17.7	18.6	18.6
					SSLT	18.6	18.6	18.6
				SC Class B	STD	19.3	23.1	30.8
					OVS	17.7	21.2	28.3
					SSLT	19.3	23.1	30.8
			A490	N		19.3	23.1	30.8
				X		19.3	23.1	30.8
				SC Class A	STD	19.3	23.1	27.6
					OVS	17.7	21.2	23.5
					SSLT	19.3	23.1	23.5
				SC Class B	STD	19.3	23.1	30.8
					OVS	17.7	21.2	28.3
					SSLT	19.3	23.1	30.8

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	9	A325/ F1852	N		35.3	42.3	56.4
				X		35.3	42.3	56.4
				SC Class A	STD	35.3	40.2	40.2
					OVS	32.4	34.1	34.1
					SSLT	34.1	34.1	34.1
				SC Class B	STD	35.3	42.3	56.4
					OVS	32.4	38.9	51.8
					SSLT	35.3	42.3	56.4
			A490	N		35.3	42.3	56.4
				X		35.3	42.3	56.4
				SC Class A	STD	35.3	42.3	50.5
					OVS	32.4	38.9	43.0
					SSLT	35.3	42.3	43.0
				SC Class B	STD	35.3	42.3	56.4
					OVS	32.4	38.9	51.8
					SSLT	35.3	42.3	56.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	9	A325/ F1852	N		53.6	64.3	85.7
				X		53.6	64.3	85.7
				SC Class A	STD	53.6	61.1	61.1
					OVS	49.2	51.9	51.9
					SSLT	51.9	51.9	51.9
				SC Class B	STD	53.6	64.3	85.7
					OVS	49.2	59.1	78.8
					SSLT	53.6	64.3	85.7
			A490	N		53.6	64.3	85.7
				X		53.6	64.3	85.7
				SC Class A	STD	53.6	64.3	76.7
					OVS	49.2	59.1	65.3
					SSLT	53.6	64.3	65.3
				SC Class B	STD	53.6	64.3	85.7
					OVS	49.2	59.1	78.8
					SSLT	53.6	64.3	85.7

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	9	A325/ F1852	N		74.7	89.7	119.5
				X		74.7	89.7	119.5
				SC Class A	STD	74.7	85.3	85.3
					OVS	68.7	72.4	72.4
					SSLT	72.4	72.4	72.4
				SC Class B	STD	74.7	89.7	119.5
					OVS	68.7	82.4	109.9
					SSLT	74.7	89.7	119.5
			A490	N		74.7	89.7	119.5
				X		74.7	89.7	119.5
				SC Class A	STD	74.7	89.7	106.9
					OVS	68.7	82.4	91.1
					SSLT	74.7	89.7	91.1
				SC Class B	STD	74.7	89.7	119.5
					OVS	68.7	82.4	109.9
					SSLT	74.7	89.7	119.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	9	A325/ F1852	N		98.0	117.7	156.9
				X		98.0	117.7	156.9
				SC Class A	STD	98.0	111.9	111.9
					OVS	90.1	95.0	95.0
					SSLT	95.0	95.0	95.0
				SC Class B	STD	98.0	117.7	156.9
					OVS	90.1	108.1	144.2
					SSLT	98.0	117.7	156.9
			A490	N		98.0	117.7	156.9
				X		98.0	117.7	156.9
				SC Class A	STD	98.0	117.7	140.3
					OVS	90.1	108.1	119.6
					SSLT	98.0	117.7	119.6
				SC Class B	STD	98.0	117.7	156.9
					OVS	90.1	108.1	144.2
					SSLT	98.0	117.7	156.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	9	A325/ F1852	N		123.1	147.7	197.0
				X		123.1	147.7	197.0
				SC Class A	STD	123.1	140.5	140.5
					OVS	113.1	119.2	119.2
					SSLT	119.2	119.2	119.2
				SC Class B	STD	123.1	147.7	197.0
					OVS	113.1	135.8	181.0
					SSLT	123.1	147.7	197.0
			A490	N		123.1	147.7	197.0
				X		123.1	147.7	197.0
				SC Class A	STD	123.1	147.7	176.2
					OVS	113.1	135.8	150.1
					SSLT	123.1	147.7	150.1
				SC Class B	STD	123.1	147.7	197.0
					OVS	113.1	135.8	181.0
					SSLT	123.1	147.7	197.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	9	A325/ F1852	N		149.1	178.9	238.6
				X		149.1	178.9	238.6
				SC Class A	STD	149.1	170.2	170.2
					OVS	137.1	144.4	144.4
					SSLT	144.4	144.4	144.4
				SC Class B	STD	149.1	178.9	238.6
					OVS	137.1	164.5	219.3
					SSLT	149.1	178.9	238.6
			A490	N		149.1	178.9	238.6
				X		149.1	178.9	238.6
				SC Class A	STD	149.1	178.9	213.4
					OVS	137.1	164.5	181.9
					SSLT	149.1	178.9	181.9
				SC Class B	STD	149.1	178.9	238.6
					OVS	137.1	164.5	219.3
					SSLT	149.1	178.9	238.6

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	9	A325/ F1852	N		176.1	211.3	281.7
				X		176.1	211.3	281.7
				SC Class A	STD	176.1	200.9	200.9
					OVS	161.8	170.6	170.6
					SSLT	170.6	170.6	170.6
				SC Class B	STD	176.1	211.3	281.7
					OVS	161.8	194.2	258.9
					SSLT	176.1	211.3	281.7
			A490	N		176.1	211.3	281.7
				X		176.1	211.3	281.7
				SC Class A	STD	176.1	211.3	252.0
					OVS	161.8	194.2	214.7
					SSLT	176.1	211.3	214.7
				SC Class B	STD	176.1	211.3	281.7
					OVS	161.8	194.2	258.9
					SSLT	176.1	211.3	281.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	9	A325/ F1852	N		203.4	244.1	325.5
				X		203.4	244.1	325.5
				SC Class A	STD	203.4	232.1	232.1
					OVS	187.0	197.0	197.0
					SSLT	197.0	197.0	197.0
				SC Class B	STD	203.4	244.1	325.5
					OVS	187.0	224.4	299.2
					SSLT	203.4	244.1	325.5
			A490	N		203.4	244.1	325.5
				X		203.4	244.1	325.5
				SC Class A	STD	203.4	244.1	291.2
					OVS	187.0	224.4	248.1
					SSLT	203.4	244.1	248.1
				SC Class B	STD	203.4	244.1	325.5
					OVS	187.0	224.4	299.2
					SSLT	203.4	244.1	325.5

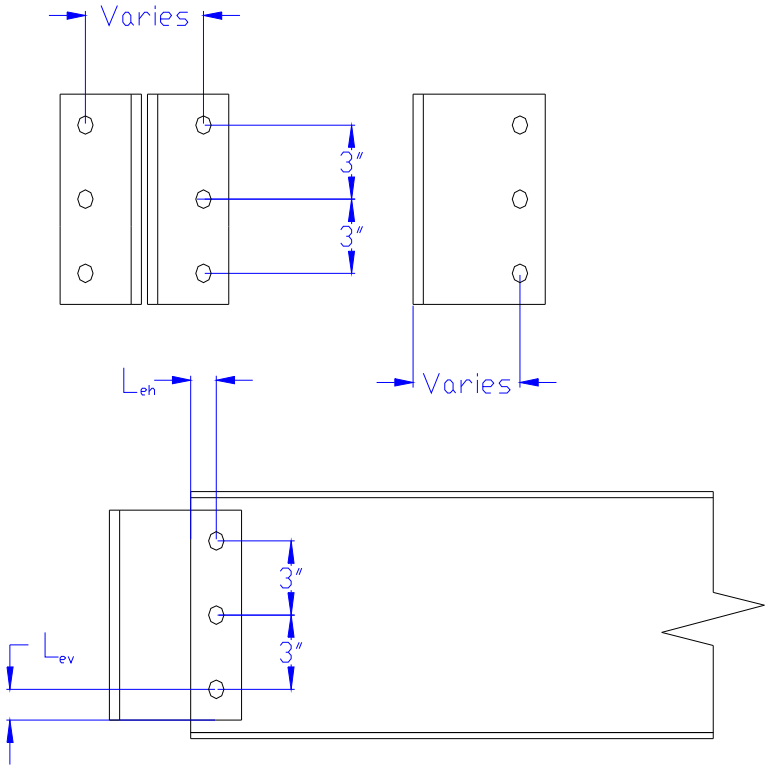
Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	9	A325/ F1852	N		231.0	277.2	369.5
				X		231.0	277.2	369.5
				SC Class A	STD	231.0	263.6	263.6
					OVS	212.3	223.7	223.7
					SSLT	223.7	223.7	223.7
				SC Class B	STD	231.0	277.2	369.5
					OVS	212.3	254.7	339.7
					SSLT	231.0	277.2	369.5
			A490	N		231.0	277.2	369.5
				X		231.0	277.2	369.5
				SC Class A	STD	231.0	277.2	330.6
					OVS	212.3	254.7	281.7
					SSLT	231.0	277.2	281.7
				SC Class B	STD	231.0	277.2	369.5
					OVS	212.3	254.7	339.7
					SSLT	231.0	277.2	369.5

APPENDIX C
1-INCH DIAMETER ALL-BOLTED A36 STEEL DOUBLE ANGLE CONNECTIONS

The tables given in Appendix C are all-bolted double angle connections. The angles are A36 angles using either A325/F1852 or A490 1-inch diameter bolts.



Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

Represents a bolt bearing limit state
Represents a bolt shear limit state
Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	6	A325/ F1852	N		12.7	15.3	20.3
				X		12.7	15.3	20.3
				SC Class A	STD	12.7	15.3	20.3
					OVS	11.1	13.3	17.5
					SSLT	12.7	15.3	17.5
				SC Class B	STD	12.7	15.3	20.3
					OVS	11.1	13.3	17.7
					SSLT	12.7	15.3	20.3
			A490	N		12.7	15.3	20.3
				X		12.7	15.3	20.3
				SC Class A	STD	12.7	15.3	20.3
					OVS	11.1	13.3	17.7
					SSLT	12.7	15.3	20.3
				SC Class B	STD	12.7	15.3	20.3
					OVS	11.1	13.3	17.7
					SSLT	12.7	15.3	20.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	6	A325/ F1852	N		28.4	34.1	45.5
				X		28.4	34.1	45.5
				SC Class A	STD	28.4	34.1	45.5
					OVS	24.7	29.6	39.2
					SSLT	28.4	34.1	39.2
				SC Class B	STD	28.4	34.1	45.5
					OVS	24.7	29.6	39.5
					SSLT	28.4	34.1	45.5
			A490	N		28.4	34.1	45.5
				X		28.4	34.1	45.5
				SC Class A	STD	28.4	34.1	45.5
					OVS	24.7	29.6	39.5
					SSLT	28.4	34.1	45.5
				SC Class B	STD	28.4	34.1	45.5
					OVS	24.7	29.6	39.5
					SSLT	28.4	34.1	45.5

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	6	A325/ F1852	N		49.2	59.0	78.7
				X		49.2	59.0	78.7
				SC Class A	STD	49.2	59.0	78.7
					OVS	42.7	51.3	67.7
					SSLT	49.2	59.0	67.7
				SC Class B	STD	49.2	59.0	78.7
					OVS	42.7	51.3	68.4
					SSLT	49.2	59.0	78.7
			A490	N		49.2	59.0	78.7
				X		49.2	59.0	78.7
				SC Class A	STD	49.2	59.0	78.7
					OVS	42.7	51.3	68.4
					SSLT	49.2	59.0	78.7
				SC Class B	STD	49.2	59.0	78.7
					OVS	42.7	51.3	68.4
					SSLT	49.2	59.0	78.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	6	A325/ F1852	N		72.0	86.3	115.1
				X		72.0	86.3	115.1
				SC Class A	STD	72.0	86.3	115.1
					OVS	62.6	75.1	99.2
					SSLT	72.0	86.3	99.2
				SC Class B	STD	72.0	86.3	115.1
					OVS	62.6	75.1	100.1
					SSLT	72.0	86.3	115.1
			A490	N		72.0	86.3	115.1
				X		72.0	86.3	115.1
				SC Class A	STD	72.0	86.3	115.1
					OVS	62.6	75.1	100.1
					SSLT	72.0	86.3	115.1
				SC Class B	STD	72.0	86.3	115.1
					OVS	62.6	75.1	100.1
					SSLT	72.0	86.3	115.1

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	6	A325/ F1852	N		96.2	115.4	153.8
				X		96.2	115.4	153.8
				SC Class A	STD	96.2	115.4	153.8
					OVS	83.6	100.3	132.5
					SSLT	96.2	115.4	132.5
				SC Class B	STD	96.2	115.4	153.8
					OVS	83.6	100.3	133.7
					SSLT	96.2	115.4	153.8
			A490	N		96.2	115.4	153.8
				X		96.2	115.4	153.8
				SC Class A	STD	96.2	115.4	153.8
					OVS	83.6	100.3	133.7
					SSLT	96.2	115.4	153.8
				SC Class B	STD	96.2	115.4	153.8
					OVS	83.6	100.3	133.7
					SSLT	96.2	115.4	153.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	6	A325/ F1852	N		121.5	145.8	194.4
				X		121.5	145.8	194.4
				SC Class A	STD	121.5	145.8	194.4
					OVS	105.6	126.8	167.5
					SSLT	121.5	145.8	167.5
				SC Class B	STD	121.5	145.8	194.4
					OVS	105.6	126.8	169.0
					SSLT	121.5	145.8	194.4
			A490	N		121.5	145.8	194.4
				X		121.5	145.8	194.4
				SC Class A	STD	121.5	145.8	194.4
					OVS	105.6	126.8	169.0
					SSLT	121.5	145.8	194.4
				SC Class B	STD	121.5	145.8	194.4
					OVS	105.6	126.8	169.0
					SSLT	121.5	145.8	194.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

Represents a bolt bearing limit state
Represents a bolt shear limit state
Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	6	A325/ F1852	N		146.7	176.0	234.7
				X		146.7	176.0	234.7
				SC Class A	STD	146.7	176.0	234.7
					OVS	127.5	153.0	202.1
					SSLT	146.7	176.0	202.1
				SC Class B	STD	146.7	176.0	234.7
					OVS	127.5	153.0	204.0
					SSLT	146.7	176.0	234.7
			A490	N		146.7	176.0	234.7
				X		146.7	176.0	234.7
				SC Class A	STD	146.7	176.0	234.7
					OVS	127.5	153.0	204.0
					SSLT	146.7	176.0	234.7
				SC Class B	STD	146.7	176.0	234.7
					OVS	127.5	153.0	204.0
					SSLT	146.7	176.0	234.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	6	A325/ F1852	N		172.1	206.6	275.4
				X		172.1	206.6	275.4
				SC Class A	STD	172.1	206.6	275.4
					OVS	149.7	179.6	237.2
					SSLT	172.1	206.6	237.2
				SC Class B	STD	172.1	206.6	275.4
					OVS	149.7	179.6	239.4
					SSLT	172.1	206.6	275.4
			A490	N		172.1	206.6	275.4
				X		172.1	206.6	275.4
				SC Class A	STD	172.1	206.6	275.4
					OVS	149.7	179.6	239.4
					SSLT	172.1	206.6	275.4
				SC Class B	STD	172.1	206.6	275.4
					OVS	149.7	179.6	239.4
					SSLT	172.1	206.6	275.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	6	A325/ F1852	N		197.3	236.8	315.8
				X		197.3	236.8	315.8
				SC Class A	STD	197.3	236.8	315.8
					OVS	171.6	205.9	272.0
					SSLT	197.3	236.8	272.0
				SC Class B	STD	197.3	236.8	315.8
					OVS	171.6	205.9	274.5
					SSLT	197.3	236.8	315.8
			A490	N		197.3	236.8	315.8
				X		197.3	236.8	315.8
				SC Class A	STD	197.3	236.8	315.8
					OVS	171.6	205.9	274.5
					SSLT	197.3	236.8	315.8
				SC Class B	STD	197.3	236.8	315.8
					OVS	171.6	205.9	274.5
					SSLT	197.3	236.8	315.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	6	A325/ F1852	N		222.5	267.0	356.1
				X		222.5	267.0	356.1
				SC Class A	STD	222.5	267.0	356.1
					OVS	193.5	232.2	306.7
					SSLT	222.5	267.0	306.7
				SC Class B	STD	222.5	267.0	356.1
					OVS	193.5	232.2	309.5
					SSLT	222.5	267.0	356.1
			A490	N		222.5	267.0	356.1
				X		222.5	267.0	356.1
				SC Class A	STD	222.5	267.0	356.1
					OVS	193.5	232.2	309.5
					SSLT	222.5	267.0	356.1
				SC Class B	STD	222.5	267.0	356.1
					OVS	193.5	232.2	309.5
					SSLT	222.5	267.0	356.1

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	6	A325/ F1852	N		246.7	296.0	394.7
				X		246.7	296.0	394.7
				SC Class A	STD	246.7	296.0	394.7
					OVS	214.4	257.3	340.0
					SSLT	246.7	296.0	340.0
				SC Class B	STD	246.7	296.0	394.7
					OVS	214.4	257.3	343.1
					SSLT	246.7	296.0	394.7
			A490	N		246.7	296.0	394.7
				X		246.7	296.0	394.7
				SC Class A	STD	246.7	296.0	394.7
					OVS	214.4	257.3	343.1
					SSLT	246.7	296.0	394.7
				SC Class B	STD	246.7	296.0	394.7
					OVS	214.4	257.3	343.1
					SSLT	246.7	296.0	394.7

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	7	A325/ F1852	N		11.7	14.1	18.8
				X		11.7	14.1	18.8
				SC Class A	STD	11.7	14.1	18.8
					OVS	10.2	12.2	16.2
					SSLT	11.7	14.1	16.2
				SC Class B	STD	11.7	14.1	18.8
					OVS	10.2	12.2	16.3
					SSLT	11.7	14.1	18.8
			A490	N		11.7	14.1	18.8
				X		11.7	14.1	18.8
				SC Class A	STD	11.7	14.1	18.8
					OVS	10.2	12.2	16.3
					SSLT	11.7	14.1	18.8
				SC Class B	STD	11.7	14.1	18.8
					OVS	10.2	12.2	16.3
					SSLT	11.7	14.1	18.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	7	A325/ F1852	N		23.8	28.5	38.1
				X		23.8	28.5	38.1
				SC Class A	STD	23.8	28.5	38.1
					OVS	20.7	24.8	32.8
					SSLT	23.8	28.5	32.8
				SC Class B	STD	23.8	28.5	38.1
					OVS	20.7	24.8	33.1
					SSLT	23.8	28.5	38.1
			A490	N		23.8	28.5	38.1
				X		23.8	28.5	38.1
				SC Class A	STD	23.8	28.5	38.1
					OVS	20.7	24.8	33.1
					SSLT	23.8	28.5	38.1
				SC Class B	STD	23.8	28.5	38.1
					OVS	20.7	24.8	33.1
					SSLT	23.8	28.5	38.1

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	7	A325/ F1852	N		42.7	51.3	68.3
				X		42.7	51.3	68.3
				SC Class A	STD	42.7	51.3	68.3
					OVS	37.1	44.6	58.9
					SSLT	42.7	51.3	58.9
				SC Class B	STD	42.7	51.3	68.3
					OVS	37.1	44.6	59.4
					SSLT	42.7	51.3	68.3
			A490	N		42.7	51.3	68.3
				X		42.7	51.3	68.3
				SC Class A	STD	42.7	51.3	68.3
					OVS	37.1	44.6	59.4
					SSLT	42.7	51.3	68.3
				SC Class B	STD	42.7	51.3	68.3
					OVS	37.1	44.6	59.4
					SSLT	42.7	51.3	68.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	7	A325/ F1852	N		62.9	75.4	100.6
				X		62.9	75.4	100.6
				SC Class A	STD	62.9	75.4	100.6
					OVS	54.7	65.6	86.6
					SSLT	62.9	75.4	86.6
				SC Class B	STD	62.9	75.4	100.6
					OVS	54.7	65.6	87.4
					SSLT	62.9	75.4	100.6
			A490	N		62.9	75.4	100.6
				X		62.9	75.4	100.6
				SC Class A	STD	62.9	75.4	100.6
					OVS	54.7	65.6	87.4
					SSLT	62.9	75.4	100.6
				SC Class B	STD	62.9	75.4	100.6
					OVS	54.7	65.6	87.4
					SSLT	62.9	75.4	100.6

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	7	A325/ F1852	N		85.7	102.9	137.2
				X		85.7	102.9	137.2
				SC Class A	STD	85.7	102.9	137.2
					OVS	74.5	89.4	118.1
					SSLT	85.7	102.9	118.1
				SC Class B	STD	85.7	102.9	137.2
					OVS	74.5	89.4	119.2
					SSLT	85.7	102.9	137.2
			A490	N		85.7	102.9	137.2
				X		85.7	102.9	137.2
				SC Class A	STD	85.7	102.9	137.2
					OVS	74.5	89.4	119.2
					SSLT	85.7	102.9	137.2
				SC Class B	STD	85.7	102.9	137.2
					OVS	74.5	89.4	119.2
					SSLT	85.7	102.9	137.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	7	A325/ F1852	N		109.9	131.9	175.9
				X		109.9	131.9	175.9
				SC Class A	STD	109.9	131.9	175.9
					OVS	95.6	114.7	151.5
					SSLT	109.9	131.9	151.5
				SC Class B	STD	109.9	131.9	175.9
					OVS	95.6	114.7	152.9
					SSLT	109.9	131.9	175.9
			A490	N		109.9	131.9	175.9
				X		109.9	131.9	175.9
				SC Class A	STD	109.9	131.9	175.9
					OVS	95.6	114.7	152.9
					SSLT	109.9	131.9	175.9
				SC Class B	STD	109.9	131.9	175.9
					OVS	95.6	114.7	152.9
					SSLT	109.9	131.9	175.9

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	7	A325/ F1852	N		134.9	161.9	215.8
				X		134.9	161.9	215.8
				SC Class A	STD	134.9	161.9	215.8
					OVS	117.3	140.7	185.9
					SSLT	134.9	161.9	185.9
				SC Class B	STD	134.9	161.9	215.8
					OVS	117.3	140.7	187.6
					SSLT	134.9	161.9	215.8
			A490	N		134.9	161.9	215.8
				X		134.9	161.9	215.8
				SC Class A	STD	134.9	161.9	215.8
					OVS	117.3	140.7	187.6
					SSLT	134.9	161.9	215.8
				SC Class B	STD	134.9	161.9	215.8
					OVS	117.3	140.7	187.6
					SSLT	134.9	161.9	215.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	7	A325/ F1852	N		160.1	192.1	256.1
				X		160.1	192.1	256.1
				SC Class A	STD	160.1	192.1	256.1
					OVS	139.2	167.0	220.6
					SSLT	160.1	192.1	220.6
				SC Class B	STD	160.1	192.1	256.1
					OVS	139.2	167.0	222.7
					SSLT	160.1	192.1	256.1
			A490	N		160.1	192.1	256.1
				X		160.1	192.1	256.1
				SC Class A	STD	160.1	192.1	256.1
					OVS	139.2	167.0	222.7
					SSLT	160.1	192.1	256.1
				SC Class B	STD	160.1	192.1	256.1
					OVS	139.2	167.0	222.7
					SSLT	160.1	192.1	256.1

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	7	A325/ F1852	N		185.6	222.7	296.9
				X		185.6	222.7	296.9
				SC Class A	STD	185.6	222.7	296.9
					OVS	161.3	193.6	255.7
					SSLT	185.6	222.7	255.7
				SC Class B	STD	185.6	222.7	296.9
					OVS	161.3	193.6	258.1
					SSLT	185.6	222.7	296.9
			A490	N		185.6	222.7	296.9
				X		185.6	222.7	296.9
				SC Class A	STD	185.6	222.7	296.9
					OVS	161.3	193.6	258.1
					SSLT	185.6	222.7	296.9
				SC Class B	STD	185.6	222.7	296.9
					OVS	161.3	193.6	258.1
					SSLT	185.6	222.7	296.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	7	A325/ F1852	N		212.6	255.2	340.2
				X		212.6	255.2	340.2
				SC Class A	STD	212.6	255.2	340.2
					OVS	184.9	221.8	293.0
					SSLT	212.6	255.2	293.0
				SC Class B	STD	212.6	255.2	340.2
					OVS	184.9	221.8	295.8
					SSLT	212.6	255.2	340.2
			A490	N		212.6	255.2	340.2
				X		212.6	255.2	340.2
				SC Class A	STD	212.6	255.2	340.2
					OVS	184.9	221.8	295.8
					SSLT	212.6	255.2	340.2
				SC Class B	STD	212.6	255.2	340.2
					OVS	184.9	221.8	295.8
					SSLT	212.6	255.2	340.2

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	7	A325/ F1852	N		236.0	283.2	377.6
				X		236.0	283.2	377.6
				SC Class A	STD	236.0	283.2	377.6
					OVS	205.2	246.2	325.3
					SSLT	236.0	283.2	325.3
				SC Class B	STD	236.0	283.2	377.6
					OVS	205.2	246.2	328.3
					SSLT	236.0	283.2	377.6
			A490	N		236.0	283.2	377.6
				X		236.0	283.2	377.6
				SC Class A	STD	236.0	283.2	377.6
					OVS	205.2	246.2	328.3
					SSLT	236.0	283.2	377.6
				SC Class B	STD	236.0	283.2	377.6
					OVS	205.2	246.2	328.3
					SSLT	236.0	283.2	377.6

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	8	A325/ F1852	N		10.2	12.2	16.2
				X		10.2	12.2	16.2
				SC Class A	STD	10.2	12.2	16.2
					OVS	8.8	10.6	14.0
					SSLT	10.2	12.2	14.0
				SC Class B	STD	10.2	12.2	16.2
					OVS	8.8	10.6	14.1
					SSLT	10.2	12.2	16.2
			A490	N		10.2	12.2	16.2
				X		10.2	12.2	16.2
				SC Class A	STD	10.2	12.2	16.2
					OVS	8.8	10.6	14.1
					SSLT	10.2	12.2	16.2
				SC Class B	STD	10.2	12.2	16.2
					OVS	8.8	10.6	14.1
					SSLT	10.2	12.2	16.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	8	A325/ F1852	N		20.5	24.6	32.9
				X		20.5	24.6	32.9
				SC Class A	STD	20.5	24.6	32.9
					OVS	17.9	21.4	28.3
					SSLT	20.5	24.6	28.3
				SC Class B	STD	20.5	24.6	32.9
					OVS	17.9	21.4	28.6
					SSLT	20.5	24.6	32.9
			A490	N		20.5	24.6	32.9
				X		20.5	24.6	32.9
				SC Class A	STD	20.5	24.6	32.9
					OVS	17.9	21.4	28.6
					SSLT	20.5	24.6	32.9
				SC Class B	STD	20.5	24.6	32.9
					OVS	17.9	21.4	28.6
					SSLT	20.5	24.6	32.9

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	8	A325/ F1852	N		37.1	44.5	59.3
				X		37.1	44.5	59.3
				SC Class A	STD	37.1	44.5	59.3
					OVS	32.2	38.7	51.1
					SSLT	37.1	44.5	51.1
				SC Class B	STD	37.1	44.5	59.3
					OVS	32.2	38.7	51.6
					SSLT	37.1	44.5	59.3
			A490	N		37.1	44.5	59.3
				X		37.1	44.5	59.3
				SC Class A	STD	37.1	44.5	59.3
					OVS	32.2	38.7	51.6
					SSLT	37.1	44.5	59.3
				SC Class B	STD	37.1	44.5	59.3
					OVS	32.2	38.7	51.6
					SSLT	37.1	44.5	59.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	8	A325/ F1852	N		55.8	67.0	89.3
				X		55.8	67.0	89.3
				SC Class A	STD	55.8	67.0	89.3
					OVS	48.5	58.2	76.9
					SSLT	55.8	67.0	76.9
				SC Class B	STD	55.8	67.0	89.3
					OVS	48.5	58.2	77.7
					SSLT	55.8	67.0	89.3
			A490	N		55.8	67.0	89.3
				X		55.8	67.0	89.3
				SC Class A	STD	55.8	67.0	89.3
					OVS	48.5	58.2	77.7
					SSLT	55.8	67.0	89.3
				SC Class B	STD	55.8	67.0	89.3
					OVS	48.5	58.2	77.7
					SSLT	55.8	67.0	89.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	8	A325/ F1852	N		77.2	92.7	123.6
				X		77.2	92.7	123.6
				SC Class A	STD	77.2	92.7	123.6
					OVS	67.1	80.6	106.4
					SSLT	77.2	92.7	106.4
				SC Class B	STD	77.2	92.7	123.6
					OVS	67.1	80.6	107.4
					SSLT	77.2	92.7	123.6
			A490	N		77.2	92.7	123.6
				X		77.2	92.7	123.6
				SC Class A	STD	77.2	92.7	123.6
					OVS	67.1	80.6	107.4
					SSLT	77.2	92.7	123.6
				SC Class B	STD	77.2	92.7	123.6
					OVS	67.1	80.6	107.4
					SSLT	77.2	92.7	123.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	8	A325/ F1852	N		100.2	120.2	160.3
				X		100.2	120.2	160.3
				SC Class A	STD	100.2	120.2	160.3
					OVS	87.1	104.5	138.1
					SSLT	100.2	120.2	138.1
				SC Class B	STD	100.2	120.2	160.3
					OVS	87.1	104.5	139.4
					SSLT	100.2	120.2	160.3
			A490	N		100.2	120.2	160.3
				X		100.2	120.2	160.3
				SC Class A	STD	100.2	120.2	160.3
					OVS	87.1	104.5	139.4
					SSLT	100.2	120.2	160.3
				SC Class B	STD	100.2	120.2	160.3
					OVS	87.1	104.5	139.4
					SSLT	100.2	120.2	160.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	8	A325/ F1852	N		124.4	149.3	199.1
				X		124.4	149.3	199.1
				SC Class A	STD	124.4	149.3	199.1
					OVS	108.2	129.8	171.5
					SSLT	124.4	149.3	171.5
				SC Class B	STD	124.4	149.3	199.1
					OVS	108.2	129.8	173.1
					SSLT	124.4	149.3	199.1
			A490	N		124.4	149.3	199.1
				X		124.4	149.3	199.1
				SC Class A	STD	124.4	149.3	199.1
					OVS	108.2	129.8	173.1
					SSLT	124.4	149.3	199.1
				SC Class B	STD	124.4	149.3	199.1
					OVS	108.2	129.8	173.1
					SSLT	124.4	149.3	199.1

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	8	A325/ F1852	N		149.2	179.0	238.7
				X		149.2	179.0	238.7
				SC Class A	STD	149.2	179.0	238.7
					OVS	129.7	155.6	205.6
					SSLT	149.2	179.0	205.6
				SC Class B	STD	149.2	179.0	238.7
					OVS	129.7	155.6	207.5
					SSLT	149.2	179.0	238.7
			A490	N		149.2	179.0	238.7
				X		149.2	179.0	238.7
				SC Class A	STD	149.2	179.0	238.7
					OVS	129.7	155.6	207.5
					SSLT	149.2	179.0	238.7
				SC Class B	STD	149.2	179.0	238.7
					OVS	129.7	155.6	207.5
					SSLT	149.2	179.0	238.7

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	8	A325/ F1852	N		174.6	209.5	279.3
				X		174.6	209.5	279.3
				SC Class A	STD	174.6	209.5	279.3
					OVS	151.8	182.1	240.6
					SSLT	174.6	209.5	240.6
				SC Class B	STD	174.6	209.5	279.3
					OVS	151.8	182.1	242.8
					SSLT	174.6	209.5	279.3
			A490	N		174.6	209.5	279.3
				X		174.6	209.5	279.3
				SC Class A	STD	174.6	209.5	279.3
					OVS	151.8	182.1	242.8
					SSLT	174.6	209.5	279.3
				SC Class B	STD	174.6	209.5	279.3
					OVS	151.8	182.1	242.8
					SSLT	174.6	209.5	279.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	8	A325/ F1852	N		199.9	239.9	319.8
				X		199.9	239.9	319.8
				SC Class A	STD	199.9	239.9	319.8
					OVS	173.8	208.5	275.5
					SSLT	199.9	239.9	275.5
				SC Class B	STD	199.9	239.9	319.8
					OVS	173.8	208.5	278.0
					SSLT	199.9	239.9	319.8
			A490	N		199.9	239.9	319.8
				X		199.9	239.9	319.8
				SC Class A	STD	199.9	239.9	319.8
					OVS	173.8	208.5	278.0
					SSLT	199.9	239.9	319.8
				SC Class B	STD	199.9	239.9	319.8
					OVS	173.8	208.5	278.0
					SSLT	199.9	239.9	319.8

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	8	A325/ F1852	N		225.3	270.3	360.4
				X		225.3	270.3	360.4
				SC Class A	STD	225.3	270.3	360.4
					OVS	195.8	235.0	310.5
					SSLT	225.3	270.3	310.5
				SC Class B	STD	225.3	270.3	360.4
					OVS	195.8	235.0	313.3
					SSLT	225.3	270.3	360.4
			A490	N		225.3	270.3	360.4
				X		225.3	270.3	360.4
				SC Class A	STD	225.3	270.3	360.4
					OVS	195.8	235.0	313.3
					SSLT	225.3	270.3	360.4
				SC Class B	STD	225.3	270.3	360.4
					OVS	195.8	235.0	313.3
					SSLT	225.3	270.3	360.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	9	A325/ F1852	N		7.6	9.1	12.2
				X		7.6	9.1	12.2
				SC Class A	STD	7.6	9.1	12.2
					OVS	6.6	7.9	10.5
					SSLT	7.6	9.1	10.5
				SC Class B	STD	7.6	9.1	12.2
					OVS	6.6	7.9	10.6
					SSLT	7.6	9.1	12.2
			A490	N		7.6	9.1	12.2
				X		7.6	9.1	12.2
				SC Class A	STD	7.6	9.1	12.2
					OVS	6.6	7.9	10.6
					SSLT	7.6	9.1	12.2
				SC Class B	STD	7.6	9.1	12.2
					OVS	6.6	7.9	10.6
					SSLT	7.6	9.1	12.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	9	A325/ F1852	N		17.7	21.2	28.3
				X		17.7	21.2	28.3
				SC Class A	STD	17.7	21.2	28.3
					OVS	15.4	18.5	24.4
					SSLT	17.7	21.2	24.4
				SC Class B	STD	17.7	21.2	28.3
					OVS	15.4	18.5	24.6
					SSLT	17.7	21.2	28.3
			A490	N		17.7	21.2	28.3
				X		17.7	21.2	28.3
				SC Class A	STD	17.7	21.2	28.3
					OVS	15.4	18.5	24.6
					SSLT	17.7	21.2	28.3
				SC Class B	STD	17.7	21.2	28.3
					OVS	15.4	18.5	24.6
					SSLT	17.7	21.2	28.3

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	9	A325/ F1852	N		32.4	38.9	51.8
				X		32.4	38.9	51.8
				SC Class A	STD	32.4	38.9	51.8
					OVS	28.2	33.8	44.7
					SSLT	32.4	38.9	44.7
				SC Class B	STD	32.4	38.9	51.8
					OVS	28.2	33.8	45.1
					SSLT	32.4	38.9	51.8
			A490	N		32.4	38.9	51.8
				X		32.4	38.9	51.8
				SC Class A	STD	32.4	38.9	51.8
					OVS	28.2	33.8	45.1
					SSLT	32.4	38.9	51.8
				SC Class B	STD	32.4	38.9	51.8
					OVS	28.2	33.8	45.1
					SSLT	32.4	38.9	51.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	9	A325/ F1852	N		49.2	59.1	78.8
				X		49.2	59.1	78.8
				SC Class A	STD	49.2	59.1	78.8
					OVS	42.8	51.3	67.8
					SSLT	49.2	59.1	67.8
				SC Class B	STD	49.2	59.1	78.8
					OVS	42.8	51.3	68.5
					SSLT	49.2	59.1	78.8
			A490	N		49.2	59.1	78.8
				X		49.2	59.1	78.8
				SC Class A	STD	49.2	59.1	78.8
					OVS	42.8	51.3	68.5
					SSLT	49.2	59.1	78.8
				SC Class B	STD	49.2	59.1	78.8
					OVS	42.8	51.3	68.5
					SSLT	49.2	59.1	78.8

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

Represents a bolt bearing limit state
Represents a bolt shear limit state
Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	9	A325/ F1852	N		68.7	82.4	109.9
				X		68.7	82.4	109.9
				SC Class A	STD	68.7	82.4	109.9
					OVS	59.7	71.6	94.6
					SSLT	68.7	82.4	94.6
				SC Class B	STD	68.7	82.4	109.9
					OVS	59.7	71.6	95.5
					SSLT	68.7	82.4	109.9
			A490	N		68.7	82.4	109.9
				X		68.7	82.4	109.9
				SC Class A	STD	68.7	82.4	109.9
					OVS	59.7	71.6	95.5
					SSLT	68.7	82.4	109.9
				SC Class B	STD	68.7	82.4	109.9
					OVS	59.7	71.6	95.5
					SSLT	68.7	82.4	109.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	9	A325/ F1852	N		90.1	108.1	144.2
				X		90.1	108.1	144.2
				SC Class A	STD	90.1	108.1	144.2
					OVS	78.3	94.0	124.2
					SSLT	90.1	108.1	124.2
				SC Class B	STD	90.1	108.1	144.2
					OVS	78.3	94.0	125.3
					SSLT	90.1	108.1	144.2
			A490	N		90.1	108.1	144.2
				X		90.1	108.1	144.2
				SC Class A	STD	90.1	108.1	144.2
					OVS	78.3	94.0	125.3
					SSLT	90.1	108.1	144.2
				SC Class B	STD	90.1	108.1	144.2
					OVS	78.3	94.0	125.3
					SSLT	90.1	108.1	144.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	9	A325/ F1852	N		113.1	135.8	181.0
				X		113.1	135.8	181.0
				SC Class A	STD	113.1	135.8	181.0
					OVS	98.4	118.0	155.9
					SSLT	113.1	135.8	155.9
				SC Class B	STD	113.1	135.8	181.0
					OVS	98.4	118.0	157.4
					SSLT	113.1	135.8	181.0
			A490	N		113.1	135.8	181.0
				X		113.1	135.8	181.0
				SC Class A	STD	113.1	135.8	181.0
					OVS	98.4	118.0	157.4
					SSLT	113.1	135.8	181.0
				SC Class B	STD	113.1	135.8	181.0
					OVS	98.4	118.0	157.4
					SSLT	113.1	135.8	181.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	9	A325/ F1852	N		137.1	164.5	219.3
				X		137.1	164.5	219.3
				SC Class A	STD	137.1	164.5	219.3
					OVS	119.1	143.0	188.9
					SSLT	137.1	164.5	188.9
				SC Class B	STD	137.1	164.5	219.3
					OVS	119.1	143.0	190.6
					SSLT	137.1	164.5	219.3
			A490	N		137.1	164.5	219.3
				X		137.1	164.5	219.3
				SC Class A	STD	137.1	164.5	219.3
					OVS	119.1	143.0	190.6
					SSLT	137.1	164.5	219.3
				SC Class B	STD	137.1	164.5	219.3
					OVS	119.1	143.0	190.6
					SSLT	137.1	164.5	219.3

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

Represents a bolt bearing limit state
Represents a bolt shear limit state
Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	9	A325/ F1852	N		161.8	194.2	258.9
				X		161.8	194.2	258.9
				SC Class A	STD	161.8	194.2	258.9
					OVS	140.7	168.8	223.0
					SSLT	161.8	194.2	223.0
				SC Class B	STD	161.8	194.2	258.9
					OVS	140.7	168.8	225.1
					SSLT	161.8	194.2	258.9
			A490	N		161.8	194.2	258.9
				X		161.8	194.2	258.9
				SC Class A	STD	161.8	194.2	258.9
					OVS	140.7	168.8	225.1
					SSLT	161.8	194.2	258.9
				SC Class B	STD	161.8	194.2	258.9
					OVS	140.7	168.8	225.1
					SSLT	161.8	194.2	258.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	9	A325/ F1852	N		187.0	224.4	299.2
				X		187.0	224.4	299.2
				SC Class A	STD	187.0	224.4	299.2
					OVS	162.5	195.0	257.7
					SSLT	187.0	224.4	257.7
				SC Class B	STD	187.0	224.4	299.2
					OVS	162.5	195.0	260.1
					SSLT	187.0	224.4	299.2
			A490	N		187.0	224.4	299.2
				X		187.0	224.4	299.2
				SC Class A	STD	187.0	224.4	299.2
					OVS	162.5	195.0	260.1
					SSLT	187.0	224.4	299.2
				SC Class B	STD	187.0	224.4	299.2
					OVS	162.5	195.0	260.1
					SSLT	187.0	224.4	299.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

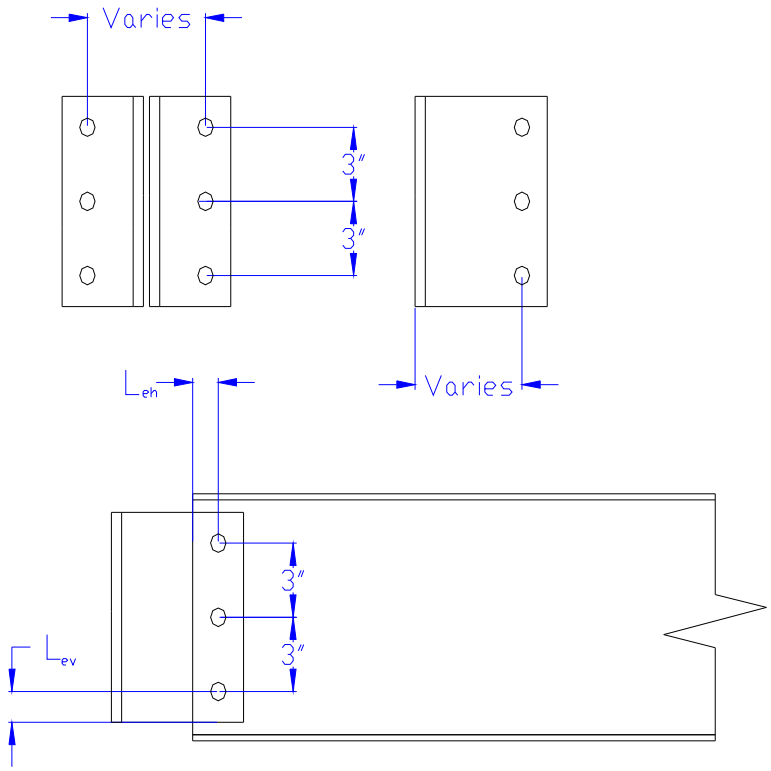
	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	9	A325/ F1852	N		212.3	254.7	339.7
				X		212.3	254.7	339.7
				SC Class A	STD	212.3	254.7	339.7
					OVS	184.5	221.5	292.6
					SSLT	212.3	254.7	292.6
				SC Class B	STD	212.3	254.7	339.7
					OVS	184.5	221.5	295.3
					SSLT	212.3	254.7	339.7
			A490	N		212.3	254.7	339.7
				X		212.3	254.7	339.7
				SC Class A	STD	212.3	254.7	339.7
					OVS	184.5	221.5	295.3
					SSLT	212.3	254.7	339.7
				SC Class B	STD	212.3	254.7	339.7
					OVS	184.5	221.5	295.3
					SSLT	212.3	254.7	339.7

APPENDIX D

3/4-INCH DIAMETER ALL-BOLTED A992 STEEL DOUBLE ANGLE CONNECTIONS

The tables given in Appendix D are all-bolted double angle connections. The angles are A992 angles using either A325/F1852 or A490 3/4-inch diameter bolts.



Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	6	A325/ F1852	N		16.7	17.3	17.3
				X		16.7	20.1	21.6
				SC Class A	STD	11.3	11.3	11.3
					OVS	9.7	9.7	9.7
					SSLT	9.7	9.7	9.7
				SC Class B	STD	16.7	17.2	17.2
					OVS	14.6	14.6	14.6
					SSLT	14.6	14.6	14.6
			A490	N		16.7	20.1	21.6
				X		16.7	20.1	26.8
				SC Class A	STD	14.2	14.2	14.2
					OVS	12.0	12.0	12.0
					SSLT	12.0	12.0	12.0
				SC Class B	STD	16.7	20.1	21.5
					OVS	15.5	18.2	18.2
					SSLT	16.7	18.2	18.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	6	A325/ F1852	N		37.4	38.6	38.6
				X		37.4	44.9	48.3
				SC Class A	STD	25.3	25.3	25.3
					OVS	21.6	21.6	21.6
					SSLT	21.6	21.6	21.6
				SC Class B	STD	37.4	38.4	38.4
					OVS	32.6	32.6	32.6
					SSLT	32.6	32.6	32.6
			A490	N		37.4	44.9	48.3
				X		37.4	44.9	59.9
				SC Class A	STD	31.6	31.6	31.6
					OVS	26.9	26.9	26.9
					SSLT	26.9	26.9	26.9
				SC Class B	STD	37.4	44.9	48.0
					OVS	34.6	40.7	40.7
					SSLT	37.4	40.7	40.7

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	6	A325/ F1852	N		64.8	66.7	66.7
				X		64.8	77.7	83.5
				SC Class A	STD	43.8	43.8	43.8
					OVS	37.3	37.3	37.3
					SSLT	37.3	37.3	37.3
				SC Class B	STD	64.8	66.4	66.4
					OVS	56.4	56.4	56.4
					SSLT	56.4	56.4	56.4
			A490	N		64.8	77.7	83.5
				X		64.8	77.7	103.6
				SC Class A	STD	54.7	54.7	54.7
					OVS	46.6	46.6	46.6
					SSLT	46.6	46.6	46.6
				SC Class B	STD	64.8	77.7	83.0
					OVS	59.9	70.5	70.5
					SSLT	64.8	70.5	70.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	6	A325/ F1852	N		94.8	97.6	97.6
				X		94.8	113.7	122.2
				SC Class A	STD	64.2	64.2	64.2
					OVS	54.6	54.6	54.6
					SSLT	54.6	54.6	54.6
				SC Class B	STD	94.8	97.1	97.1
					OVS	82.6	82.6	82.6
					SSLT	82.6	82.6	82.6
			A490	N		94.8	113.7	122.2
				X		94.8	113.7	151.7
				SC Class A	STD	80.1	80.1	80.1
					OVS	68.2	68.2	68.2
					SSLT	68.2	68.2	68.2
				SC Class B	STD	94.8	113.7	121.4
					OVS	87.7	103.2	103.2
					SSLT	94.8	103.2	103.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	6	A325/ F1852	N		126.7	130.5	130.5
				X		126.7	152.0	163.3
				SC Class A	STD	85.7	85.7	85.7
					OVS	73.0	73.0	73.0
					SSLT	73.0	73.0	73.0
				SC Class B	STD	126.7	129.8	129.8
					OVS	110.3	110.3	110.3
					SSLT	110.3	110.3	110.3
			A490	N		126.7	152.0	163.3
				X		126.7	152.0	202.7
				SC Class A	STD	107.1	107.1	107.1
					OVS	91.1	91.1	91.1
					SSLT	91.1	91.1	91.1
				SC Class B	STD	126.7	152.0	162.3
					OVS	117.2	137.8	137.8
					SSLT	126.7	137.8	137.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	6	A325/ F1852	N		160.1	164.9	164.9
				X		160.1	192.1	206.4
				SC Class A	STD	108.4	108.4	108.4
					OVS	92.3	92.3	92.3
					SSLT	92.3	92.3	92.3
				SC Class B	STD	160.1	164.1	164.1
					OVS	139.4	139.4	139.4
					SSLT	139.4	139.4	139.4
			A490	N		160.1	192.1	206.4
				X		160.1	192.1	256.1
				SC Class A	STD	135.3	135.3	135.3
					OVS	115.1	115.1	115.1
					SSLT	115.1	115.1	115.1
				SC Class B	STD	160.1	192.1	205.1
					OVS	148.1	174.2	174.2
					SSLT	160.1	174.2	174.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	6	A325/ F1852	N		193.2	199.0	199.0
				X		193.2	231.8	249.0
				SC Class A	STD	130.8	130.8	130.8
					OVS	111.4	111.4	111.4
					SSLT	111.4	111.4	111.4
				SC Class B	STD	193.2	198.0	198.0
					OVS	168.3	168.3	168.3
					SSLT	168.3	168.3	168.3
			A490	N		193.2	231.8	249.0
				X		193.2	231.8	309.1
				SC Class A	STD	163.3	163.3	163.3
					OVS	138.9	138.9	138.9
					SSLT	138.9	138.9	138.9
				SC Class B	STD	193.2	231.8	247.5
					OVS	178.7	210.3	210.3
					SSLT	193.2	210.3	210.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	6	A325/ F1852	N		226.8	233.6	233.6
				X		226.8	272.1	292.3
				SC Class A	STD	153.5	153.5	153.5
					OVS	130.7	130.7	130.7
					SSLT	130.7	130.7	130.7
				SC Class B	STD	226.8	232.4	232.4
					OVS	197.5	197.5	197.5
					SSLT	197.5	197.5	197.5
			A490	N		226.8	272.1	292.3
				X		226.8	272.1	362.8
				SC Class A	STD	191.7	191.7	191.7
					OVS	163.1	163.1	163.1
					SSLT	163.1	163.1	163.1
				SC Class B	STD	226.8	272.1	290.5
					OVS	209.8	246.8	246.8
					SSLT	226.8	246.8	246.8

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	6	A325/ F1852	N		260.0	267.8	267.8
				X		260.0	312.0	335.1
				SC Class A	STD	176.0	176.0	176.0
					OVS	149.9	149.9	149.9
					SSLT	149.9	149.9	149.9
				SC Class B	STD	260.0	266.4	266.4
					OVS	226.4	226.4	226.4
					SSLT	226.4	226.4	226.4
			A490	N		260.0	312.0	335.1
				X		260.0	312.0	415.9
				SC Class A	STD	219.8	219.8	219.8
					OVS	186.9	186.9	186.9
					SSLT	186.9	186.9	186.9
				SC Class B	STD	260.0	312.0	333.0
					OVS	240.5	282.9	282.9
					SSLT	260.0	282.9	282.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	6	A325/ F1852	N		293.2	301.9	301.9
				X		293.2	351.8	377.9
				SC Class A	STD	198.4	198.4	198.4
					OVS	169.0	169.0	169.0
					SSLT	169.0	169.0	169.0
				SC Class B	STD	293.2	300.4	300.4
					OVS	255.4	255.4	255.4
					SSLT	255.4	255.4	255.4
			A490	N		293.2	351.8	377.9
				X		293.2	351.8	469.1
				SC Class A	STD	247.8	247.8	247.8
					OVS	210.8	210.8	210.8
					SSLT	210.8	210.8	210.8
				SC Class B	STD	293.2	351.8	375.5
					OVS	271.2	319.0	319.0
					SSLT	293.2	319.0	319.0

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	6	A325/ F1852	N		325.0	334.7	334.7
				X		325.0	390.0	418.9
				SC Class A	STD	220.0	220.0	220.0
					OVS	187.3	187.3	187.3
					SSLT	187.3	187.3	187.3
				SC Class B	STD	325.0	333.0	333.0
					OVS	283.1	283.1	283.1
					SSLT	283.1	283.1	283.1
			A490	N		325.0	390.0	418.9
				X		325.0	390.0	519.9
				SC Class A	STD	274.7	274.7	274.7
					OVS	233.7	233.7	233.7
					SSLT	233.7	233.7	233.7
				SC Class B	STD	325.0	390.0	416.3
					OVS	300.6	353.6	353.6
					SSLT	325.0	353.6	353.6

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	7	A325/ F1852	N		15.4	15.9	15.9
				X		15.4	18.5	19.9
				SC Class A	STD	10.5	10.5	10.5
					OVS	8.9	8.9	8.9
					SSLT	8.9	8.9	8.9
				SC Class B	STD	15.4	15.8	15.8
					OVS	13.4	13.4	13.4
					SSLT	13.4	13.4	13.4
			A490	N		15.4	18.5	19.9
				X		15.4	18.5	24.7
				SC Class A	STD	13.1	13.1	13.1
					OVS	11.1	11.1	11.1
					SSLT	11.1	11.1	11.1
				SC Class B	STD	15.4	18.5	19.8
					OVS	14.3	16.8	16.8
					SSLT	15.4	16.8	16.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	7	A325/ F1852	N		31.3	32.3	32.3
				X		31.3	37.6	40.4
				SC Class A	STD	21.2	21.2	21.2
					OVS	18.1	18.1	18.1
					SSLT	18.1	18.1	18.1
				SC Class B	STD	31.3	32.1	32.1
					OVS	27.3	27.3	27.3
					SSLT	27.3	27.3	27.3
			A490	N		31.3	37.6	40.4
				X		31.3	37.6	50.1
				SC Class A	STD	26.5	26.5	26.5
					OVS	22.5	22.5	22.5
					SSLT	22.5	22.5	22.5
				SC Class B	STD	31.3	37.6	40.1
					OVS	29.0	34.1	34.1
					SSLT	31.3	34.1	34.1

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	7	A325/ F1852	N		56.3	58.0	58.0
				X		56.3	67.5	72.5
				SC Class A	STD	38.1	38.1	38.1
					OVS	32.4	32.4	32.4
					SSLT	32.4	32.4	32.4
				SC Class B	STD	56.3	57.7	57.7
					OVS	49.0	49.0	49.0
					SSLT	49.0	49.0	49.0
			A490	N		56.3	67.5	72.5
				X		56.3	67.5	90.0
				SC Class A	STD	47.6	47.6	47.6
					OVS	40.5	40.5	40.5
					SSLT	40.5	40.5	40.5
				SC Class B	STD	56.3	67.5	72.1
					OVS	52.1	61.2	61.2
					SSLT	56.3	61.2	61.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	7	A325/ F1852	N		82.8	85.3	85.3
				X		82.8	99.4	106.8
				SC Class A	STD	56.1	56.1	56.1
					OVS	47.7	47.7	47.7
					SSLT	47.7	47.7	47.7
				SC Class B	STD	82.8	84.9	84.9
					OVS	72.1	72.1	72.1
					SSLT	72.1	72.1	72.1
			A490	N		82.8	99.4	106.8
				X		82.8	99.4	132.5
				SC Class A	STD	70.0	70.0	70.0
					OVS	59.6	59.6	59.6
					SSLT	59.6	59.6	59.6
				SC Class B	STD	82.8	99.4	106.1
					OVS	76.6	90.1	90.1
					SSLT	82.8	90.1	90.1

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	7	A325/ F1852	N		112.9	116.3	116.3
				X		112.9	135.5	145.6
				SC Class A	STD	76.4	76.4	76.4
					OVS	65.1	65.1	65.1
					SSLT	65.1	65.1	65.1
				SC Class B	STD	112.9	115.7	115.7
					OVS	98.4	98.4	98.4
					SSLT	98.4	98.4	98.4
			A490	N		112.9	135.5	145.6
				X		112.9	135.5	180.7
				SC Class A	STD	95.5	95.5	95.5
					OVS	81.2	81.2	81.2
					SSLT	81.2	81.2	81.2
				SC Class B	STD	112.9	135.5	144.7
					OVS	104.5	122.9	122.9
					SSLT	112.9	122.9	122.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	7	A325/ F1852	N		144.8	149.1	149.1
				X		144.8	173.8	186.7
				SC Class A	STD	98.0	98.0	98.0
					OVS	83.5	83.5	83.5
					SSLT	83.5	83.5	83.5
				SC Class B	STD	144.8	148.4	148.4
					OVS	126.1	126.1	126.1
					SSLT	126.1	126.1	126.1
			A490	N		144.8	173.8	186.7
				X		144.8	173.8	231.7
				SC Class A	STD	122.4	122.4	122.4
					OVS	104.1	104.1	104.1
					SSLT	104.1	104.1	104.1
				SC Class B	STD	144.8	173.8	185.5
					OVS	134.0	157.6	157.6
					SSLT	144.8	157.6	157.6

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	7	A325/ F1852	N		177.7	183.0	183.0
				X		177.7	213.2	229.0
				SC Class A	STD	120.3	120.3	120.3
					OVS	102.4	102.4	102.4
					SSLT	102.4	102.4	102.4
				SC Class B	STD	177.7	182.1	182.1
					OVS	154.8	154.8	154.8
					SSLT	154.8	154.8	154.8
			A490	N		177.7	213.2	229.0
				X		177.7	213.2	284.3
				SC Class A	STD	150.2	150.2	150.2
					OVS	127.8	127.8	127.8
					SSLT	127.8	127.8	127.8
				SC Class B	STD	177.7	213.2	227.6
					OVS	164.4	193.4	193.4
					SSLT	177.7	193.4	193.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	7	A325/ F1852	N		210.9	217.2	217.2
				X		210.9	253.1	271.8
				SC Class A	STD	142.7	142.7	142.7
					OVS	121.6	121.6	121.6
					SSLT	121.6	121.6	121.6
				SC Class B	STD	210.9	216.1	216.1
					OVS	183.7	183.7	183.7
					SSLT	183.7	183.7	183.7
			A490	N		210.9	253.1	271.8
				X		210.9	253.1	337.4
				SC Class A	STD	178.3	178.3	178.3
					OVS	151.6	151.6	151.6
					SSLT	151.6	151.6	151.6
				SC Class B	STD	210.9	253.1	270.1
					OVS	195.1	229.5	229.5
					SSLT	210.9	229.5	229.5

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	7	A325/ F1852	N		244.5	251.8	251.8
				X		244.5	293.3	315.1
				SC Class A	STD	165.5	165.5	165.5
					OVS	140.9	140.9	140.9
					SSLT	140.9	140.9	140.9
				SC Class B	STD	244.5	250.5	250.5
					OVS	212.9	212.9	212.9
					SSLT	212.9	212.9	212.9
			A490	N		244.5	293.3	315.1
				X		244.5	293.3	391.1
				SC Class A	STD	206.6	206.6	206.6
					OVS	175.8	175.8	175.8
					SSLT	175.8	175.8	175.8
				SC Class B	STD	244.5	293.3	313.1
					OVS	226.1	266.0	266.0
					SSLT	244.5	266.0	266.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	7	A325/ F1852	N		280.1	288.5	288.5
				X		280.1	336.1	361.1
				SC Class A	STD	189.6	189.6	189.6
					OVS	161.5	161.5	161.5
					SSLT	161.5	161.5	161.5
				SC Class B	STD	280.1	287.1	287.1
					OVS	244.0	244.0	244.0
					SSLT	244.0	244.0	244.0
			A490	N		280.1	336.1	361.1
				X		280.1	336.1	448.2
				SC Class A	STD	236.8	236.8	236.8
					OVS	201.4	201.4	201.4
					SSLT	201.4	201.4	201.4
				SC Class B	STD	280.1	336.1	358.8
					OVS	259.1	304.8	304.8
					SSLT	280.1	304.8	304.8

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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	7	A325/ F1852	N		310.9	320.2	320.2
				X		310.9	373.1	400.8
				SC Class A	STD	210.5	210.5	210.5
					OVS	179.2	179.2	179.2
					SSLT	179.2	179.2	179.2
				SC Class B	STD	310.9	318.6	318.6
					OVS	270.8	270.8	270.8
					SSLT	270.8	270.8	270.8
			A490	N		310.9	373.1	400.8
				X		310.9	373.1	497.5
				SC Class A	STD	262.8	262.8	262.8
					OVS	223.6	223.6	223.6
					SSLT	223.6	223.6	223.6
				SC Class B	STD	310.9	373.1	398.3
					OVS	287.6	338.4	338.4
					SSLT	310.9	338.4	338.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	8	A325/ F1852	N		13.4	13.8	13.8
				X		13.4	16.0	17.2
				SC Class A	STD	9.1	9.1	9.1
					OVS	7.7	7.7	7.7
					SSLT	7.7	7.7	7.7
				SC Class B	STD	13.4	13.7	13.7
					OVS	11.6	11.6	11.6
					SSLT	11.6	11.6	11.6
			A490	N		13.4	16.0	17.2
				X		13.4	16.0	21.4
				SC Class A	STD	11.3	11.3	11.3
					OVS	9.6	9.6	9.6
					SSLT	9.6	9.6	9.6
				SC Class B	STD	13.4	16.0	17.1
					OVS	12.4	14.6	14.6
					SSLT	13.4	14.6	14.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	8	A325/ F1852	N		27.1	27.9	27.9
				X		27.1	32.5	34.9
				SC Class A	STD	18.3	18.3	18.3
					OVS	15.6	15.6	15.6
					SSLT	15.6	15.6	15.6
				SC Class B	STD	27.1	27.7	27.7
					OVS	23.6	23.6	23.6
					SSLT	23.6	23.6	23.6
			A490	N		27.1	32.5	34.9
				X		27.1	32.5	43.3
				SC Class A	STD	22.9	22.9	22.9
					OVS	19.5	19.5	19.5
					SSLT	19.5	19.5	19.5
				SC Class B	STD	27.1	32.5	34.7
					OVS	25.0	29.4	29.4
					SSLT	27.1	29.4	29.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	8	A325/ F1852	N		48.9	50.3	50.3
				X		48.9	58.6	63.0
				SC Class A	STD	33.1	33.1	33.1
					OVS	28.2	28.2	28.2
					SSLT	28.2	28.2	28.2
				SC Class B	STD	48.9	50.1	50.1
					OVS	42.6	42.6	42.6
					SSLT	42.6	42.6	42.6
			A490	N		48.9	58.6	63.0
				X		48.9	58.6	78.2
				SC Class A	STD	41.3	41.3	41.3
					OVS	35.1	35.1	35.1
					SSLT	35.1	35.1	35.1
				SC Class B	STD	48.9	58.6	62.6
					OVS	45.2	53.2	53.2
					SSLT	48.9	53.2	53.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	8	A325/ F1852	N		73.6	75.8	75.8
				X		73.6	88.3	94.8
				SC Class A	STD	49.8	49.8	49.8
					OVS	42.4	42.4	42.4
					SSLT	42.4	42.4	42.4
				SC Class B	STD	73.6	75.4	75.4
					OVS	64.1	64.1	64.1
					SSLT	64.1	64.1	64.1
			A490	N		73.6	88.3	94.8
				X		73.6	88.3	117.7
				SC Class A	STD	62.2	62.2	62.2
					OVS	52.9	52.9	52.9
					SSLT	52.9	52.9	52.9
				SC Class B	STD	73.6	88.3	94.2
					OVS	68.0	80.0	80.0
					SSLT	73.6	80.0	80.0

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	8	A325/ F1852	N		101.7	104.8	104.8
				X		101.7	122.1	131.2
				SC Class A	STD	68.9	68.9	68.9
					OVS	58.7	58.7	58.7
					SSLT	58.7	58.7	58.7
				SC Class B	STD	101.7	104.3	104.3
					OVS	88.6	88.6	88.6
					SSLT	88.6	88.6	88.6
			A490	N		101.7	122.1	131.2
				X		101.7	122.1	162.8
				SC Class A	STD	86.0	86.0	86.0
					OVS	73.2	73.2	73.2
					SSLT	73.2	73.2	73.2
				SC Class B	STD	101.7	122.1	130.3
					OVS	94.1	110.7	110.7
					SSLT	101.7	110.7	110.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	8	A325/ F1852	N		132.0	136.0	136.0
				X		132.0	158.4	170.2
				SC Class A	STD	89.4	89.4	89.4
					OVS	76.1	76.1	76.1
					SSLT	76.1	76.1	76.1
				SC Class B	STD	132.0	135.3	135.3
					OVS	115.0	115.0	115.0
					SSLT	115.0	115.0	115.0
			A490	N		132.0	158.4	170.2
				X		132.0	158.4	211.2
				SC Class A	STD	111.6	111.6	111.6
					OVS	94.9	94.9	94.9
					SSLT	94.9	94.9	94.9
				SC Class B	STD	132.0	158.4	169.1
					OVS	122.1	143.6	143.6
					SSLT	132.0	143.6	143.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	8	A325/ F1852	N		163.9	168.8	168.8
				X		163.9	196.7	211.3
				SC Class A	STD	110.9	110.9	110.9
					OVS	94.5	94.5	94.5
					SSLT	94.5	94.5	94.5
				SC Class B	STD	163.9	168.0	168.0
					OVS	142.8	142.8	142.8
					SSLT	142.8	142.8	142.8
			A490	N		163.9	196.7	211.3
				X		163.9	196.7	262.2
				SC Class A	STD	138.5	138.5	138.5
					OVS	117.8	117.8	117.8
					SSLT	117.8	117.8	117.8
				SC Class B	STD	163.9	196.7	209.9
					OVS	151.6	178.4	178.4
					SSLT	163.9	178.4	178.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	8	A325/ F1852	N		196.5	202.4	202.4
				X		196.5	235.8	253.3
				SC Class A	STD	133.0	133.0	133.0
					OVS	113.3	113.3	113.3
					SSLT	113.3	113.3	113.3
				SC Class B	STD	196.5	201.4	201.4
					OVS	171.2	171.2	171.2
					SSLT	171.2	171.2	171.2
			A490	N		196.5	235.8	253.3
				X		196.5	235.8	314.4
				SC Class A	STD	166.1	166.1	166.1
					OVS	141.3	141.3	141.3
					SSLT	141.3	141.3	141.3
				SC Class B	STD	196.5	235.8	251.7
					OVS	181.8	213.9	213.9
					SSLT	196.5	213.9	213.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	8	A325/ F1852	N		230.0	236.9	236.9
				X		230.0	276.0	296.4
				SC Class A	STD	155.7	155.7	155.7
					OVS	132.6	132.6	132.6
					SSLT	132.6	132.6	132.6
				SC Class B	STD	230.0	235.7	235.7
					OVS	200.3	200.3	200.3
					SSLT	200.3	200.3	200.3
			A490	N		230.0	276.0	296.4
				X		230.0	276.0	367.9
				SC Class A	STD	194.4	194.4	194.4
					OVS	165.4	165.4	165.4
					SSLT	165.4	165.4	165.4
				SC Class B	STD	230.0	276.0	294.6
					OVS	212.7	250.3	250.3
					SSLT	230.0	250.3	250.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	8	A325/ F1852	N		263.3	271.2	271.2
				X		263.3	316.0	339.4
				SC Class A	STD	178.2	178.2	178.2
					OVS	151.8	151.8	151.8
					SSLT	151.8	151.8	151.8
				SC Class B	STD	263.3	269.8	269.8
					OVS	229.4	229.4	229.4
					SSLT	229.4	229.4	229.4
			A490	N		263.3	316.0	339.4
				X		263.3	316.0	421.3
				SC Class A	STD	222.6	222.6	222.6
					OVS	189.3	189.3	189.3
					SSLT	189.3	189.3	189.3
				SC Class B	STD	263.3	316.0	337.3
					OVS	243.6	286.6	286.6
					SSLT	263.3	286.6	286.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	8	A325/ F1852	N		296.8	305.6	305.6
				X		296.8	356.1	382.5
				SC Class A	STD	200.9	200.9	200.9
					OVS	171.1	171.1	171.1
					SSLT	171.1	171.1	171.1
				SC Class B	STD	296.8	304.1	304.1
					OVS	258.5	258.5	258.5
					SSLT	258.5	258.5	258.5
			A490	N		296.8	356.1	382.5
				X		296.8	356.1	474.8
				SC Class A	STD	250.9	250.9	250.9
					OVS	213.4	213.4	213.4
					SSLT	213.4	213.4	213.4
				SC Class B	STD	296.8	356.1	380.1
					OVS	274.5	322.9	322.9
					SSLT	296.8	322.9	322.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	3/4	9	A325/ F1852	N		10.0	10.3	10.3
				X		10.0	12.0	12.9
				SC Class A	STD	6.8	6.8	6.8
					OVS	5.8	5.8	5.8
					SSLT	5.8	5.8	5.8
				SC Class B	STD	10.0	10.3	10.3
					OVS	8.7	8.7	8.7
					SSLT	8.7	8.7	8.7
			A490	N		10.0	12.0	12.9
				X		10.0	12.0	16.1
				SC Class A	STD	8.5	8.5	8.5
					OVS	7.2	7.2	7.2
					SSLT	7.2	7.2	7.2
				SC Class B	STD	10.0	12.0	12.9
					OVS	9.3	10.9	10.9
					SSLT	10.0	10.9	10.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	3/4	9	A325/ F1852	N		23.3	24.0	24.0
				X		23.3	28.0	30.0
				SC Class A	STD	15.8	15.8	15.8
					OVS	13.4	13.4	13.4
					SSLT	13.4	13.4	13.4
				SC Class B	STD	23.3	23.9	23.9
					OVS	20.3	20.3	20.3
					SSLT	20.3	20.3	20.3
			A490	N		23.3	28.0	30.0
				X		23.3	28.0	37.3
				SC Class A	STD	19.7	19.7	19.7
					OVS	16.8	16.8	16.8
					SSLT	16.8	16.8	16.8
				SC Class B	STD	23.3	28.0	29.9
					OVS	21.6	25.4	25.4
					SSLT	23.3	25.4	25.4

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	3/4	9	A325/ F1852	N		42.7	44.0	44.0
				X		42.7	51.2	55.0
				SC Class A	STD	28.9	28.9	28.9
					OVS	24.6	24.6	24.6
					SSLT	24.6	24.6	24.6
				SC Class B	STD	42.7	43.7	43.7
					OVS	37.2	37.2	37.2
					SSLT	37.2	37.2	37.2
			A490	N		42.7	51.2	55.0
				X		42.7	51.2	68.3
				SC Class A	STD	36.1	36.1	36.1
					OVS	30.7	30.7	30.7
					SSLT	30.7	30.7	30.7
				SC Class B	STD	42.7	51.2	54.7
					OVS	39.5	46.5	46.5
					SSLT	42.7	46.5	46.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	3/4	9	A325/ F1852	N		64.8	66.8	66.8
				X		64.8	77.8	83.6
				SC Class A	STD	43.9	43.9	43.9
					OVS	37.4	37.4	37.4
					SSLT	37.4	37.4	37.4
				SC Class B	STD	64.8	66.4	66.4
					OVS	56.5	56.5	56.5
					SSLT	56.5	56.5	56.5
			A490	N		64.8	77.8	83.6
				X		64.8	77.8	103.7
				SC Class A	STD	54.8	54.8	54.8
					OVS	46.6	46.6	46.6
					SSLT	46.6	46.6	46.6
				SC Class B	STD	64.8	77.8	83.1
					OVS	60.0	70.6	70.6
					SSLT	64.8	70.6	70.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	3/4	9	A325/ F1852	N		90.5	93.2	93.2
				X		90.5	108.6	116.6
				SC Class A	STD	61.2	61.2	61.2
					OVS	52.2	52.2	52.2
					SSLT	52.2	52.2	52.2
				SC Class B	STD	90.5	92.7	92.7
					OVS	78.8	78.8	78.8
					SSLT	78.8	78.8	78.8
			A490	N		90.5	108.6	116.6
				X		90.5	108.6	144.7
				SC Class A	STD	76.5	76.5	76.5
					OVS	65.0	65.0	65.0
					SSLT	65.0	65.0	65.0
				SC Class B	STD	90.5	108.6	115.9
					OVS	83.7	98.4	98.4
					SSLT	90.5	98.4	98.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	3/4	9	A325/ F1852	N		118.7	122.3	122.3
				X		118.7	142.5	153.0
				SC Class A	STD	80.4	80.4	80.4
					OVS	68.4	68.4	68.4
					SSLT	68.4	68.4	68.4
				SC Class B	STD	118.7	121.7	121.7
					OVS	103.4	103.4	103.4
					SSLT	103.4	103.4	103.4
			A490	N		118.7	142.5	153.0
				X		118.7	142.5	189.9
				SC Class A	STD	100.4	100.4	100.4
					OVS	85.4	85.4	85.4
					SSLT	85.4	85.4	85.4
				SC Class B	STD	118.7	142.5	152.1
					OVS	109.8	129.2	129.2
					SSLT	118.7	129.2	129.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	3/4	9	A325/ F1852	N		149.0	153.5	153.5
				X		149.0	178.9	192.1
				SC Class A	STD	100.9	100.9	100.9
					OVS	85.9	85.9	85.9
					SSLT	85.9	85.9	85.9
				SC Class B	STD	149.0	152.7	152.7
					OVS	129.8	129.8	129.8
					SSLT	129.8	129.8	129.8
			A490	N		149.0	178.9	192.1
				X		149.0	178.9	238.5
				SC Class A	STD	126.0	126.0	126.0
					OVS	107.2	107.2	107.2
					SSLT	107.2	107.2	107.2
				SC Class B	STD	149.0	178.9	190.9
					OVS	137.9	162.2	162.2
					SSLT	149.0	162.2	162.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	3/4	9	A325/ F1852	N		180.5	186.0	186.0
				X		180.5	216.6	232.7
				SC Class A	STD	122.2	122.2	122.2
					OVS	104.1	104.1	104.1
					SSLT	104.1	104.1	104.1
				SC Class B	STD	180.5	185.0	185.0
					OVS	157.3	157.3	157.3
					SSLT	157.3	157.3	157.3
			A490	N		180.5	216.6	232.7
				X		180.5	216.6	288.9
				SC Class A	STD	152.6	152.6	152.6
					OVS	129.8	129.8	129.8
					SSLT	129.8	129.8	129.8
				SC Class B	STD	180.5	216.6	231.3
					OVS	167.0	196.5	196.5
					SSLT	180.5	196.5	196.5

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	3/4	9	A325/ F1852	N		213.2	219.6	219.6
				X		213.2	255.8	274.8
				SC Class A	STD	144.3	144.3	144.3
					OVS	122.9	122.9	122.9
					SSLT	122.9	122.9	122.9
				SC Class B	STD	213.2	218.5	218.5
					OVS	185.7	185.7	185.7
					SSLT	185.7	185.7	185.7
			A490	N		213.2	255.8	274.8
				X		213.2	255.8	341.1
				SC Class A	STD	180.2	180.2	180.2
					OVS	153.3	153.3	153.3
					SSLT	153.3	153.3	153.3
				SC Class B	STD	213.2	255.8	273.1
					OVS	197.2	232.0	232.0
					SSLT	213.2	232.0	232.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	3/4	9	A325/ F1852	N		246.3	253.7	253.7
				X		246.3	295.6	317.5
				SC Class A	STD	166.7	166.7	166.7
					OVS	142.0	142.0	142.0
					SSLT	142.0	142.0	142.0
				SC Class B	STD	246.3	252.4	252.4
					OVS	214.5	214.5	214.5
					SSLT	214.5	214.5	214.5
			A490	N		246.3	295.6	317.5
				X		246.3	295.6	394.1
				SC Class A	STD	208.2	208.2	208.2
					OVS	177.1	177.1	177.1
					SSLT	177.1	177.1	177.1
				SC Class B	STD	246.3	295.6	315.5
					OVS	227.9	268.0	268.0
					SSLT	246.3	268.0	268.0

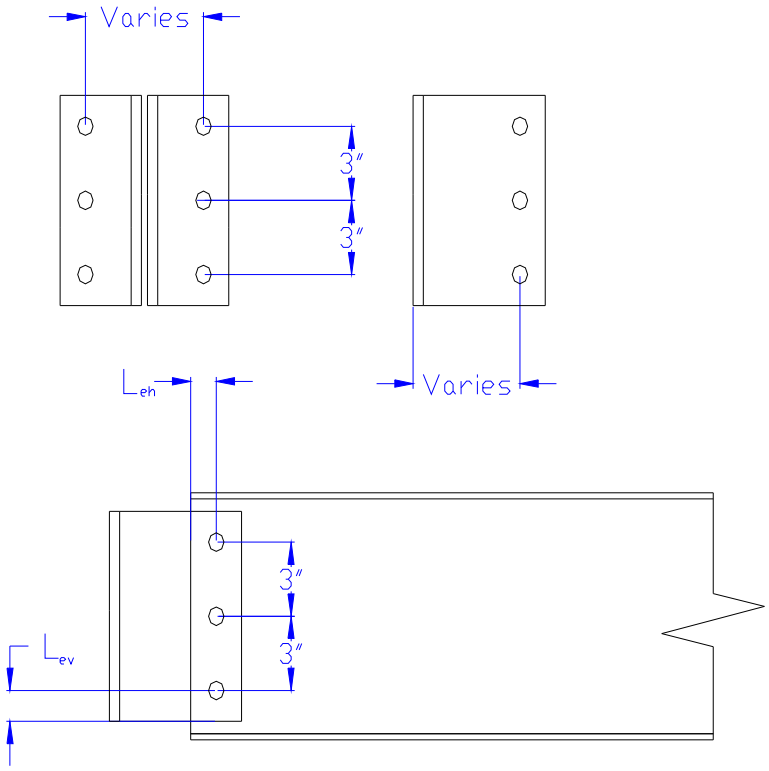
Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	3/4	9	A325/ F1852	N		279.7	288.0	288.0
				X		279.7	335.6	360.5
				SC Class A	STD	189.3	189.3	189.3
					OVS	161.2	161.2	161.2
					SSLT	161.2	161.2	161.2
				SC Class B	STD	279.7	286.6	286.6
					OVS	243.6	243.6	243.6
					SSLT	243.6	243.6	243.6
			A490	N		279.7	335.6	360.5
				X		279.7	335.6	447.4
				SC Class A	STD	236.4	236.4	236.4
					OVS	201.1	201.1	201.1
					SSLT	201.1	201.1	201.1
				SC Class B	STD	279.7	335.6	358.2
					OVS	258.7	304.3	304.3
					SSLT	279.7	304.3	304.3

APPENDIX E
7/8-INCH DIAMETER ALL-BOLTED A992 STEEL DOUBLE ANGLE CONNECTIONS

The tables given in Appendix E are all-bolted double angle connections. The angles are A992 angles using either A325/F1852 or A490 7/8-inch diameter bolts.



Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	6	A325/ F1852	N		15.5	18.6	23.5
				X		15.5	18.6	24.8
				SC Class A	STD	15.5	15.8	15.8
					OVS	13.4	13.4	13.4
					SSLT	13.4	13.4	13.4
				SC Class B	STD	15.5	18.6	23.9
					OVS	14.2	17.1	20.3
					SSLT	15.5	18.6	20.3
			A490	N		15.5	18.6	24.8
				X		15.5	18.6	24.8
				SC Class A	STD	15.5	18.6	19.8
					OVS	14.2	16.9	16.9
					SSLT	15.5	16.9	16.9
				SC Class B	STD	15.5	18.6	24.8
					OVS	14.2	17.1	22.8
					SSLT	15.5	18.6	24.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	6	A325/ F1852	N		34.6	41.6	52.5
				X		34.6	41.6	55.4
				SC Class A	STD	34.6	35.3	35.3
					OVS	29.9	29.9	29.9
					SSLT	29.9	29.9	29.9
				SC Class B	STD	34.6	41.6	53.4
					OVS	31.8	38.2	45.5
					SSLT	34.6	41.6	45.5
			A490	N		34.6	41.6	55.4
				X		34.6	41.6	55.4
				SC Class A	STD	34.6	41.6	44.3
					OVS	31.8	37.7	37.7
					SSLT	34.6	37.7	37.7
				SC Class B	STD	34.6	41.6	55.4
					OVS	31.8	38.2	50.9
					SSLT	34.6	41.6	55.4

Notes:
Angles are assumed to be A992 Steel
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	6	A325/ F1852	N		59.9	71.9	90.8
				X		59.9	71.9	95.9
				SC Class A	STD	59.9	61.0	61.0
					OVS	51.8	51.8	51.8
					SSLT	51.8	51.8	51.8
				SC Class B	STD	59.9	71.9	92.4
					OVS	55.1	66.1	78.7
					SSLT	59.9	71.9	78.7
			A490	N		59.9	71.9	95.9
				X		59.9	71.9	95.9
				SC Class A	STD	59.9	71.9	76.6
					OVS	55.1	65.2	65.2
					SSLT	59.9	65.2	65.2
				SC Class B	STD	59.9	71.9	95.9
					OVS	55.1	66.1	88.1
					SSLT	59.9	71.9	95.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	6	A325/ F1852	N		87.7	105.2	132.9
				X		87.7	105.2	140.3
				SC Class A	STD	87.7	89.3	89.3
					OVS	75.8	75.8	75.8
					SSLT	75.8	75.8	75.8
				SC Class B	STD	87.7	105.2	135.3
					OVS	80.6	96.7	115.1
					SSLT	87.7	105.2	115.1
			A490	N		87.7	105.2	140.3
				X		87.7	105.2	140.3
				SC Class A	STD	87.7	105.2	112.1
					OVS	80.6	95.5	95.5
					SSLT	87.7	95.5	95.5
				SC Class B	STD	87.7	105.2	140.3
					OVS	80.6	96.7	128.9
					SSLT	87.7	105.2	140.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	6	A325/ F1852	N		117.2	140.6	177.6
				X		117.2	140.6	187.5
				SC Class A	STD	117.2	119.4	119.4
					OVS	101.3	101.3	101.3
					SSLT	101.3	101.3	101.3
				SC Class B	STD	117.2	140.6	180.8
					OVS	107.7	129.2	153.8
					SSLT	117.2	140.6	153.8
			A490	N		117.2	140.6	187.5
				X		117.2	140.6	187.5
				SC Class A	STD	117.2	140.6	149.7
					OVS	107.7	127.6	127.6
					SSLT	117.2	127.6	127.6
				SC Class B	STD	117.2	140.6	187.5
					OVS	107.7	129.2	172.3
					SSLT	117.2	140.6	187.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	6	A325/ F1852	N		148.1	177.7	224.5
				X		148.1	177.7	237.0
				SC Class A	STD	148.1	150.9	150.9
					OVS	128.1	128.1	128.1
					SSLT	128.1	128.1	128.1
				SC Class B	STD	148.1	177.7	228.5
					OVS	136.1	163.3	194.4
					SSLT	148.1	177.7	194.4
			A490	N		148.1	177.7	237.0
				X		148.1	177.7	237.0
				SC Class A	STD	148.1	177.7	189.3
					OVS	136.1	161.3	161.3
					SSLT	148.1	161.3	161.3
				SC Class B	STD	148.1	177.7	237.0
					OVS	136.1	163.3	217.8
					SSLT	148.1	177.7	237.0

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	6	A325/ F1852	N		178.7	214.5	270.9
				X		178.7	214.5	286.0
				SC Class A	STD	178.7	182.1	182.1
					OVS	154.6	154.6	154.6
					SSLT	154.6	154.6	154.6
				SC Class B	STD	178.7	214.5	275.8
					OVS	164.3	197.1	234.7
					SSLT	178.7	214.5	234.7
			A490	N		178.7	214.5	286.0
				X		178.7	214.5	286.0
				SC Class A	STD	178.7	214.5	228.4
					OVS	164.3	194.6	194.6
					SSLT	178.7	194.6	194.6
				SC Class B	STD	178.7	214.5	286.0
					OVS	164.3	197.1	262.8
					SSLT	178.7	214.5	286.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	6	A325/ F1852	N		209.8	251.7	318.0
				X		209.8	251.7	335.7
				SC Class A	STD	209.8	213.7	213.7
					OVS	181.4	181.4	181.4
					SSLT	181.4	181.4	181.4
				SC Class B	STD	209.8	251.7	323.7
					OVS	192.8	231.4	275.4
					SSLT	209.8	251.7	275.4
			A490	N		209.8	251.7	335.7
				X		209.8	251.7	335.7
				SC Class A	STD	209.8	251.7	268.1
					OVS	192.8	228.4	228.4
					SSLT	209.8	228.4	228.4
				SC Class B	STD	209.8	251.7	335.7
					OVS	192.8	231.4	308.5
					SSLT	209.8	251.7	335.7

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	6	A325/ F1852	N		240.5	288.6	364.6
				X		240.5	288.6	384.8
				SC Class A	STD	240.5	245.0	245.0
					OVS	208.0	208.0	208.0
					SSLT	208.0	208.0	208.0
				SC Class B	STD	240.5	288.6	371.1
					OVS	221.0	265.2	315.8
					SSLT	240.5	288.6	315.8
			A490	N		240.5	288.6	384.8
				X		240.5	288.6	384.8
				SC Class A	STD	240.5	288.6	307.3
					OVS	221.0	261.9	261.9
					SSLT	240.5	261.9	261.9
				SC Class B	STD	240.5	288.6	384.8
					OVS	221.0	265.2	353.6
					SSLT	240.5	288.6	384.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	6	A325/ F1852	N		271.2	325.4	411.1
				X		271.2	325.4	433.9
				SC Class A	STD	271.2	276.3	276.3
					OVS	234.5	234.5	234.5
					SSLT	234.5	234.5	234.5
				SC Class B	STD	271.2	325.4	418.4
					OVS	249.2	299.1	356.1
					SSLT	271.2	325.4	356.1
			A490	N		271.2	325.4	433.9
				X		271.2	325.4	433.9
				SC Class A	STD	271.2	325.4	346.6
					OVS	249.2	295.3	295.3
					SSLT	271.2	295.3	295.3
				SC Class B	STD	271.2	325.4	433.9
					OVS	249.2	299.1	398.8
					SSLT	271.2	325.4	433.9

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	6	A325/ F1852	N		300.6	360.7	455.7
				X		300.6	360.7	481.0
				SC Class A	STD	300.6	306.3	306.3
					OVS	260.0	260.0	260.0
					SSLT	260.0	260.0	260.0
				SC Class B	STD	300.6	360.7	463.8
					OVS	276.3	331.5	394.7
					SSLT	300.6	360.7	394.7
			A490	N		300.6	360.7	481.0
				X		300.6	360.7	481.0
				SC Class A	STD	300.6	360.7	384.2
					OVS	276.3	327.3	327.3
					SSLT	300.6	327.3	327.3
				SC Class B	STD	300.6	360.7	481.0
					OVS	276.3	331.5	442.1
					SSLT	300.6	360.7	481.0

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	7	A325/ F1852	N		14.3	17.1	21.7
				X		14.3	17.1	22.9
				SC Class A	STD	14.3	14.6	14.6
					OVS	12.4	12.4	12.4
					SSLT	12.4	12.4	12.4
				SC Class B	STD	14.3	17.1	22.0
					OVS	13.1	15.8	18.8
					SSLT	14.3	17.1	18.8
			A490	N		14.3	17.1	22.9
				X		14.3	17.1	22.9
				SC Class A	STD	14.3	17.1	18.3
					OVS	13.1	15.6	15.6
					SSLT	14.3	15.6	15.6
				SC Class B	STD	14.3	17.1	22.9
					OVS	13.1	15.8	21.0
					SSLT	14.3	17.1	22.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	7	A325/ F1852	N		29.0	34.8	43.9
				X		29.0	34.8	46.4
				SC Class A	STD	29.0	29.5	29.5
					OVS	25.1	25.1	25.1
					SSLT	25.1	25.1	25.1
				SC Class B	STD	29.0	34.8	44.7
					OVS	26.6	32.0	38.1
					SSLT	29.0	34.8	38.1
			A490	N		29.0	34.8	46.4
				X		29.0	34.8	46.4
				SC Class A	STD	29.0	34.8	37.0
					OVS	26.6	31.6	31.6
					SSLT	29.0	31.6	31.6
				SC Class B	STD	29.0	34.8	46.4
					OVS	26.6	32.0	42.6
					SSLT	29.0	34.8	46.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	7	A325/ F1852	N		52.1	62.5	78.9
				X		52.1	62.5	83.3
				SC Class A	STD	52.1	53.0	53.0
					OVS	45.0	45.0	45.0
					SSLT	45.0	45.0	45.0
				SC Class B	STD	52.1	62.5	80.3
					OVS	47.8	57.4	68.3
					SSLT	52.1	62.5	68.3
			A490	N		52.1	62.5	83.3
				X		52.1	62.5	83.3
				SC Class A	STD	52.1	62.5	66.5
					OVS	47.8	56.7	56.7
					SSLT	52.1	56.7	56.7
				SC Class B	STD	52.1	62.5	83.3
					OVS	47.8	57.4	76.5
					SSLT	52.1	62.5	83.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	7	A325/ F1852	N		76.6	91.9	116.2
				X		76.6	91.9	122.6
				SC Class A	STD	76.6	78.1	78.1
					OVS	66.3	66.3	66.3
					SSLT	66.3	66.3	66.3
				SC Class B	STD	76.6	91.9	118.2
					OVS	70.4	84.5	100.6
					SSLT	76.6	91.9	100.6
			A490	N		76.6	91.9	122.6
				X		76.6	91.9	122.6
				SC Class A	STD	76.6	91.9	97.9
					OVS	70.4	83.4	83.4
					SSLT	76.6	83.4	83.4
				SC Class B	STD	76.6	91.9	122.6
					OVS	70.4	84.5	112.7
					SSLT	76.6	91.9	122.6

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	7	A325/ F1852	N		104.5	125.4	158.4
				X		104.5	125.4	167.1
				SC Class A	STD	104.5	106.4	106.4
					OVS	90.3	90.3	90.3
					SSLT	90.3	90.3	90.3
				SC Class B	STD	104.5	125.4	161.2
					OVS	96.0	115.2	137.2
					SSLT	104.5	125.4	137.2
			A490	N		104.5	125.4	167.1
				X		104.5	125.4	167.1
				SC Class A	STD	104.5	125.4	133.5
					OVS	96.0	113.7	113.7
					SSLT	104.5	113.7	113.7
				SC Class B	STD	104.5	125.4	167.1
					OVS	96.0	115.2	153.6
					SSLT	104.5	125.4	167.1

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	7	A325/ F1852	N		134.0	160.7	203.1
				X		134.0	160.7	214.3
				SC Class A	STD	134.0	136.5	136.5
					OVS	115.8	115.8	115.8
					SSLT	115.8	115.8	115.8
				SC Class B	STD	134.0	160.7	206.7
					OVS	123.1	147.7	175.9
					SSLT	134.0	160.7	175.9
			A490	N		134.0	160.7	214.3
				X		134.0	160.7	214.3
				SC Class A	STD	134.0	160.7	171.2
					OVS	123.1	145.9	145.9
					SSLT	134.0	145.9	145.9
				SC Class B	STD	134.0	160.7	214.3
					OVS	123.1	147.7	197.0
					SSLT	134.0	160.7	214.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	7	A325/ F1852	N		164.4	197.3	249.2
				X		164.4	197.3	263.0
				SC Class A	STD	164.4	167.5	167.5
					OVS	142.1	142.1	142.1
					SSLT	142.1	142.1	142.1
				SC Class B	STD	164.4	197.3	253.6
					OVS	151.1	181.3	215.8
					SSLT	164.4	197.3	215.8
			A490	N		164.4	197.3	263.0
				X		164.4	197.3	263.0
				SC Class A	STD	164.4	197.3	210.1
					OVS	151.1	179.0	179.0
					SSLT	164.4	179.0	179.0
				SC Class B	STD	164.4	197.3	263.0
					OVS	151.1	181.3	241.7
					SSLT	164.4	197.3	263.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	7	A325/ F1852	N		195.1	234.1	295.7
				X		195.1	234.1	312.1
				SC Class A	STD	195.1	198.8	198.8
					OVS	168.7	168.7	168.7
					SSLT	168.7	168.7	168.7
				SC Class B	STD	195.1	234.1	301.0
					OVS	179.3	215.1	256.1
					SSLT	195.1	234.1	256.1
			A490	N		195.1	234.1	312.1
				X		195.1	234.1	312.1
				SC Class A	STD	195.1	234.1	249.3
					OVS	179.3	212.4	212.4
					SSLT	195.1	212.4	212.4
				SC Class B	STD	195.1	234.1	312.1
					OVS	179.3	215.1	286.9
					SSLT	195.1	234.1	312.1

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	7	A325/ F1852	N		226.1	271.4	342.8
				X		226.1	271.4	361.8
				SC Class A	STD	226.1	230.4	230.4
					OVS	195.6	195.6	195.6
					SSLT	195.6	195.6	195.6
				SC Class B	STD	226.1	271.4	348.9
					OVS	207.8	249.4	296.9
					SSLT	226.1	271.4	296.9
			A490	N		226.1	271.4	361.8
				X		226.1	271.4	361.8
				SC Class A	STD	226.1	271.4	289.0
					OVS	207.8	246.2	246.2
					SSLT	226.1	246.2	246.2
				SC Class B	STD	226.1	271.4	361.8
					OVS	207.8	249.4	332.5
					SSLT	226.1	271.4	361.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	7	A325/ F1852	N		259.1	311.0	392.8
				X		259.1	311.0	414.6
				SC Class A	STD	259.1	264.0	264.0
					OVS	224.1	224.1	224.1
					SSLT	224.1	224.1	224.1
				SC Class B	STD	259.1	311.0	399.8
					OVS	238.2	285.8	340.2
					SSLT	259.1	311.0	340.2
			A490	N		259.1	311.0	414.6
				X		259.1	311.0	414.6
				SC Class A	STD	259.1	311.0	331.1
					OVS	238.2	282.2	282.2
					SSLT	259.1	282.2	282.2
				SC Class B	STD	259.1	311.0	414.6
					OVS	238.2	285.8	381.0
					SSLT	259.1	311.0	414.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	7	A325/ F1852	N		287.6	345.1	436.0
				X		287.6	345.1	460.2
				SC Class A	STD	287.6	293.0	293.0
					OVS	248.7	248.7	248.7
					SSLT	248.7	248.7	248.7
				SC Class B	STD	287.6	345.1	443.8
					OVS	264.3	317.2	377.6
					SSLT	287.6	345.1	377.6
			A490	N		287.6	345.1	460.2
				X		287.6	345.1	460.2
				SC Class A	STD	287.6	345.1	367.6
					OVS	264.3	313.2	313.2
					SSLT	287.6	313.2	313.2
				SC Class B	STD	287.6	345.1	460.2
					OVS	264.3	317.2	422.9
					SSLT	287.6	345.1	460.2

Notes:
Angles are assumed to be A992 Steel
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	Represents a bolt bearing limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	8	A325/ F1852	N		12.4	14.8	18.8
				X		12.4	14.8	19.8
				SC Class A	STD	12.4	12.6	12.6
					OVS	10.7	10.7	10.7
					SSLT	10.7	10.7	10.7
				SC Class B	STD	12.4	14.8	19.1
					OVS	11.4	13.6	16.2
					SSLT	12.4	14.8	16.2
			A490	N		12.4	14.8	19.8
				X		12.4	14.8	19.8
				SC Class A	STD	12.4	14.8	15.8
					OVS	11.4	13.5	13.5
					SSLT	12.4	13.5	13.5
				SC Class B	STD	12.4	14.8	19.8
					OVS	11.4	13.6	18.2
					SSLT	12.4	14.8	19.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	8	A325/ F1852	N		25.0	30.0	37.9
				X		25.0	30.0	40.0
				SC Class A	STD	25.0	25.5	25.5
					OVS	21.6	21.6	21.6
					SSLT	21.6	21.6	21.6
				SC Class B	STD	25.0	30.0	38.6
					OVS	23.0	27.6	32.9
					SSLT	25.0	30.0	32.9
			A490	N		25.0	30.0	40.0
				X		25.0	30.0	40.0
				SC Class A	STD	25.0	30.0	32.0
					OVS	23.0	27.2	27.2
					SSLT	25.0	27.2	27.2
				SC Class B	STD	25.0	30.0	40.0
					OVS	23.0	27.6	36.8
					SSLT	25.0	30.0	40.0

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	8	A325/ F1852	N		45.2	54.2	68.5
				X		45.2	54.2	72.3
				SC Class A	STD	45.2	46.1	46.1
					OVS	39.1	39.1	39.1
					SSLT	39.1	39.1	39.1
				SC Class B	STD	45.2	54.2	69.7
					OVS	41.5	49.9	59.3
					SSLT	45.2	54.2	59.3
			A490	N		45.2	54.2	72.3
				X		45.2	54.2	72.3
				SC Class A	STD	45.2	54.2	57.8
					OVS	41.5	49.2	49.2
					SSLT	45.2	49.2	49.2
				SC Class B	STD	45.2	54.2	72.3
					OVS	41.5	49.9	66.5
					SSLT	45.2	54.2	72.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	8	A325/ F1852	N		68.0	81.7	103.2
				X		68.0	81.7	108.9
				SC Class A	STD	68.0	69.3	69.3
					OVS	58.8	58.8	58.8
					SSLT	58.8	58.8	58.8
				SC Class B	STD	68.0	81.7	105.0
					OVS	62.5	75.0	89.3
					SSLT	68.0	81.7	89.3
			A490	N		68.0	81.7	108.9
				X		68.0	81.7	108.9
				SC Class A	STD	68.0	81.7	87.0
					OVS	62.5	74.1	74.1
					SSLT	68.0	74.1	74.1
				SC Class B	STD	68.0	81.7	108.9
					OVS	62.5	75.0	100.1
					SSLT	68.0	81.7	108.9

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	8	A325/ F1852	N		94.1	112.9	142.7
				X		94.1	112.9	150.6
				SC Class A	STD	94.1	95.9	95.9
					OVS	81.4	81.4	81.4
					SSLT	81.4	81.4	81.4
				SC Class B	STD	94.1	112.9	145.2
					OVS	86.5	103.8	123.6
					SSLT	94.1	112.9	123.6
			A490	N		94.1	112.9	150.6
				X		94.1	112.9	150.6
				SC Class A	STD	94.1	112.9	120.3
					OVS	86.5	102.5	102.5
					SSLT	94.1	102.5	102.5
				SC Class B	STD	94.1	112.9	150.6
					OVS	86.5	103.8	138.4
					SSLT	94.1	112.9	150.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	8	A325/ F1852	N		122.1	146.5	185.1
				X		122.1	146.5	195.4
				SC Class A	STD	122.1	124.4	124.4
					OVS	105.6	105.6	105.6
					SSLT	105.6	105.6	105.6
				SC Class B	STD	122.1	146.5	188.4
					OVS	112.2	134.7	160.3
					SSLT	122.1	146.5	160.3
			A490	N		122.1	146.5	195.4
				X		122.1	146.5	195.4
				SC Class A	STD	122.1	146.5	156.0
					OVS	112.2	133.0	133.0
					SSLT	122.1	133.0	133.0
				SC Class B	STD	122.1	146.5	195.4
					OVS	112.2	134.7	179.6
					SSLT	122.1	146.5	195.4

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	8	A325/ F1852	N		151.6	181.9	229.9
				X		151.6	181.9	242.6
				SC Class A	STD	151.6	154.5	154.5
					OVS	131.1	131.1	131.1
					SSLT	131.1	131.1	131.1
				SC Class B	STD	151.6	181.9	233.9
					OVS	139.3	167.2	199.1
					SSLT	151.6	181.9	199.1
			A490	N		151.6	181.9	242.6
				X		151.6	181.9	242.6
				SC Class A	STD	151.6	181.9	193.8
					OVS	139.3	165.1	165.1
					SSLT	151.6	165.1	165.1
				SC Class B	STD	151.6	181.9	242.6
					OVS	139.3	167.2	223.0
					SSLT	151.6	181.9	242.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	8	A325/ F1852	N		181.8	218.2	275.6
				X		181.8	218.2	290.9
				SC Class A	STD	181.8	185.2	185.2
					OVS	157.2	157.2	157.2
					SSLT	157.2	157.2	157.2
				SC Class B	STD	181.8	218.2	280.5
					OVS	167.1	200.5	238.7
					SSLT	181.8	218.2	238.7
			A490	N		181.8	218.2	290.9
				X		181.8	218.2	290.9
				SC Class A	STD	181.8	218.2	232.3
					OVS	167.1	198.0	198.0
					SSLT	181.8	198.0	198.0
				SC Class B	STD	181.8	218.2	290.9
					OVS	167.1	200.5	267.3
					SSLT	181.8	218.2	290.9

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	8	A325/ F1852	N		212.7	255.3	322.5
				X		212.7	255.3	340.4
				SC Class A	STD	212.7	216.7	216.7
					OVS	184.0	184.0	184.0
					SSLT	184.0	184.0	184.0
				SC Class B	STD	212.7	255.3	328.2
					OVS	195.5	234.6	279.3
					SSLT	212.7	255.3	279.3
			A490	N		212.7	255.3	340.4
				X		212.7	255.3	340.4
				SC Class A	STD	212.7	255.3	271.9
					OVS	195.5	231.6	231.6
					SSLT	212.7	231.6	231.6
				SC Class B	STD	212.7	255.3	340.4
					OVS	195.5	234.6	312.8
					SSLT	212.7	255.3	340.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	8	A325/ F1852	N		243.6	292.3	369.3
				X		243.6	292.3	389.7
				SC Class A	STD	243.6	248.2	248.2
					OVS	210.6	210.6	210.6
					SSLT	210.6	210.6	210.6
				SC Class B	STD	243.6	292.3	375.8
					OVS	223.9	268.6	319.8
					SSLT	243.6	292.3	319.8
			A490	N		243.6	292.3	389.7
				X		243.6	292.3	389.7
				SC Class A	STD	243.6	292.3	311.3
					OVS	223.9	265.2	265.2
					SSLT	243.6	265.2	265.2
				SC Class B	STD	243.6	292.3	389.7
					OVS	223.9	268.6	358.2
					SSLT	243.6	292.3	389.7

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	8	A325/ F1852	N		274.5	329.4	416.2
				X		274.5	329.4	439.3
				SC Class A	STD	274.5	279.7	279.7
					OVS	237.4	237.4	237.4
					SSLT	237.4	237.4	237.4
				SC Class B	STD	274.5	329.4	423.6
					OVS	252.3	302.8	360.4
					SSLT	274.5	329.4	360.4
			A490	N		274.5	329.4	439.3
				X		274.5	329.4	439.3
				SC Class A	STD	274.5	329.4	350.8
					OVS	252.3	298.9	298.9
					SSLT	274.5	298.9	298.9
				SC Class B	STD	274.5	329.4	439.3
					OVS	252.3	302.8	403.7
					SSLT	274.5	329.4	439.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	7/8	9	A325/ F1852	N		9.3	11.1	14.1
				X		9.3	11.1	14.9
				SC Class A	STD	9.3	9.5	9.5
					OVS	8.0	8.0	8.0
					SSLT	8.0	8.0	8.0
				SC Class B	STD	9.3	11.1	14.3
					OVS	8.5	10.2	12.2
					SSLT	9.3	11.1	12.2
			A490	N		9.3	11.1	14.9
				X		9.3	11.1	14.9
				SC Class A	STD	9.3	11.1	11.9
					OVS	8.5	10.1	10.1
					SSLT	9.3	10.1	10.1
				SC Class B	STD	9.3	11.1	14.9
					OVS	8.5	10.2	13.7
					SSLT	9.3	11.1	14.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	7/8	9	A325/ F1852	N		21.6	25.9	32.7
				X		21.6	25.9	34.5
				SC Class A	STD	21.6	22.0	22.0
					OVS	18.6	18.6	18.6
					SSLT	18.6	18.6	18.6
				SC Class B	STD	21.6	25.9	33.3
					OVS	19.8	23.8	28.3
					SSLT	21.6	25.9	28.3
			A490	N		21.6	25.9	34.5
				X		21.6	25.9	34.5
				SC Class A	STD	21.6	25.9	27.6
					OVS	19.8	23.5	23.5
					SSLT	21.6	23.5	23.5
				SC Class B	STD	21.6	25.9	34.5
					OVS	19.8	23.8	31.7
					SSLT	21.6	25.9	34.5

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	7/8	9	A325/ F1852	N		39.5	47.4	59.9
				X		39.5	47.4	63.2
				SC Class A	STD	39.5	40.2	40.2
					OVS	34.1	34.1	34.1
					SSLT	34.1	34.1	34.1
				SC Class B	STD	39.5	47.4	60.9
					OVS	36.3	43.5	51.8
					SSLT	39.5	47.4	51.8
			A490	N		39.5	47.4	63.2
				X		39.5	47.4	63.2
				SC Class A	STD	39.5	47.4	50.5
					OVS	36.3	43.0	43.0
					SSLT	39.5	43.0	43.0
				SC Class B	STD	39.5	47.4	63.2
					OVS	36.3	43.5	58.1
					SSLT	39.5	47.4	63.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	7/8	9	A325/ F1852	N		60.0	72.0	90.9
				X		60.0	72.0	96.0
				SC Class A	STD	60.0	61.1	61.1
					OVS	51.9	51.9	51.9
					SSLT	51.9	51.9	51.9
				SC Class B	STD	60.0	72.0	92.5
					OVS	55.1	66.2	78.8
					SSLT	60.0	72.0	78.8
			A490	N		60.0	72.0	96.0
				X		60.0	72.0	96.0
				SC Class A	STD	60.0	72.0	76.7
					OVS	55.1	65.3	65.3
					SSLT	60.0	65.3	65.3
				SC Class B	STD	60.0	72.0	96.0
					OVS	55.1	66.2	88.2
					SSLT	60.0	72.0	96.0

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	7/8	9	A325/ F1852	N		83.7	100.4	126.9
				X		83.7	100.4	133.9
				SC Class A	STD	83.7	85.3	85.3
					OVS	72.4	72.4	72.4
					SSLT	72.4	72.4	72.4
				SC Class B	STD	83.7	100.4	129.1
					OVS	76.9	92.3	109.9
					SSLT	83.7	100.4	109.9
			A490	N		83.7	100.4	133.9
				X		83.7	100.4	133.9
				SC Class A	STD	83.7	100.4	106.9
					OVS	76.9	91.1	91.1
					SSLT	83.7	91.1	91.1
				SC Class B	STD	83.7	100.4	133.9
					OVS	76.9	92.3	123.1
					SSLT	83.7	100.4	133.9

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	7/8	9	A325/ F1852	N		109.8	131.8	166.5
				X		109.8	131.8	175.7
				SC Class A	STD	109.8	111.9	111.9
					OVS	95.0	95.0	95.0
					SSLT	95.0	95.0	95.0
				SC Class B	STD	109.8	131.8	169.4
					OVS	100.9	121.1	144.2
					SSLT	109.8	131.8	144.2
			A490	N		109.8	131.8	175.7
				X		109.8	131.8	175.7
				SC Class A	STD	109.8	131.8	140.3
					OVS	100.9	119.6	119.6
					SSLT	109.8	119.6	119.6
				SC Class B	STD	109.8	131.8	175.7
					OVS	100.9	121.1	161.5
					SSLT	109.8	131.8	175.7

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	7/8	9	A325/ F1852	N		137.9	165.5	209.0
				X		137.9	165.5	220.6
				SC Class A	STD	137.9	140.5	140.5
					OVS	119.2	119.2	119.2
					SSLT	119.2	119.2	119.2
				SC Class B	STD	137.9	165.5	212.7
					OVS	126.7	152.1	181.0
					SSLT	137.9	165.5	181.0
			A490	N		137.9	165.5	220.6
				X		137.9	165.5	220.6
				SC Class A	STD	137.9	165.5	176.2
					OVS	126.7	150.1	150.1
					SSLT	137.9	150.1	150.1
				SC Class B	STD	137.9	165.5	220.6
					OVS	126.7	152.1	202.8
					SSLT	137.9	165.5	220.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	7/8	9	A325/ F1852	N		167.0	200.4	253.2
				X		167.0	200.4	267.2
				SC Class A	STD	167.0	170.2	170.2
					OVS	144.4	144.4	144.4
					SSLT	144.4	144.4	144.4
				SC Class B	STD	167.0	200.4	257.7
					OVS	153.5	184.2	219.3
					SSLT	167.0	200.4	219.3
			A490	N		167.0	200.4	267.2
				X		167.0	200.4	267.2
				SC Class A	STD	167.0	200.4	213.4
					OVS	153.5	181.9	181.9
					SSLT	167.0	181.9	181.9
				SC Class B	STD	167.0	200.4	267.2
					OVS	153.5	184.2	245.6
					SSLT	167.0	200.4	267.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	7/8	9	A325/ F1852	N		197.2	236.7	299.0
				X		197.2	236.7	315.6
				SC Class A	STD	197.2	200.9	200.9
					OVS	170.6	170.6	170.6
					SSLT	170.6	170.6	170.6
				SC Class B	STD	197.2	236.7	304.3
					OVS	181.3	217.5	258.9
					SSLT	197.2	236.7	258.9
			A490	N		197.2	236.7	315.6
				X		197.2	236.7	315.6
				SC Class A	STD	197.2	236.7	252.0
					OVS	181.3	214.7	214.7
					SSLT	197.2	214.7	214.7
				SC Class B	STD	197.2	236.7	315.6
					OVS	181.3	217.5	290.0
					SSLT	197.2	236.7	315.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	7/8	9	A325/ F1852	N		227.9	273.4	345.4
				X		227.9	273.4	364.6
				SC Class A	STD	227.9	232.1	232.1
					OVS	197.0	197.0	197.0
					SSLT	197.0	197.0	197.0
				SC Class B	STD	227.9	273.4	351.6
					OVS	209.4	251.3	299.2
					SSLT	227.9	273.4	299.2
			A490	N		227.9	273.4	364.6
				X		227.9	273.4	364.6
				SC Class A	STD	227.9	273.4	291.2
					OVS	209.4	248.1	248.1
					SSLT	227.9	248.1	248.1
				SC Class B	STD	227.9	273.4	364.6
					OVS	209.4	251.3	335.1
					SSLT	227.9	273.4	364.6

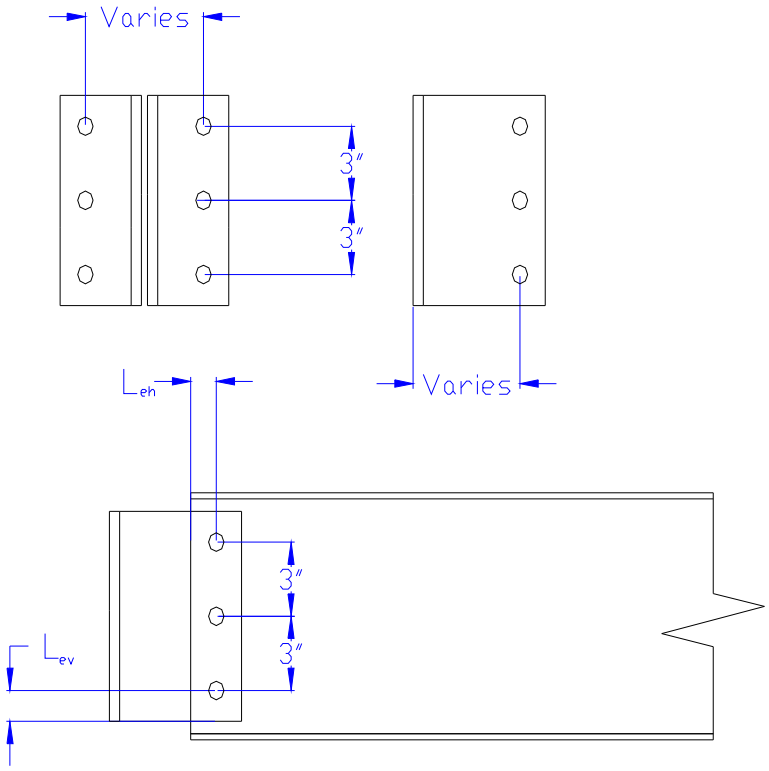
Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	7/8	9	A325/ F1852	N		258.7	310.4	392.2
				X		258.7	310.4	413.9
				SC Class A	STD	258.7	263.6	263.6
					OVS	223.7	223.7	223.7
					SSLT	223.7	223.7	223.7
				SC Class B	STD	258.7	310.4	399.2
					OVS	237.8	285.3	339.7
					SSLT	258.7	310.4	339.7
			A490	N		258.7	310.4	413.9
				X		258.7	310.4	413.9
				SC Class A	STD	258.7	310.4	330.6
					OVS	237.8	281.7	281.7
					SSLT	258.7	281.7	281.7
				SC Class B	STD	258.7	310.4	413.9
					OVS	237.8	285.3	380.4
					SSLT	258.7	310.4	413.9

APPENDIX F
1-INCH DIAMETER ALL-BOLTED A992 STEEL DOUBLE ANGLE CONNECTIONS

The tables given in Appendix F are all-bolted double angle connections. The angles are A992 angles using either A325/F1852 or A490 1-inch diameter bolts.



Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	6	A325/ F1852	N		14.2	17.1	22.8
				X		14.2	17.1	22.8
				SC Class A	STD	14.2	17.1	20.6
					OVS	12.4	14.9	17.5
					SSLT	14.2	17.1	17.5
				SC Class B	STD	14.2	17.1	22.8
					OVS	12.4	14.9	19.9
					SSLT	14.2	17.1	22.8
			A490	N		14.2	17.1	22.8
				X		14.2	17.1	22.8
				SC Class A	STD	14.2	17.1	22.8
					OVS	12.4	14.9	22.0
					SSLT	14.2	17.1	22.0
				SC Class B	STD	14.2	17.1	22.8
					OVS	12.4	14.9	19.9
					SSLT	14.2	17.1	22.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	6	A325/ F1852	N		31.8	38.2	50.9
				X		31.8	38.2	50.9
				SC Class A	STD	31.8	38.2	46.1
					OVS	27.7	33.3	39.2
					SSLT	31.8	38.2	39.2
				SC Class B	STD	31.8	38.2	50.9
					OVS	27.7	33.3	44.4
					SSLT	31.8	38.2	50.9
			A490	N		31.8	38.2	50.9
				X		31.8	38.2	50.9
				SC Class A	STD	31.8	38.2	50.9
					OVS	27.7	33.3	49.2
					SSLT	31.8	38.2	49.2
				SC Class B	STD	31.8	38.2	50.9
					OVS	27.7	33.3	44.4
					SSLT	31.8	38.2	50.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	6	A325/ F1852	N		55.1	66.1	88.1
				X		55.1	66.1	88.1
				SC Class A	STD	55.1	66.1	79.7
					OVS	48.0	57.6	67.7
					SSLT	55.1	66.1	67.7
				SC Class B	STD	55.1	66.1	88.1
					OVS	48.0	57.6	76.8
					SSLT	55.1	66.1	88.1
			A490	N		55.1	66.1	88.1
				X		55.1	66.1	88.1
				SC Class A	STD	55.1	66.1	88.1
					OVS	48.0	57.6	85.2
					SSLT	55.1	66.1	85.2
				SC Class B	STD	55.1	66.1	88.1
					OVS	48.0	57.6	76.8
					SSLT	55.1	66.1	88.1

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	6	A325/ F1852	N		80.6	96.7	128.9
				X		80.6	96.7	128.9
				SC Class A	STD	80.6	96.7	116.7
					OVS	70.2	84.3	99.2
					SSLT	80.6	96.7	99.2
				SC Class B	STD	80.6	96.7	128.9
					OVS	70.2	84.3	112.4
					SSLT	80.6	96.7	128.9
			A490	N		80.6	96.7	128.9
				X		80.6	96.7	128.9
				SC Class A	STD	80.6	96.7	128.9
					OVS	70.2	84.3	124.6
					SSLT	80.6	96.7	124.6
				SC Class B	STD	80.6	96.7	128.9
					OVS	70.2	84.3	112.4
					SSLT	80.6	96.7	128.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	6	A325/ F1852	N		107.7	129.2	172.3
				X		107.7	129.2	172.3
				SC Class A	STD	107.7	129.2	155.9
					OVS	93.8	112.6	132.5
					SSLT	107.7	129.2	132.5
				SC Class B	STD	107.7	129.2	172.3
					OVS	93.8	112.6	150.2
					SSLT	107.7	129.2	172.3
			A490	N		107.7	129.2	172.3
				X		107.7	129.2	172.3
				SC Class A	STD	107.7	129.2	172.3
					OVS	93.8	112.6	166.6
					SSLT	107.7	129.2	166.6
				SC Class B	STD	107.7	129.2	172.3
					OVS	93.8	112.6	150.2
					SSLT	107.7	129.2	172.3

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	6	A325/ F1852	N		136.1	163.3	217.8
				X		136.1	163.3	217.8
				SC Class A	STD	136.1	163.3	197.0
					OVS	118.6	142.3	167.5
					SSLT	136.1	163.3	167.5
				SC Class B	STD	136.1	163.3	217.8
					OVS	118.6	142.3	189.8
					SSLT	136.1	163.3	217.8
			A490	N		136.1	163.3	217.8
				X		136.1	163.3	217.8
				SC Class A	STD	136.1	163.3	217.8
					OVS	118.6	142.3	210.5
					SSLT	136.1	163.3	210.5
				SC Class B	STD	136.1	163.3	217.8
					OVS	118.6	142.3	189.8
					SSLT	136.1	163.3	217.8

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	6	A325/ F1852	N		164.3	197.1	262.8
				X		164.3	197.1	262.8
				SC Class A	STD	164.3	197.1	237.8
					OVS	143.1	171.8	202.1
					SSLT	164.3	197.1	202.1
				SC Class B	STD	164.3	197.1	262.8
					OVS	143.1	171.8	229.0
					SSLT	164.3	197.1	262.8
			A490	N		164.3	197.1	262.8
				X		164.3	197.1	262.8
				SC Class A	STD	164.3	197.1	262.8
					OVS	143.1	171.8	254.1
					SSLT	164.3	197.1	254.1
				SC Class B	STD	164.3	197.1	262.8
					OVS	143.1	171.8	229.0
					SSLT	164.3	197.1	262.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	6	A325/ F1852	N		192.8	231.4	308.5
				X		192.8	231.4	308.5
				SC Class A	STD	192.8	231.4	279.1
					OVS	168.0	201.6	237.2
					SSLT	192.8	231.4	237.2
				SC Class B	STD	192.8	231.4	308.5
					OVS	168.0	201.6	268.8
					SSLT	192.8	231.4	308.5
			A490	N		192.8	231.4	308.5
				X		192.8	231.4	308.5
				SC Class A	STD	192.8	231.4	308.5
					OVS	168.0	201.6	298.2
					SSLT	192.8	231.4	298.2
				SC Class B	STD	192.8	231.4	308.5
					OVS	168.0	201.6	268.8
					SSLT	192.8	231.4	308.5

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	6	A325/ F1852	N		221.0	265.2	353.6
				X		221.0	265.2	353.6
				SC Class A	STD	221.0	265.2	320.0
					OVS	192.6	231.1	272.0
					SSLT	221.0	265.2	272.0
				SC Class B	STD	221.0	265.2	353.6
					OVS	192.6	231.1	308.2
					SSLT	221.0	265.2	353.6
			A490	N		221.0	265.2	353.6
				X		221.0	265.2	353.6
				SC Class A	STD	221.0	265.2	353.6
					OVS	192.6	231.1	341.9
					SSLT	221.0	265.2	341.9
				SC Class B	STD	221.0	265.2	353.6
					OVS	192.6	231.1	308.2
					SSLT	221.0	265.2	353.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	6	A325/ F1852	N		249.2	299.1	398.8
				X		249.2	299.1	398.8
				SC Class A	STD	249.2	299.1	360.8
					OVS	217.2	260.6	306.7
					SSLT	249.2	299.1	306.7
				SC Class B	STD	249.2	299.1	398.8
					OVS	217.2	260.6	347.5
					SSLT	249.2	299.1	398.8
			A490	N		249.2	299.1	398.8
				X		249.2	299.1	398.8
				SC Class A	STD	249.2	299.1	398.8
					OVS	217.2	260.6	385.5
					SSLT	249.2	299.1	385.5
				SC Class B	STD	249.2	299.1	398.8
					OVS	217.2	260.6	347.5
					SSLT	249.2	299.1	398.8

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	6	A325/ F1852	N		276.3	331.5	442.1
				X		276.3	331.5	442.1
				SC Class A	STD	276.3	331.5	400.0
					OVS	240.8	288.9	340.0
					SSLT	276.3	331.5	340.0
				SC Class B	STD	276.3	331.5	442.1
					OVS	240.8	288.9	385.2
					SSLT	276.3	331.5	442.1
			A490	N		276.3	331.5	442.1
				X		276.3	331.5	442.1
				SC Class A	STD	276.3	331.5	442.1
					OVS	240.8	288.9	427.3
					SSLT	276.3	331.5	427.3
				SC Class B	STD	276.3	331.5	442.1
					OVS	240.8	288.9	385.2
					SSLT	276.3	331.5	442.1

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	7	A325/ F1852	N		13.1	15.8	21.0
				X		13.1	15.8	21.0
				SC Class A	STD	13.1	15.8	19.0
					OVS	11.4	13.7	16.2
					SSLT	13.1	15.8	16.2
				SC Class B	STD	13.1	15.8	21.0
					OVS	11.4	13.7	18.3
					SSLT	13.1	15.8	21.0
			A490	N		13.1	15.8	21.0
				X		13.1	15.8	21.0
				SC Class A	STD	13.1	15.8	21.0
					OVS	11.4	13.7	20.3
					SSLT	13.1	15.8	20.3
				SC Class B	STD	13.1	15.8	21.0
					OVS	11.4	13.7	18.3
					SSLT	13.1	15.8	21.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	7	A325/ F1852	N		26.6	32.0	42.6
				X		26.6	32.0	42.6
				SC Class A	STD	26.6	32.0	38.6
					OVS	23.2	27.9	32.8
					SSLT	26.6	32.0	32.8
				SC Class B	STD	26.6	32.0	42.6
					OVS	23.2	27.9	37.1
					SSLT	26.6	32.0	42.6
			A490	N		26.6	32.0	42.6
				X		26.6	32.0	42.6
				SC Class A	STD	26.6	32.0	42.6
					OVS	23.2	27.9	41.2
					SSLT	26.6	32.0	41.2
				SC Class B	STD	26.6	32.0	42.6
					OVS	23.2	27.9	37.1
					SSLT	26.6	32.0	42.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	7	A325/ F1852	N		47.8	57.4	76.5
				X		47.8	57.4	76.5
				SC Class A	STD	47.8	57.4	69.3
					OVS	41.7	50.0	58.9
					SSLT	47.8	57.4	58.9
				SC Class B	STD	47.8	57.4	76.5
					OVS	41.7	50.0	66.7
					SSLT	47.8	57.4	76.5
			A490	N		47.8	57.4	76.5
				X		47.8	57.4	76.5
				SC Class A	STD	47.8	57.4	76.5
					OVS	41.7	50.0	74.0
					SSLT	47.8	57.4	74.0
				SC Class B	STD	47.8	57.4	76.5
					OVS	41.7	50.0	66.7
					SSLT	47.8	57.4	76.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	7	A325/ F1852	N		70.4	84.5	112.7
				X		70.4	84.5	112.7
				SC Class A	STD	70.4	84.5	101.9
					OVS	61.4	73.6	86.6
					SSLT	70.4	84.5	86.6
				SC Class B	STD	70.4	84.5	112.7
					OVS	61.4	73.6	98.2
					SSLT	70.4	84.5	112.7
			A490	N		70.4	84.5	112.7
				X		70.4	84.5	112.7
				SC Class A	STD	70.4	84.5	112.7
					OVS	61.4	73.6	108.9
					SSLT	70.4	84.5	108.9
				SC Class B	STD	70.4	84.5	112.7
					OVS	61.4	73.6	98.2
					SSLT	70.4	84.5	112.7

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	7	A325/ F1852	N		96.0	115.2	153.6
				X		96.0	115.2	153.6
				SC Class A	STD	96.0	115.2	139.0
					OVS	83.7	100.4	118.1
					SSLT	96.0	115.2	118.1
				SC Class B	STD	96.0	115.2	153.6
					OVS	83.7	100.4	133.9
					SSLT	96.0	115.2	153.6
			A490	N		96.0	115.2	153.6
				X		96.0	115.2	153.6
				SC Class A	STD	96.0	115.2	153.6
					OVS	83.7	100.4	148.5
					SSLT	96.0	115.2	148.5
				SC Class B	STD	96.0	115.2	153.6
					OVS	83.7	100.4	133.9
					SSLT	96.0	115.2	153.6

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	7	A325/ F1852	N		123.1	147.7	197.0
				X		123.1	147.7	197.0
				SC Class A	STD	123.1	147.7	178.2
					OVS	107.3	128.7	151.5
					SSLT	123.1	147.7	151.5
				SC Class B	STD	123.1	147.7	197.0
					OVS	107.3	128.7	171.7
					SSLT	123.1	147.7	197.0
			A490	N		123.1	147.7	197.0
				X		123.1	147.7	197.0
				SC Class A	STD	123.1	147.7	197.0
					OVS	107.3	128.7	190.4
					SSLT	123.1	147.7	190.4
				SC Class B	STD	123.1	147.7	197.0
					OVS	107.3	128.7	171.7
					SSLT	123.1	147.7	197.0

Notes:
Angles are assumed to be A992 Steel
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Represents a bolt bearing limit state
Represents a bolt shear limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	7	A325/ F1852	N		151.1	181.3	241.7
				X		151.1	181.3	241.7
				SC Class A	STD	151.1	181.3	218.7
					OVS	131.6	158.0	185.9
					SSLT	151.1	181.3	185.9
				SC Class B	STD	151.1	181.3	241.7
					OVS	131.6	158.0	210.6
					SSLT	151.1	181.3	241.7
			A490	N		151.1	181.3	241.7
				X		151.1	181.3	241.7
				SC Class A	STD	151.1	181.3	241.7
					OVS	131.6	158.0	233.7
					SSLT	151.1	181.3	233.7
				SC Class B	STD	151.1	181.3	241.7
					OVS	131.6	158.0	210.6
					SSLT	151.1	181.3	241.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	7	A325/ F1852	N		179.3	215.1	286.9
				X		179.3	215.1	286.9
				SC Class A	STD	179.3	215.1	259.5
					OVS	156.2	187.5	220.6
					SSLT	179.3	215.1	220.6
				SC Class B	STD	179.3	215.1	286.9
					OVS	156.2	187.5	250.0
					SSLT	179.3	215.1	286.9
			A490	N		179.3	215.1	286.9
				X		179.3	215.1	286.9
				SC Class A	STD	179.3	215.1	286.9
					OVS	156.2	187.5	277.3
					SSLT	179.3	215.1	277.3
				SC Class B	STD	179.3	215.1	286.9
					OVS	156.2	187.5	250.0
					SSLT	179.3	215.1	286.9

Notes:
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	Represents a bolt bearing limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	7	A325/ F1852	N		207.8	249.4	332.5
				X		207.8	249.4	332.5
				SC Class A	STD	207.8	249.4	300.9
					OVS	181.1	217.3	255.7
					SSLT	207.8	249.4	255.7
				SC Class B	STD	207.8	249.4	332.5
					OVS	181.1	217.3	289.8
					SSLT	207.8	249.4	332.5
			A490	N		207.8	249.4	332.5
				X		207.8	249.4	332.5
				SC Class A	STD	207.8	249.4	332.5
					OVS	181.1	217.3	321.5
					SSLT	207.8	249.4	321.5
				SC Class B	STD	207.8	249.4	332.5
					OVS	181.1	217.3	289.8
					SSLT	207.8	249.4	332.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	7	A325/ F1852	N		238.2	285.8	381.0
				X		238.2	285.8	381.0
				SC Class A	STD	238.2	285.8	344.8
					OVS	207.5	249.0	293.0
					SSLT	238.2	285.8	293.0
				SC Class B	STD	238.2	285.8	381.0
					OVS	207.5	249.0	332.1
					SSLT	238.2	285.8	381.0
			A490	N		238.2	285.8	381.0
				X		238.2	285.8	381.0
				SC Class A	STD	238.2	285.8	381.0
					OVS	207.5	249.0	368.3
					SSLT	238.2	285.8	368.3
				SC Class B	STD	238.2	285.8	381.0
					OVS	207.5	249.0	332.1
					SSLT	238.2	285.8	381.0

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	7	A325/ F1852	N		264.3	317.2	422.9
				X		264.3	317.2	422.9
				SC Class A	STD	264.3	317.2	382.7
					OVS	230.4	276.4	325.3
					SSLT	264.3	317.2	325.3
				SC Class B	STD	264.3	317.2	422.9
					OVS	230.4	276.4	368.6
					SSLT	264.3	317.2	422.9
			A490	N		264.3	317.2	422.9
				X		264.3	317.2	422.9
				SC Class A	STD	264.3	317.2	422.9
					OVS	230.4	276.4	408.8
					SSLT	264.3	317.2	408.8
				SC Class B	STD	264.3	317.2	422.9
					OVS	230.4	276.4	368.6
					SSLT	264.3	317.2	422.9

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	8	A325/ F1852	N		11.4	13.6	18.2
				X		11.4	13.6	18.2
				SC Class A	STD	11.4	13.6	16.5
					OVS	9.9	11.9	14.0
					SSLT	11.4	13.6	14.0
				SC Class B	STD	11.4	13.6	18.2
					OVS	9.9	11.9	15.9
					SSLT	11.4	13.6	18.2
			A490	N		11.4	13.6	18.2
				X		11.4	13.6	18.2
				SC Class A	STD	11.4	13.6	18.2
					OVS	9.9	11.9	17.6
					SSLT	11.4	13.6	17.6
				SC Class B	STD	11.4	13.6	18.2
					OVS	9.9	11.9	15.9
					SSLT	11.4	13.6	18.2

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	8	A325/ F1852	N		23.0	27.6	36.8
				X		23.0	27.6	36.8
				SC Class A	STD	23.0	27.6	33.3
					OVS	20.0	24.1	28.3
					SSLT	23.0	27.6	28.3
				SC Class B	STD	23.0	27.6	36.8
					OVS	20.0	24.1	32.1
					SSLT	23.0	27.6	36.8
			A490	N		23.0	27.6	36.8
				X		23.0	27.6	36.8
				SC Class A	STD	23.0	27.6	36.8
					OVS	20.0	24.1	35.6
					SSLT	23.0	27.6	35.6
				SC Class B	STD	23.0	27.6	36.8
					OVS	20.0	24.1	32.1
					SSLT	23.0	27.6	36.8

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	8	A325/ F1852	N		41.5	49.9	66.5
				X		41.5	49.9	66.5
				SC Class A	STD	41.5	49.9	60.1
					OVS	36.2	43.4	51.1
					SSLT	41.5	49.9	51.1
				SC Class B	STD	41.5	49.9	66.5
					OVS	36.2	43.4	57.9
					SSLT	41.5	49.9	66.5
			A490	N		41.5	49.9	66.5
				X		41.5	49.9	66.5
				SC Class A	STD	41.5	49.9	66.5
					OVS	36.2	43.4	64.3
					SSLT	41.5	49.9	64.3
				SC Class B	STD	41.5	49.9	66.5
					OVS	36.2	43.4	57.9
					SSLT	41.5	49.9	66.5

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	8	A325/ F1852	N		62.5	75.0	100.1
				X		62.5	75.0	100.1
				SC Class A	STD	62.5	75.0	90.5
					OVS	54.5	65.4	76.9
					SSLT	62.5	75.0	76.9
				SC Class B	STD	62.5	75.0	100.1
					OVS	54.5	65.4	87.2
					SSLT	62.5	75.0	100.1
			A490	N		62.5	75.0	100.1
				X		62.5	75.0	100.1
				SC Class A	STD	62.5	75.0	100.1
					OVS	54.5	65.4	96.7
					SSLT	62.5	75.0	96.7
				SC Class B	STD	62.5	75.0	100.1
					OVS	54.5	65.4	87.2
					SSLT	62.5	75.0	100.1

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	8	A325/ F1852	N		86.5	103.8	138.4
				X		86.5	103.8	138.4
				SC Class A	STD	86.5	103.8	125.2
					OVS	75.4	90.5	106.4
					SSLT	86.5	103.8	106.4
				SC Class B	STD	86.5	103.8	138.4
					OVS	75.4	90.5	120.6
					SSLT	86.5	103.8	138.4
			A490	N		86.5	103.8	138.4
				X		86.5	103.8	138.4
				SC Class A	STD	86.5	103.8	138.4
					OVS	75.4	90.5	133.8
					SSLT	86.5	103.8	133.8
				SC Class B	STD	86.5	103.8	138.4
					OVS	75.4	90.5	120.6
					SSLT	86.5	103.8	138.4

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	8	A325/ F1852	N		112.2	134.7	179.6
				X		112.2	134.7	179.6
				SC Class A	STD	112.2	134.7	162.5
					OVS	97.8	117.4	138.1
					SSLT	112.2	134.7	138.1
				SC Class B	STD	112.2	134.7	179.6
					OVS	97.8	117.4	156.5
					SSLT	112.2	134.7	179.6
			A490	N		112.2	134.7	179.6
				X		112.2	134.7	179.6
				SC Class A	STD	112.2	134.7	179.6
					OVS	97.8	117.4	173.6
					SSLT	112.2	134.7	173.6
				SC Class B	STD	112.2	134.7	179.6
					OVS	97.8	117.4	156.5
					SSLT	112.2	134.7	179.6

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	8	A325/ F1852	N		139.3	167.2	223.0
				X		139.3	167.2	223.0
				SC Class A	STD	139.3	167.2	201.7
					OVS	121.4	145.7	171.5
					SSLT	139.3	167.2	171.5
				SC Class B	STD	139.3	167.2	223.0
					OVS	121.4	145.7	194.3
					SSLT	139.3	167.2	223.0
			A490	N		139.3	167.2	223.0
				X		139.3	167.2	223.0
				SC Class A	STD	139.3	167.2	223.0
					OVS	121.4	145.7	215.5
					SSLT	139.3	167.2	215.5
				SC Class B	STD	139.3	167.2	223.0
					OVS	121.4	145.7	194.3
					SSLT	139.3	167.2	223.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	8	A325/ F1852	N		167.1	200.5	267.3
				X		167.1	200.5	267.3
				SC Class A	STD	167.1	200.5	241.9
					OVS	145.6	174.7	205.6
					SSLT	167.1	200.5	205.6
				SC Class B	STD	167.1	200.5	267.3
					OVS	145.6	174.7	233.0
					SSLT	167.1	200.5	267.3
			A490	N		167.1	200.5	267.3
				X		167.1	200.5	267.3
				SC Class A	STD	167.1	200.5	267.3
					OVS	145.6	174.7	258.4
					SSLT	167.1	200.5	258.4
				SC Class B	STD	167.1	200.5	267.3
					OVS	145.6	174.7	233.0
					SSLT	167.1	200.5	267.3

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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	8	A325/ F1852	N		195.5	234.6	312.8
				X		195.5	234.6	312.8
				SC Class A	STD	195.5	234.6	283.0
					OVS	170.4	204.5	240.6
					SSLT	195.5	234.6	240.6
				SC Class B	STD	195.5	234.6	312.8
					OVS	170.4	204.5	272.6
					SSLT	195.5	234.6	312.8
			A490	N		195.5	234.6	312.8
				X		195.5	234.6	312.8
				SC Class A	STD	195.5	234.6	312.8
					OVS	170.4	204.5	302.4
					SSLT	195.5	234.6	302.4
				SC Class B	STD	195.5	234.6	312.8
					OVS	170.4	204.5	272.6
					SSLT	195.5	234.6	312.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	8	A325/ F1852	N		223.9	268.6	358.2
				X		223.9	268.6	358.2
				SC Class A	STD	223.9	268.6	324.1
					OVS	195.1	234.1	275.5
					SSLT	223.9	268.6	275.5
				SC Class B	STD	223.9	268.6	358.2
					OVS	195.1	234.1	312.1
					SSLT	223.9	268.6	358.2
			A490	N		223.9	268.6	358.2
				X		223.9	268.6	358.2
				SC Class A	STD	223.9	268.6	358.2
					OVS	195.1	234.1	346.2
					SSLT	223.9	268.6	346.2
				SC Class B	STD	223.9	268.6	358.2
					OVS	195.1	234.1	312.1
					SSLT	223.9	268.6	358.2

Notes:
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	8	A325/ F1852	N		252.3	302.8	403.7
				X		252.3	302.8	403.7
				SC Class A	STD	252.3	302.8	365.2
					OVS	219.9	263.8	310.5
					SSLT	252.3	302.8	310.5
				SC Class B	STD	252.3	302.8	403.7
					OVS	219.9	263.8	351.8
					SSLT	252.3	302.8	403.7
			A490	N		252.3	302.8	403.7
				X		252.3	302.8	403.7
				SC Class A	STD	252.3	302.8	403.7
					OVS	219.9	263.8	390.2
					SSLT	252.3	302.8	390.2
				SC Class B	STD	252.3	302.8	403.7
					OVS	219.9	263.8	351.8
					SSLT	252.3	302.8	403.7

Notes:
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	Represents a bolt bearing limit state
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All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
2	1	9	A325/ F1852	N		8.5	10.2	13.7
				X		8.5	10.2	13.7
				SC Class A	STD	8.5	10.2	12.4
					OVS	7.4	8.9	10.5
					SSLT	8.5	10.2	10.5
				SC Class B	STD	8.5	10.2	13.7
					OVS	7.4	8.9	11.9
					SSLT	8.5	10.2	13.7
			A490	N		8.5	10.2	13.7
				X		8.5	10.2	13.7
				SC Class A	STD	8.5	10.2	13.7
					OVS	7.4	8.9	13.2
					SSLT	8.5	10.2	13.2
				SC Class B	STD	8.5	10.2	13.7
					OVS	7.4	8.9	11.9
					SSLT	8.5	10.2	13.7

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
3	1	9	A325/ F1852	N		19.8	23.8	31.7
				X		19.8	23.8	31.7
				SC Class A	STD	19.8	23.8	28.7
					OVS	17.3	20.7	24.4
					SSLT	19.8	23.8	24.4
				SC Class B	STD	19.8	23.8	31.7
					OVS	17.3	20.7	27.6
					SSLT	19.8	23.8	31.7
			A490	N		19.8	23.8	31.7
				X		19.8	23.8	31.7
				SC Class A	STD	19.8	23.8	31.7
					OVS	17.3	20.7	30.7
					SSLT	19.8	23.8	30.7
				SC Class B	STD	19.8	23.8	31.7
					OVS	17.3	20.7	27.6
					SSLT	19.8	23.8	31.7

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
4	1	9	A325/ F1852	N		36.3	43.5	58.1
				X		36.3	43.5	58.1
				SC Class A	STD	36.3	43.5	52.5
					OVS	31.6	37.9	44.7
					SSLT	36.3	43.5	44.7
				SC Class B	STD	36.3	43.5	58.1
					OVS	31.6	37.9	50.6
					SSLT	36.3	43.5	58.1
			A490	N		36.3	43.5	58.1
				X		36.3	43.5	58.1
				SC Class A	STD	36.3	43.5	58.1
					OVS	31.6	37.9	56.1
					SSLT	36.3	43.5	56.1
				SC Class B	STD	36.3	43.5	58.1
					OVS	31.6	37.9	50.6
					SSLT	36.3	43.5	58.1

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
5	1	9	A325/ F1852	N		55.1	66.2	88.2
				X		55.1	66.2	88.2
				SC Class A	STD	55.1	66.2	79.8
					OVS	48.0	57.6	67.8
					SSLT	55.1	66.2	67.8
				SC Class B	STD	55.1	66.2	88.2
					OVS	48.0	57.6	76.9
					SSLT	55.1	66.2	88.2
			A490	N		55.1	66.2	88.2
				X		55.1	66.2	88.2
				SC Class A	STD	55.1	66.2	88.2
					OVS	48.0	57.6	85.3
					SSLT	55.1	66.2	85.3
				SC Class B	STD	55.1	66.2	88.2
					OVS	48.0	57.6	76.9
					SSLT	55.1	66.2	88.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
6	1	9	A325/ F1852	N		76.9	92.3	123.1
				X		76.9	92.3	123.1
				SC Class A	STD	76.9	92.3	111.3
					OVS	67.0	80.4	94.6
					SSLT	76.9	92.3	94.6
				SC Class B	STD	76.9	92.3	123.1
					OVS	67.0	80.4	107.2
					SSLT	76.9	92.3	123.1
			A490	N		76.9	92.3	123.1
				X		76.9	92.3	123.1
				SC Class A	STD	76.9	92.3	123.1
					OVS	67.0	80.4	119.0
					SSLT	76.9	92.3	119.0
				SC Class B	STD	76.9	92.3	123.1
					OVS	67.0	80.4	107.2
					SSLT	76.9	92.3	123.1

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
7	1	9	A325/ F1852	N		100.9	121.1	161.5
				X		100.9	121.1	161.5
				SC Class A	STD	100.9	121.1	146.1
					OVS	88.0	105.5	124.2
					SSLT	100.9	121.1	124.2
				SC Class B	STD	100.9	121.1	161.5
					OVS	88.0	105.5	140.7
					SSLT	100.9	121.1	161.5
			A490	N		100.9	121.1	161.5
				X		100.9	121.1	161.5
				SC Class A	STD	100.9	121.1	161.5
					OVS	88.0	105.5	156.1
					SSLT	100.9	121.1	156.1
				SC Class B	STD	100.9	121.1	161.5
					OVS	88.0	105.5	140.7
					SSLT	100.9	121.1	161.5

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
8	1	9	A325/ F1852	N		126.7	152.1	202.8
				X		126.7	152.1	202.8
				SC Class A	STD	126.7	152.1	183.4
					OVS	110.4	132.5	155.9
					SSLT	126.7	152.1	155.9
				SC Class B	STD	126.7	152.1	202.8
					OVS	110.4	132.5	176.7
					SSLT	126.7	152.1	202.8
			A490	N		126.7	152.1	202.8
				X		126.7	152.1	202.8
				SC Class A	STD	126.7	152.1	202.8
					OVS	110.4	132.5	196.0
					SSLT	126.7	152.1	196.0
				SC Class B	STD	126.7	152.1	202.8
					OVS	110.4	132.5	176.7
					SSLT	126.7	152.1	202.8

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
9	1	9	A325/ F1852	N		153.5	184.2	245.6
				X		153.5	184.2	245.6
				SC Class A	STD	153.5	184.2	222.2
					OVS	133.8	160.5	188.9
					SSLT	153.5	184.2	188.9
				SC Class B	STD	153.5	184.2	245.6
					OVS	133.8	160.5	214.0
					SSLT	153.5	184.2	245.6
			A490	N		153.5	184.2	245.6
				X		153.5	184.2	245.6
				SC Class A	STD	153.5	184.2	245.6
					OVS	133.8	160.5	237.4
					SSLT	153.5	184.2	237.4
				SC Class B	STD	153.5	184.2	245.6
					OVS	133.8	160.5	214.0
					SSLT	153.5	184.2	245.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
10	1	9	A325/ F1852	N		181.3	217.5	290.0
				X		181.3	217.5	290.0
				SC Class A	STD	181.3	217.5	262.4
					OVS	158.0	189.5	223.0
					SSLT	181.3	217.5	223.0
				SC Class B	STD	181.3	217.5	290.0
					OVS	158.0	189.5	252.7
					SSLT	181.3	217.5	290.0
			A490	N		181.3	217.5	290.0
				X		181.3	217.5	290.0
				SC Class A	STD	181.3	217.5	290.0
					OVS	158.0	189.5	280.3
					SSLT	181.3	217.5	280.3
				SC Class B	STD	181.3	217.5	290.0
					OVS	158.0	189.5	252.7
					SSLT	181.3	217.5	290.0

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
11	1	9	A325/ F1852	N		209.4	251.3	335.1
				X		209.4	251.3	335.1
				SC Class A	STD	209.4	251.3	303.1
					OVS	182.5	219.0	257.7
					SSLT	209.4	251.3	257.7
				SC Class B	STD	209.4	251.3	335.1
					OVS	182.5	219.0	292.0
					SSLT	209.4	251.3	335.1
			A490	N		209.4	251.3	335.1
				X		209.4	251.3	335.1
				SC Class A	STD	209.4	251.3	335.1
					OVS	182.5	219.0	323.9
					SSLT	209.4	251.3	323.9
				SC Class B	STD	209.4	251.3	335.1
					OVS	182.5	219.0	292.0
					SSLT	209.4	251.3	335.1

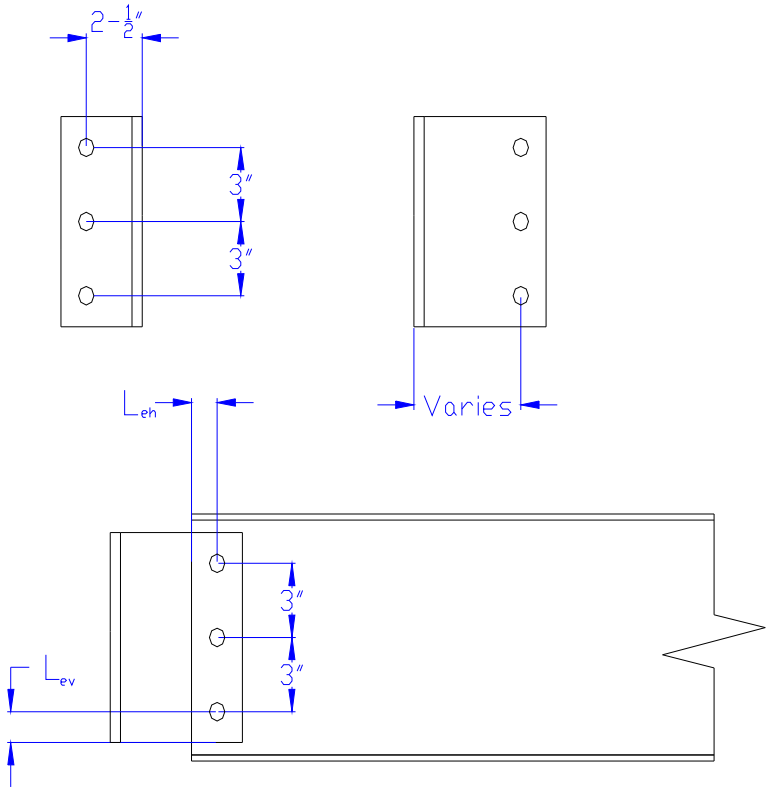
Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Double-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						5/16	3/8	1/2
12	1	9	A325/ F1852	N		237.8	285.3	380.4
				X		237.8	285.3	380.4
				SC Class A	STD	237.8	285.3	344.2
					OVS	207.2	248.6	292.6
					SSLT	237.8	285.3	292.6
				SC Class B	STD	237.8	285.3	380.4
					OVS	207.2	248.6	331.5
					SSLT	237.8	285.3	380.4
			A490	N		237.8	285.3	380.4
				X		237.8	285.3	380.4
				SC Class A	STD	237.8	285.3	380.4
					OVS	207.2	248.6	367.7
					SSLT	237.8	285.3	367.7
				SC Class B	STD	237.8	285.3	380.4
					OVS	207.2	248.6	331.5
					SSLT	237.8	285.3	380.4

APPENDIX G
3/4-INCH DIAMETER ALL-BOLTED A36 STEEL SINGLE ANGLE CONNECTIONS

The tables given in Appendix G are all-bolted single angle connections. The angles are A36 angles using either A325/F1852 or A490 3/4-inch diameter bolts.



Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	6	A325/ F1852	N		8.6	8.6	8.6
				X		9.0	10.8	10.8
				SC Class A	STD	5.6	5.6	5.6
					OVS	4.8	4.8	4.8
					SSLT	4.8	4.8	4.8
				SC Class B	STD	8.6	8.6	8.6
					OVS	7.3	7.3	7.3
					SSLT	7.3	7.3	7.3
			A490	N		9.0	10.8	10.8
				X		9.0	11.9	13.5
				SC Class A	STD	7.1	7.1	7.1
					OVS	6.0	6.0	6.0
					SSLT	6.0	6.0	6.0
				SC Class B	STD	9.0	10.8	10.8
					OVS	9.0	9.2	9.2
					SSLT	9.0	9.2	9.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	6	A325/ F1852	N		19.3	19.3	19.3
				X		20.0	24.1	24.1
				SC Class A	STD	12.6	12.6	12.6
					OVS	10.8	10.8	10.8
					SSLT	10.8	10.8	10.8
				SC Class B	STD	19.2	19.2	19.2
					OVS	16.4	16.4	16.4
					SSLT	16.4	16.4	16.4
			A490	N		20.0	24.1	24.1
				X		20.0	26.7	30.2
				SC Class A	STD	15.9	15.9	15.9
					OVS	13.5	13.5	13.5
					SSLT	13.5	13.5	13.5
				SC Class B	STD	20.0	24.1	24.1
					OVS	20.0	20.5	20.5
					SSLT	20.0	20.5	20.5

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	6	A325/ F1852	N		33.4	33.4	33.4
				X		34.6	41.7	41.7
				SC Class A	STD	21.8	21.8	21.8
					OVS	18.6	18.6	18.6
					SSLT	18.6	18.6	18.6
				SC Class B	STD	33.2	33.2	33.2
					OVS	28.3	28.3	28.3
					SSLT	28.3	28.3	28.3
			A490	N		34.6	41.7	41.7
				X		34.6	46.1	52.2
				SC Class A	STD	27.5	27.5	27.5
					OVS	23.3	23.3	23.3
					SSLT	23.3	23.3	23.3
				SC Class B	STD	34.6	41.8	41.8
					OVS	34.6	35.4	35.4
					SSLT	34.6	35.4	35.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	6	A325/ F1852	N		48.8	48.8	48.8
				X		50.7	61.1	61.1
				SC Class A	STD	31.9	31.9	31.9
					OVS	27.3	27.3	27.3
					SSLT	27.3	27.3	27.3
				SC Class B	STD	48.5	48.5	48.5
					OVS	41.4	41.4	41.4
					SSLT	41.4	41.4	41.4
			A490	N		50.7	61.1	61.1
				X		50.7	67.5	76.4
				SC Class A	STD	40.2	40.2	40.2
					OVS	34.1	34.1	34.1
					SSLT	34.1	34.1	34.1
				SC Class B	STD	50.7	61.1	61.1
					OVS	50.7	51.8	51.8
					SSLT	50.7	51.8	51.8

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	6	A325/ F1852	N		65.2	65.2	65.2
				X		67.7	81.6	81.6
				SC Class A	STD	42.7	42.7	42.7
					OVS	36.4	36.4	36.4
					SSLT	36.4	36.4	36.4
				SC Class B	STD	64.9	64.9	64.9
					OVS	55.4	55.4	55.4
					SSLT	55.4	55.4	55.4
			A490	N		67.7	81.6	81.6
				X		67.7	90.3	102.2
				SC Class A	STD	53.7	53.7	53.7
					OVS	45.5	45.5	45.5
					SSLT	45.5	45.5	45.5
				SC Class B	STD	67.7	81.7	81.7
					OVS	67.7	69.2	69.2
					SSLT	67.7	69.2	69.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	6	A325/ F1852	N		82.4	82.4	82.4
				X		85.6	103.2	103.2
				SC Class A	STD	53.9	53.9	53.9
					OVS	46.0	46.0	46.0
					SSLT	46.0	46.0	46.0
				SC Class B	STD	82.0	82.0	82.0
					OVS	70.0	70.0	70.0
					SSLT	70.0	70.0	70.0
			A490	N		85.6	103.2	103.2
				X		85.6	114.1	129.1
				SC Class A	STD	67.9	67.9	67.9
					OVS	57.6	57.6	57.6
					SSLT	57.6	57.6	57.6
				SC Class B	STD	85.6	103.2	103.2
					OVS	85.6	87.5	87.5
					SSLT	85.6	87.5	87.5

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	6	A325/ F1852	N		99.5	99.5	99.5
				X		103.2	124.5	124.5
				SC Class A	STD	65.1	65.1	65.1
					OVS	55.6	55.6	55.6
					SSLT	55.6	55.6	55.6
				SC Class B	STD	98.9	98.9	98.9
					OVS	84.5	84.5	84.5
					SSLT	84.5	84.5	84.5
			A490	N		103.2	124.5	124.5
				X		103.2	137.7	155.8
				SC Class A	STD	82.0	82.0	82.0
					OVS	69.5	69.5	69.5
					SSLT	69.5	69.5	69.5
				SC Class B	STD	103.2	124.6	124.6
					OVS	103.2	105.6	105.6
					SSLT	103.2	105.6	105.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	6	A325/ F1852	N		116.8	116.8	116.8
				X		121.2	146.2	146.2
				SC Class A	STD	76.4	76.4	76.4
					OVS	65.2	65.2	65.2
					SSLT	65.2	65.2	65.2
				SC Class B	STD	116.1	116.1	116.1
					OVS	99.1	99.1	99.1
					SSLT	99.1	99.1	99.1
			A490	N		121.2	146.2	146.2
				X		121.2	161.6	182.9
				SC Class A	STD	96.2	96.2	96.2
					OVS	81.5	81.5	81.5
					SSLT	81.5	81.5	81.5
				SC Class B	STD	121.2	146.3	146.3
					OVS	121.2	123.9	123.9
					SSLT	121.2	123.9	123.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	6	A325/ F1852	N		133.9	133.9	133.9
				X		138.9	167.6	167.6
				SC Class A	STD	87.6	87.6	87.6
					OVS	74.8	74.8	74.8
					SSLT	74.8	74.8	74.8
				SC Class B	STD	133.1	133.1	133.1
					OVS	113.6	113.6	113.6
					SSLT	113.6	113.6	113.6
			A490	N		138.9	167.6	167.6
				X		138.9	185.2	209.7
				SC Class A	STD	110.3	110.3	110.3
					OVS	93.5	93.5	93.5
					SSLT	93.5	93.5	93.5
				SC Class B	STD	138.9	167.7	167.7
					OVS	138.9	142.1	142.1
					SSLT	138.9	142.1	142.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	6	A325/ F1852	N		151.0	151.0	151.0
				X		156.7	189.0	189.0
				SC Class A	STD	98.7	98.7	98.7
					OVS	84.3	84.3	84.3
					SSLT	84.3	84.3	84.3
				SC Class B	STD	150.1	150.1	150.1
					OVS	128.2	128.2	128.2
					SSLT	128.2	128.2	128.2
			A490	N		156.7	189.0	189.0
				X		156.7	208.9	236.4
				SC Class A	STD	124.4	124.4	124.4
					OVS	105.4	105.4	105.4
					SSLT	105.4	105.4	105.4
				SC Class B	STD	156.7	189.1	189.1
					OVS	156.7	160.2	160.2
					SSLT	156.7	160.2	160.2

Notes:
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L_{eh} is assumed to be 1.25 in.

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	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	6	A325/ F1852	N		167.3	167.3	167.3
				X		173.7	209.4	209.4
				SC Class A	STD	109.5	109.5	109.5
					OVS	93.5	93.5	93.5
					SSLT	93.5	93.5	93.5
				SC Class B	STD	166.4	166.4	166.4
					OVS	142.1	142.1	142.1
					SSLT	142.1	142.1	142.1
			A490	N		173.7	209.4	209.4
				X		173.7	231.6	262.1
				SC Class A	STD	137.9	137.9	137.9
					OVS	116.8	116.8	116.8
					SSLT	116.8	116.8	116.8
				SC Class B	STD	173.7	209.6	209.6
					OVS	173.7	177.6	177.6
					SSLT	173.7	177.6	177.6

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	7	A325/ F1852	N		8.0	8.0	8.0
				X		8.3	10.0	10.0
				SC Class A	STD	5.2	5.2	5.2
					OVS	4.4	4.4	4.4
					SSLT	4.4	4.4	4.4
				SC Class B	STD	7.9	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
			A490	N		8.3	10.0	10.0
				X		8.3	11.0	12.5
				SC Class A	STD	6.6	6.6	6.6
					OVS	5.6	5.6	5.6
					SSLT	5.6	5.6	5.6
				SC Class B	STD	8.3	10.0	10.0
					OVS	8.3	8.4	8.4
					SSLT	8.3	8.4	8.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	7	A325/ F1852	N		16.1	16.1	16.1
				X		16.7	20.2	20.2
				SC Class A	STD	10.6	10.6	10.6
					OVS	9.0	9.0	9.0
					SSLT	9.0	9.0	9.0
				SC Class B	STD	16.0	16.0	16.0
					OVS	13.7	13.7	13.7
					SSLT	13.7	13.7	13.7
			A490	N		16.7	20.2	20.2
				X		16.7	22.3	25.3
				SC Class A	STD	13.3	13.3	13.3
					OVS	11.3	11.3	11.3
					SSLT	11.3	11.3	11.3
				SC Class B	STD	16.7	20.2	20.2
					OVS	16.7	17.1	17.1
					SSLT	16.7	17.1	17.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	7	A325/ F1852	N		29.0	29.0	29.0
				X		30.1	36.3	36.3
				SC Class A	STD	19.0	19.0	19.0
					OVS	16.2	16.2	16.2
					SSLT	16.2	16.2	16.2
				SC Class B	STD	28.8	28.8	28.8
					OVS	24.6	24.6	24.6
					SSLT	24.6	24.6	24.6
			A490	N		30.1	36.3	36.3
				X		30.1	40.1	45.4
				SC Class A	STD	23.9	23.9	23.9
					OVS	20.2	20.2	20.2
					SSLT	20.2	20.2	20.2
				SC Class B	STD	30.1	36.3	36.3
					OVS	30.1	30.7	30.7
					SSLT	30.1	30.7	30.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	7	A325/ F1852	N		42.7	42.7	42.7
				X		44.3	53.4	53.4
				SC Class A	STD	27.9	27.9	27.9
					OVS	23.8	23.8	23.8
					SSLT	23.8	23.8	23.8
				SC Class B	STD	42.4	42.4	42.4
					OVS	36.2	36.2	36.2
					SSLT	36.2	36.2	36.2
			A490	N		44.3	53.4	53.4
				X		44.3	59.0	66.8
				SC Class A	STD	35.1	35.1	35.1
					OVS	29.8	29.8	29.8
					SSLT	29.8	29.8	29.8
				SC Class B	STD	44.3	53.4	53.4
					OVS	44.3	45.3	45.3
					SSLT	44.3	45.3	45.3

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	7	A325/ F1852	N		58.2	58.2	58.2
				X		60.3	72.8	72.8
				SC Class A	STD	38.0	38.0	38.0
					OVS	32.5	32.5	32.5
					SSLT	32.5	32.5	32.5
				SC Class B	STD	57.8	57.8	57.8
					OVS	49.4	49.4	49.4
					SSLT	49.4	49.4	49.4
			A490	N		60.3	72.8	72.8
				X		60.3	80.5	91.1
				SC Class A	STD	47.9	47.9	47.9
					OVS	40.6	40.6	40.6
					SSLT	40.6	40.6	40.6
				SC Class B	STD	60.3	72.8	72.8
					OVS	60.3	61.7	61.7
					SSLT	60.3	61.7	61.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	7	A325/ F1852	N		74.6	74.6	74.6
				X		77.4	93.3	93.3
				SC Class A	STD	48.8	48.8	48.8
					OVS	41.6	41.6	41.6
					SSLT	41.6	41.6	41.6
				SC Class B	STD	74.1	74.1	74.1
					OVS	63.3	63.3	63.3
					SSLT	63.3	63.3	63.3
			A490	N		77.4	93.3	93.3
				X		77.4	103.2	116.8
				SC Class A	STD	61.4	61.4	61.4
					OVS	52.1	52.1	52.1
					SSLT	52.1	52.1	52.1
				SC Class B	STD	77.4	93.4	93.4
					OVS	77.4	79.1	79.1
					SSLT	77.4	79.1	79.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	7	A325/ F1852	N		91.5	91.5	91.5
				X		95.0	114.5	114.5
				SC Class A	STD	59.9	59.9	59.9
					OVS	51.1	51.1	51.1
					SSLT	51.1	51.1	51.1
				SC Class B	STD	91.0	91.0	91.0
					OVS	77.7	77.7	77.7
					SSLT	77.7	77.7	77.7
			A490	N		95.0	114.5	114.5
				X		95.0	126.6	143.3
				SC Class A	STD	75.4	75.4	75.4
					OVS	63.9	63.9	63.9
					SSLT	63.9	63.9	63.9
				SC Class B	STD	95.0	114.6	114.6
					OVS	95.0	97.1	97.1
					SSLT	95.0	97.1	97.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	7	A325/ F1852	N		108.6	108.6	108.6
				X		112.7	135.9	135.9
				SC Class A	STD	71.0	71.0	71.0
					OVS	60.7	60.7	60.7
					SSLT	60.7	60.7	60.7
				SC Class B	STD	108.0	108.0	108.0
					OVS	92.2	92.2	92.2
					SSLT	92.2	92.2	92.2
			A490	N		112.7	135.9	135.9
				X		112.7	150.3	170.1
				SC Class A	STD	89.5	89.5	89.5
					OVS	75.8	75.8	75.8
					SSLT	75.8	75.8	75.8
				SC Class B	STD	112.7	136.0	136.0
					OVS	112.7	115.2	115.2
					SSLT	112.7	115.2	115.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	7	A325/ F1852	N		125.9	125.9	125.9
				X		130.6	157.6	157.6
				SC Class A	STD	82.3	82.3	82.3
					OVS	70.3	70.3	70.3
					SSLT	70.3	70.3	70.3
				SC Class B	STD	125.2	125.2	125.2
					OVS	106.9	106.9	106.9
					SSLT	106.9	106.9	106.9
			A490	N		130.6	157.6	157.6
				X		130.6	174.2	197.1
				SC Class A	STD	103.7	103.7	103.7
					OVS	87.9	87.9	87.9
					SSLT	87.9	87.9	87.9
				SC Class B	STD	130.6	157.7	157.7
					OVS	130.6	133.6	133.6
					SSLT	130.6	133.6	133.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	7	A325/ F1852	N		144.3	144.3	144.3
				X		149.7	180.5	180.5
				SC Class A	STD	94.4	94.4	94.4
					OVS	80.6	80.6	80.6
					SSLT	80.6	80.6	80.6
				SC Class B	STD	143.4	143.4	143.4
					OVS	122.5	122.5	122.5
					SSLT	122.5	122.5	122.5
			A490	N		149.7	180.5	180.5
				X		149.7	199.6	225.9
				SC Class A	STD	118.8	118.8	118.8
					OVS	100.7	100.7	100.7
					SSLT	100.7	100.7	100.7
				SC Class B	STD	149.7	180.7	180.7
					OVS	149.7	153.1	153.1
					SSLT	149.7	153.1	153.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	7	A325/ F1852	N		160.1	160.1	160.1
				X		166.2	200.4	200.4
				SC Class A	STD	104.7	104.7	104.7
					OVS	89.4	89.4	89.4
					SSLT	89.4	89.4	89.4
				SC Class B	STD	159.2	159.2	159.2
					OVS	135.9	135.9	135.9
					SSLT	135.9	135.9	135.9
			A490	N		166.2	200.4	200.4
				X		166.2	221.5	250.7
				SC Class A	STD	131.9	131.9	131.9
					OVS	111.8	111.8	111.8
					SSLT	111.8	111.8	111.8
				SC Class B	STD	166.2	200.5	200.5
					OVS	166.2	169.9	169.9
					SSLT	166.2	169.9	169.9

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	8	A325/ F1852	N		6.9	6.9	6.9
				X		7.1	8.6	8.6
				SC Class A	STD	4.5	4.5	4.5
					OVS	3.8	3.8	3.8
					SSLT	3.8	3.8	3.8
				SC Class B	STD	6.8	6.8	6.8
					OVS	5.8	5.8	5.8
					SSLT	5.8	5.8	5.8
			A490	N		7.1	8.6	8.6
				X		7.1	9.5	10.8
				SC Class A	STD	5.7	5.7	5.7
					OVS	4.8	4.8	4.8
					SSLT	4.8	4.8	4.8
				SC Class B	STD	7.1	8.6	8.6
					OVS	7.1	7.3	7.3
					SSLT	7.1	7.3	7.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	8	A325/ F1852	N		13.9	13.9	13.9
				X		14.5	17.4	17.4
				SC Class A	STD	9.1	9.1	9.1
					OVS	7.8	7.8	7.8
					SSLT	7.8	7.8	7.8
				SC Class B	STD	13.9	13.9	13.9
					OVS	11.8	11.8	11.8
					SSLT	11.8	11.8	11.8
			A490	N		14.5	17.4	17.4
				X		14.5	19.3	21.8
				SC Class A	STD	11.5	11.5	11.5
					OVS	9.7	9.7	9.7
					SSLT	9.7	9.7	9.7
				SC Class B	STD	14.5	17.4	17.4
					OVS	14.5	14.8	14.8
					SSLT	14.5	14.8	14.8

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	8	A325/ F1852	N		25.2	25.2	25.2
				X		26.1	31.5	31.5
				SC Class A	STD	16.5	16.5	16.5
					OVS	14.1	14.1	14.1
					SSLT	14.1	14.1	14.1
				SC Class B	STD	25.0	25.0	25.0
					OVS	21.4	21.4	21.4
					SSLT	21.4	21.4	21.4
			A490	N		26.1	31.5	31.5
				X		26.1	34.8	39.4
				SC Class A	STD	20.7	20.7	20.7
					OVS	17.6	17.6	17.6
					SSLT	17.6	17.6	17.6
				SC Class B	STD	26.1	31.5	31.5
					OVS	26.1	26.7	26.7
					SSLT	26.1	26.7	26.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	8	A325/ F1852	N		37.9	37.9	37.9
				X		39.3	47.4	47.4
				SC Class A	STD	24.8	24.8	24.8
					OVS	21.2	21.2	21.2
					SSLT	21.2	21.2	21.2
				SC Class B	STD	37.7	37.7	37.7
					OVS	32.2	32.2	32.2
					SSLT	32.2	32.2	32.2
			A490	N		39.3	47.4	47.4
				X		39.3	52.4	59.3
				SC Class A	STD	31.2	31.2	31.2
					OVS	26.4	26.4	26.4
					SSLT	26.4	26.4	26.4
				SC Class B	STD	39.3	47.4	47.4
					OVS	39.3	40.2	40.2
					SSLT	39.3	40.2	40.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	8	A325/ F1852	N		52.4	52.4	52.4
				X		54.4	65.6	65.6
				SC Class A	STD	34.3	34.3	34.3
					OVS	29.3	29.3	29.3
					SSLT	29.3	29.3	29.3
				SC Class B	STD	52.1	52.1	52.1
					OVS	44.5	44.5	44.5
					SSLT	44.5	44.5	44.5
			A490	N		54.4	65.6	65.6
				X		54.4	72.5	82.1
				SC Class A	STD	43.2	43.2	43.2
					OVS	36.6	36.6	36.6
					SSLT	36.6	36.6	36.6
				SC Class B	STD	54.4	65.6	65.6
					OVS	54.4	55.6	55.6
					SSLT	54.4	55.6	55.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	8	A325/ F1852	N		68.0	68.0	68.0
				X		70.5	85.1	85.1
				SC Class A	STD	44.5	44.5	44.5
					OVS	38.0	38.0	38.0
					SSLT	38.0	38.0	38.0
				SC Class B	STD	67.6	67.6	67.6
					OVS	57.7	57.7	57.7
					SSLT	57.7	57.7	57.7
			A490	N		70.5	85.1	85.1
				X		70.5	94.1	106.5
				SC Class A	STD	56.0	56.0	56.0
					OVS	47.5	47.5	47.5
					SSLT	47.5	47.5	47.5
				SC Class B	STD	70.5	85.1	85.1
					OVS	70.5	72.1	72.1
					SSLT	70.5	72.1	72.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	8	A325/ F1852	N		84.4	84.4	84.4
				X		87.6	105.6	105.6
				SC Class A	STD	55.2	55.2	55.2
					OVS	47.1	47.1	47.1
					SSLT	47.1	47.1	47.1
				SC Class B	STD	83.9	83.9	83.9
					OVS	71.7	71.7	71.7
					SSLT	71.7	71.7	71.7
			A490	N		87.6	105.6	105.6
				X		87.6	116.8	132.2
				SC Class A	STD	69.5	69.5	69.5
					OVS	58.9	58.9	58.9
					SSLT	58.9	58.9	58.9
				SC Class B	STD	87.6	105.7	105.7
					OVS	87.6	89.6	89.6
					SSLT	87.6	89.6	89.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	8	A325/ F1852	N		101.2	101.2	101.2
				X		105.0	126.7	126.7
				SC Class A	STD	66.2	66.2	66.2
					OVS	56.5	56.5	56.5
					SSLT	56.5	56.5	56.5
				SC Class B	STD	100.6	100.6	100.6
					OVS	85.9	85.9	85.9
					SSLT	85.9	85.9	85.9
			A490	N		105.0	126.7	126.7
				X		105.0	140.0	158.5
				SC Class A	STD	83.4	83.4	83.4
					OVS	70.7	70.7	70.7
					SSLT	70.7	70.7	70.7
				SC Class B	STD	105.0	126.7	126.7
					OVS	105.0	107.4	107.4
					SSLT	105.0	107.4	107.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	8	A325/ F1852	N		118.4	118.4	118.4
				X		122.9	148.2	148.2
				SC Class A	STD	77.5	77.5	77.5
					OVS	66.1	66.1	66.1
					SSLT	66.1	66.1	66.1
				SC Class B	STD	117.7	117.7	117.7
					OVS	100.5	100.5	100.5
					SSLT	100.5	100.5	100.5
			A490	N		122.9	148.2	148.2
				X		122.9	163.9	185.5
				SC Class A	STD	97.6	97.6	97.6
					OVS	82.7	82.7	82.7
					SSLT	82.7	82.7	82.7
				SC Class B	STD	122.9	148.3	148.3
					OVS	122.9	125.7	125.7
					SSLT	122.9	125.7	125.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	8	A325/ F1852	N		135.6	135.6	135.6
				X		140.7	169.7	169.7
				SC Class A	STD	88.7	88.7	88.7
					OVS	75.7	75.7	75.7
					SSLT	75.7	75.7	75.7
				SC Class B	STD	134.8	134.8	134.8
					OVS	115.1	115.1	115.1
					SSLT	115.1	115.1	115.1
			A490	N		140.7	169.7	169.7
				X		140.7	187.6	212.4
				SC Class A	STD	111.7	111.7	111.7
					OVS	94.7	94.7	94.7
					SSLT	94.7	94.7	94.7
				SC Class B	STD	140.7	169.8	169.8
					OVS	140.7	143.9	143.9
					SSLT	140.7	143.9	143.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	8	A325/ F1852	N		152.8	152.8	152.8
				X		158.6	191.3	191.3
				SC Class A	STD	100.0	100.0	100.0
					OVS	85.4	85.4	85.4
					SSLT	85.4	85.4	85.4
				SC Class B	STD	151.9	151.9	151.9
					OVS	129.7	129.7	129.7
					SSLT	129.7	129.7	129.7
			A490	N		158.6	191.3	191.3
				X		158.6	211.5	239.3
				SC Class A	STD	125.9	125.9	125.9
					OVS	106.7	106.7	106.7
					SSLT	106.7	106.7	106.7
				SC Class B	STD	158.6	191.4	191.4
					OVS	158.6	162.2	162.2
					SSLT	158.6	162.2	162.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	9	A325/ F1852	N		5.2	5.2	5.2
				X		5.4	6.5	6.5
				SC Class A	STD	3.4	3.4	3.4
					OVS	2.9	2.9	2.9
					SSLT	2.9	2.9	2.9
				SC Class B	STD	5.1	5.1	5.1
					OVS	4.4	4.4	4.4
					SSLT	4.4	4.4	4.4
			A490	N		5.4	6.5	6.5
				X		5.4	7.2	8.1
				SC Class A	STD	4.3	4.3	4.3
					OVS	3.6	3.6	3.6
					SSLT	3.6	3.6	3.6
				SC Class B	STD	5.4	6.5	6.5
					OVS	5.4	5.5	5.5
					SSLT	5.4	5.5	5.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	9	A325/ F1852	N		12.0	12.0	12.0
				X		12.5	15.0	15.0
				SC Class A	STD	7.9	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
				SC Class B	STD	11.9	11.9	11.9
					OVS	10.2	10.2	10.2
					SSLT	10.2	10.2	10.2
			A490	N		12.5	15.0	15.0
				X		12.5	16.6	18.8
				SC Class A	STD	9.9	9.9	9.9
					OVS	8.4	8.4	8.4
					SSLT	8.4	8.4	8.4
				SC Class B	STD	12.5	15.0	15.0
					OVS	12.5	12.7	12.7
					SSLT	12.5	12.7	12.7

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	9	A325/ F1852	N		22.0	22.0	22.0
				X		22.8	27.5	27.5
				SC Class A	STD	14.4	14.4	14.4
					OVS	12.3	12.3	12.3
					SSLT	12.3	12.3	12.3
				SC Class B	STD	21.9	21.9	21.9
					OVS	18.7	18.7	18.7
					SSLT	18.7	18.7	18.7
			A490	N		22.8	27.5	27.5
				X		22.8	30.4	34.4
				SC Class A	STD	18.1	18.1	18.1
					OVS	15.3	15.3	15.3
					SSLT	15.3	15.3	15.3
				SC Class B	STD	22.8	27.5	27.5
					OVS	22.8	23.3	23.3
					SSLT	22.8	23.3	23.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	9	A325/ F1852	N		33.4	33.4	33.4
				X		34.7	41.8	41.8
				SC Class A	STD	21.8	21.8	21.8
					OVS	18.6	18.6	18.6
					SSLT	18.6	18.6	18.6
				SC Class B	STD	33.2	33.2	33.2
					OVS	28.3	28.3	28.3
					SSLT	28.3	28.3	28.3
			A490	N		34.7	41.8	41.8
				X		34.7	46.2	52.3
				SC Class A	STD	27.5	27.5	27.5
					OVS	23.3	23.3	23.3
					SSLT	23.3	23.3	23.3
				SC Class B	STD	34.7	41.8	41.8
					OVS	34.7	35.4	35.4
					SSLT	34.7	35.4	35.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	9	A325/ F1852	N		46.6	46.6	46.6
				X		48.3	58.3	58.3
				SC Class A	STD	30.5	30.5	30.5
					OVS	26.0	26.0	26.0
					SSLT	26.0	26.0	26.0
				SC Class B	STD	46.3	46.3	46.3
					OVS	39.5	39.5	39.5
					SSLT	39.5	39.5	39.5
			A490	N		48.3	58.3	58.3
				X		48.3	64.5	73.0
				SC Class A	STD	38.4	38.4	38.4
					OVS	32.5	32.5	32.5
					SSLT	32.5	32.5	32.5
				SC Class B	STD	48.3	58.3	58.3
					OVS	48.3	49.4	49.4
					SSLT	48.3	49.4	49.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	9	A325/ F1852	N		61.1	61.1	61.1
				X		63.4	76.5	76.5
				SC Class A	STD	40.0	40.0	40.0
					OVS	34.1	34.1	34.1
					SSLT	34.1	34.1	34.1
				SC Class B	STD	60.8	60.8	60.8
					OVS	51.9	51.9	51.9
					SSLT	51.9	51.9	51.9
			A490	N		63.4	76.5	76.5
				X		63.4	84.6	95.7
				SC Class A	STD	50.4	50.4	50.4
					OVS	42.7	42.7	42.7
					SSLT	42.7	42.7	42.7
				SC Class B	STD	63.4	76.6	76.6
					OVS	63.4	64.9	64.9
					SSLT	63.4	64.9	64.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	9	A325/ F1852	N		76.8	76.8	76.8
				X		79.7	96.1	96.1
				SC Class A	STD	50.2	50.2	50.2
					OVS	42.9	42.9	42.9
					SSLT	42.9	42.9	42.9
				SC Class B	STD	76.3	76.3	76.3
					OVS	65.2	65.2	65.2
					SSLT	65.2	65.2	65.2
			A490	N		79.7	96.1	96.1
				X		79.7	106.2	120.2
				SC Class A	STD	63.2	63.2	63.2
					OVS	53.6	53.6	53.6
					SSLT	53.6	53.6	53.6
				SC Class B	STD	79.7	96.1	96.1
					OVS	79.7	81.4	81.4
					SSLT	79.7	81.4	81.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	9	A325/ F1852	N		93.0	93.0	93.0
				X		96.5	116.4	116.4
				SC Class A	STD	60.8	60.8	60.8
					OVS	51.9	51.9	51.9
					SSLT	51.9	51.9	51.9
				SC Class B	STD	92.4	92.4	92.4
					OVS	78.9	78.9	78.9
					SSLT	78.9	78.9	78.9
			A490	N		96.5	116.4	116.4
				X		96.5	128.6	145.6
				SC Class A	STD	76.6	76.6	76.6
					OVS	64.9	64.9	64.9
					SSLT	64.9	64.9	64.9
				SC Class B	STD	96.5	116.4	116.4
					OVS	96.5	98.7	98.7
					SSLT	96.5	98.7	98.7

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	9	A325/ F1852	N		109.8	109.8	109.8
				X		113.9	137.4	137.4
				SC Class A	STD	71.8	71.8	71.8
					OVS	61.3	61.3	61.3
					SSLT	61.3	61.3	61.3
				SC Class B	STD	109.2	109.2	109.2
					OVS	93.2	93.2	93.2
					SSLT	93.2	93.2	93.2
			A490	N		113.9	137.4	137.4
				X		113.9	151.9	171.9
				SC Class A	STD	90.5	90.5	90.5
					OVS	76.6	76.6	76.6
					SSLT	76.6	76.6	76.6
				SC Class B	STD	113.9	137.5	137.5
					OVS	113.9	116.5	116.5
					SSLT	113.9	116.5	116.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	9	A325/ F1852	N		126.8	126.8	126.8
				X		131.6	158.8	158.8
				SC Class A	STD	83.0	83.0	83.0
					OVS	70.8	70.8	70.8
					SSLT	70.8	70.8	70.8
				SC Class B	STD	126.1	126.1	126.1
					OVS	107.7	107.7	107.7
					SSLT	107.7	107.7	107.7
			A490	N		131.6	158.8	158.8
				X		131.6	175.5	198.6
				SC Class A	STD	104.5	104.5	104.5
					OVS	88.6	88.6	88.6
					SSLT	88.6	88.6	88.6
				SC Class B	STD	131.6	158.8	158.8
					OVS	131.6	134.6	134.6
					SSLT	131.6	134.6	134.6

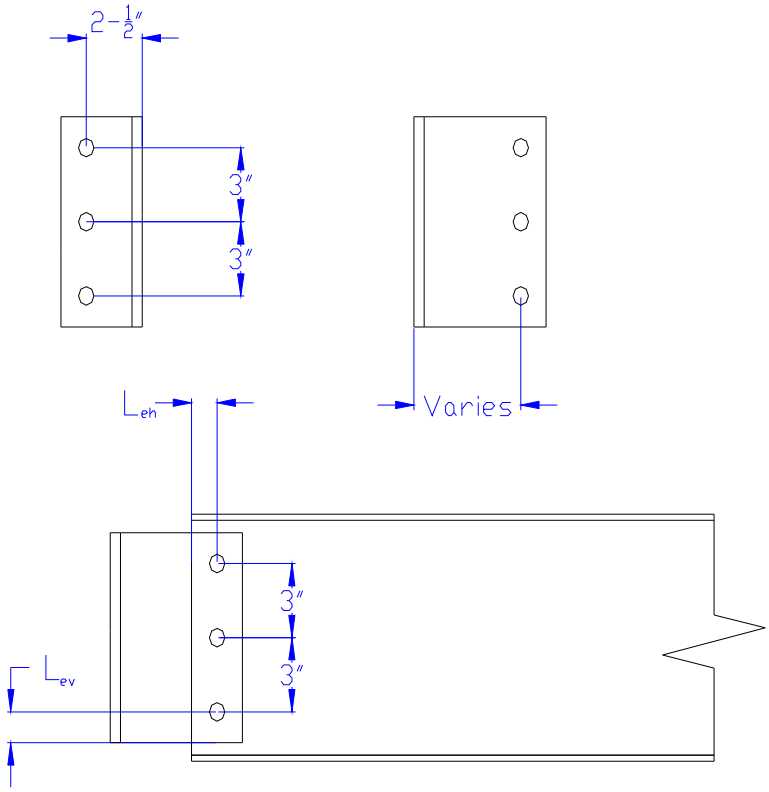
Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	9	A325/ F1852	N		144.0	144.0	144.0
				X		149.4	180.2	180.2
				SC Class A	STD	94.2	94.2	94.2
					OVS	80.4	80.4	80.4
					SSLT	80.4	80.4	80.4
				SC Class B	STD	143.2	143.2	143.2
					OVS	122.3	122.3	122.3
					SSLT	122.3	122.3	122.3
			A490	N		149.4	180.2	180.2
				X		149.4	199.3	225.5
				SC Class A	STD	118.7	118.7	118.7
					OVS	100.5	100.5	100.5
					SSLT	100.5	100.5	100.5
				SC Class B	STD	149.4	180.4	180.4
					OVS	149.4	152.8	152.8
					SSLT	149.4	152.8	152.8

APPENDIX H
7/8-INCH DIAMETER ALL-BOLTED A36 STEEL SINGLE ANGLE CONNECTIONS

The tables given in Appendix H are all-bolted single angle connections. The angles are A36 angles using either A325/F1852 or A490 7/8-inch diameter bolts.



Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	6	A325/ F1852	N		8.3	11.1	13.8
				X		8.3	11.1	13.8
				SC Class A	STD	7.9	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
				SC Class B	STD	8.3	11.1	12.0
					OVS	7.6	10.2	10.2
					SSLT	8.3	10.2	10.2
			A490	N		8.3	11.1	13.8
				X		8.3	11.1	13.8
				SC Class A	STD	8.3	9.9	9.9
					OVS	7.6	8.4	8.4
					SSLT	8.3	8.4	8.4
				SC Class B	STD	8.3	11.1	13.8
					OVS	7.6	10.2	12.7
					SSLT	8.3	11.1	12.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	6	A325/ F1852	N		18.6	24.7	30.9
				X		18.6	24.7	30.9
				SC Class A	STD	17.6	17.6	17.6
					OVS	15.0	15.0	15.0
					SSLT	15.0	15.0	15.0
				SC Class B	STD	18.6	24.7	26.7
					OVS	17.1	22.7	22.9
					SSLT	18.6	22.9	22.9
			A490	N		18.6	24.7	30.9
				X		18.6	24.7	30.9
				SC Class A	STD	18.6	22.2	22.2
					OVS	17.1	18.8	18.8
					SSLT	18.6	18.8	18.8
				SC Class B	STD	18.6	24.7	30.9
					OVS	17.1	22.7	28.4
					SSLT	18.6	24.7	28.6

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	6	A325/ F1852	N		32.1	42.8	53.5
				X		32.1	42.8	53.5
				SC Class A	STD	30.4	30.4	30.4
					OVS	26.0	26.0	26.0
					SSLT	26.0	26.0	26.0
				SC Class B	STD	32.1	42.8	46.2
					OVS	29.5	39.3	39.5
					SSLT	32.1	39.5	39.5
			A490	N		32.1	42.8	53.5
				X		32.1	42.8	53.5
				SC Class A	STD	32.1	38.4	38.4
					OVS	29.5	32.5	32.5
					SSLT	32.1	32.5	32.5
				SC Class B	STD	32.1	42.8	53.5
					OVS	29.5	39.3	49.2
					SSLT	32.1	42.8	49.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	6	A325/ F1852	N		47.0	62.6	78.3
				X		47.0	62.6	78.3
				SC Class A	STD	44.5	44.5	44.5
					OVS	38.1	38.1	38.1
					SSLT	38.1	38.1	38.1
				SC Class B	STD	47.0	62.6	67.7
					OVS	43.2	57.6	57.9
					SSLT	47.0	57.9	57.9
			A490	N		47.0	62.6	78.3
				X		47.0	62.6	78.3
				SC Class A	STD	47.0	56.2	56.2
					OVS	43.2	47.6	47.6
					SSLT	47.0	47.6	47.6
				SC Class B	STD	47.0	62.6	78.3
					OVS	43.2	57.6	72.0
					SSLT	47.0	62.6	72.3

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	6	A325/ F1852	N		62.8	83.7	104.6
				X		62.8	83.7	104.6
				SC Class A	STD	59.5	59.5	59.5
					OVS	50.9	50.9	50.9
					SSLT	50.9	50.9	50.9
				SC Class B	STD	62.8	83.7	90.4
					OVS	57.7	76.9	77.3
					SSLT	62.8	77.3	77.3
			A490	N		62.8	83.7	104.6
				X		62.8	83.7	104.6
				SC Class A	STD	62.8	75.1	75.1
					OVS	57.7	63.6	63.6
					SSLT	62.8	63.6	63.6
				SC Class B	STD	62.8	83.7	104.6
					OVS	57.7	76.9	96.2
					SSLT	62.8	83.7	96.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	6	A325/ F1852	N		79.3	105.8	132.2
				X		79.3	105.8	132.2
				SC Class A	STD	75.2	75.2	75.2
					OVS	64.3	64.3	64.3
					SSLT	64.3	64.3	64.3
				SC Class B	STD	79.3	105.8	114.3
					OVS	72.9	97.2	97.7
					SSLT	79.3	97.7	97.7
			A490	N		79.3	105.8	132.2
				X		79.3	105.8	132.2
				SC Class A	STD	79.3	94.9	94.9
					OVS	72.9	80.4	80.4
					SSLT	79.3	80.4	80.4
				SC Class B	STD	79.3	105.8	132.2
					OVS	72.9	97.2	121.5
					SSLT	79.3	105.8	122.2

Notes:
Angles are assumed to be A36 Steel
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	6	A325/ F1852	N		95.7	127.7	159.6
				X		95.7	127.7	159.6
				SC Class A	STD	90.7	90.7	90.7
					OVS	77.6	77.6	77.6
					SSLT	77.6	77.6	77.6
				SC Class B	STD	95.7	127.7	137.9
					OVS	88.0	117.3	117.9
					SSLT	95.7	117.9	117.9
			A490	N		95.7	127.7	159.6
				X		95.7	127.7	159.6
				SC Class A	STD	95.7	114.5	114.5
					OVS	88.0	97.0	97.0
					SSLT	95.7	97.0	97.0
				SC Class B	STD	95.7	127.7	159.6
					OVS	88.0	117.3	146.7
					SSLT	95.7	127.7	147.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	6	A325/ F1852	N		112.4	149.8	187.3
				X		112.4	149.8	187.3
				SC Class A	STD	106.5	106.5	106.5
					OVS	91.1	91.1	91.1
					SSLT	91.1	91.1	91.1
				SC Class B	STD	112.4	149.8	161.9
					OVS	103.3	137.7	138.4
					SSLT	112.4	138.4	138.4
			A490	N		112.4	149.8	187.3
				X		112.4	149.8	187.3
				SC Class A	STD	112.4	134.4	134.4
					OVS	103.3	113.8	113.8
					SSLT	112.4	113.8	113.8
				SC Class B	STD	112.4	149.8	187.3
					OVS	103.3	137.7	172.1
					SSLT	112.4	149.8	173.0

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	6	A325/ F1852	N		128.8	171.8	214.7
				X		128.8	171.8	214.7
				SC Class A	STD	122.1	122.1	122.1
					OVS	104.4	104.4	104.4
					SSLT	104.4	104.4	104.4
				SC Class B	STD	128.8	171.8	185.6
					OVS	118.4	157.9	158.7
					SSLT	128.8	158.7	158.7
			A490	N		128.8	171.8	214.7
				X		128.8	171.8	214.7
				SC Class A	STD	128.8	154.1	154.1
					OVS	118.4	130.5	130.5
					SSLT	128.8	130.5	130.5
				SC Class B	STD	128.8	171.8	214.7
					OVS	118.4	157.9	197.3
					SSLT	128.8	171.8	198.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	6	A325/ F1852	N		145.3	193.7	242.1
				X		145.3	193.7	242.1
				SC Class A	STD	137.7	137.7	137.7
					OVS	117.7	117.7	117.7
					SSLT	117.7	117.7	117.7
				SC Class B	STD	145.3	193.7	209.3
					OVS	133.5	178.0	179.0
					SSLT	145.3	179.0	179.0
			A490	N		145.3	193.7	242.1
				X		145.3	193.7	242.1
				SC Class A	STD	145.3	173.8	173.8
					OVS	133.5	147.2	147.2
					SSLT	145.3	147.2	147.2
				SC Class B	STD	145.3	193.7	242.1
					OVS	133.5	178.0	222.5
					SSLT	145.3	193.7	223.7

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	6	A325/ F1852	N		161.0	214.7	268.4
				X		161.0	214.7	268.4
				SC Class A	STD	152.6	152.6	152.6
					OVS	130.5	130.5	130.5
					SSLT	130.5	130.5	130.5
				SC Class B	STD	161.0	214.7	232.0
					OVS	148.0	197.3	198.4
					SSLT	161.0	198.4	198.4
			A490	N		161.0	214.7	268.4
				X		161.0	214.7	268.4
				SC Class A	STD	161.0	192.6	192.6
					OVS	148.0	163.1	163.1
					SSLT	161.0	163.1	163.1
				SC Class B	STD	161.0	214.7	268.4
					OVS	148.0	197.3	246.7
					SSLT	161.0	214.7	248.0

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	7	A325/ F1852	N		7.7	10.2	12.8
				X		7.7	10.2	12.8
				SC Class A	STD	7.3	7.3	7.3
					OVS	6.2	6.2	6.2
					SSLT	6.2	6.2	6.2
				SC Class B	STD	7.7	10.2	11.0
					OVS	7.0	9.4	9.4
					SSLT	7.7	9.4	9.4
			A490	N		7.7	10.2	12.8
				X		7.7	10.2	12.8
				SC Class A	STD	7.7	9.2	9.2
					OVS	7.0	7.8	7.8
					SSLT	7.7	7.8	7.8
				SC Class B	STD	7.7	10.2	12.8
					OVS	7.0	9.4	11.7
					SSLT	7.7	10.2	11.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	7	A325/ F1852	N		15.5	20.7	25.9
				X		15.5	20.7	25.9
				SC Class A	STD	14.7	14.7	14.7
					OVS	12.6	12.6	12.6
					SSLT	12.6	12.6	12.6
				SC Class B	STD	15.5	20.7	22.4
					OVS	14.3	19.0	19.1
					SSLT	15.5	19.1	19.1
			A490	N		15.5	20.7	25.9
				X		15.5	20.7	25.9
				SC Class A	STD	15.5	18.6	18.6
					OVS	14.3	15.7	15.7
					SSLT	15.5	15.7	15.7
				SC Class B	STD	15.5	20.7	25.9
					OVS	14.3	19.0	23.8
					SSLT	15.5	20.7	23.9

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	7	A325/ F1852	N		27.9	37.2	46.5
				X		27.9	37.2	46.5
				SC Class A	STD	26.4	26.4	26.4
					OVS	22.6	22.6	22.6
					SSLT	22.6	22.6	22.6
				SC Class B	STD	27.9	37.2	40.2
					OVS	25.6	34.2	34.4
					SSLT	27.9	34.4	34.4
			A490	N		27.9	37.2	46.5
				X		27.9	37.2	46.5
				SC Class A	STD	27.9	33.4	33.4
					OVS	25.6	28.2	28.2
					SSLT	27.9	28.2	28.2
				SC Class B	STD	27.9	37.2	46.5
					OVS	25.6	34.2	42.7
					SSLT	27.9	37.2	42.9

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	7	A325/ F1852	N		41.0	54.7	68.4
				X		41.0	54.7	68.4
				SC Class A	STD	38.9	38.9	38.9
					OVS	33.3	33.3	33.3
					SSLT	33.3	33.3	33.3
				SC Class B	STD	41.0	54.7	59.1
					OVS	37.7	50.3	50.6
					SSLT	41.0	50.6	50.6
			A490	N		41.0	54.7	68.4
				X		41.0	54.7	68.4
				SC Class A	STD	41.0	49.1	49.1
					OVS	37.7	41.6	41.6
					SSLT	41.0	41.6	41.6
				SC Class B	STD	41.0	54.7	68.4
					OVS	37.7	50.3	62.9
					SSLT	41.0	54.7	63.2

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	7	A325/ F1852	N		56.0	74.6	93.3
				X		56.0	74.6	93.3
				SC Class A	STD	53.0	53.0	53.0
					OVS	45.4	45.4	45.4
					SSLT	45.4	45.4	45.4
				SC Class B	STD	56.0	74.6	80.6
					OVS	51.4	68.6	68.9
					SSLT	56.0	68.9	68.9
			A490	N		56.0	74.6	93.3
				X		56.0	74.6	93.3
				SC Class A	STD	56.0	66.9	66.9
					OVS	51.4	56.7	56.7
					SSLT	56.0	56.7	56.7
				SC Class B	STD	56.0	74.6	93.3
					OVS	51.4	68.6	85.7
					SSLT	56.0	74.6	86.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	7	A325/ F1852	N		71.8	95.7	119.6
				X		71.8	95.7	119.6
				SC Class A	STD	68.0	68.0	68.0
					OVS	58.2	58.2	58.2
					SSLT	58.2	58.2	58.2
				SC Class B	STD	71.8	95.7	103.4
					OVS	66.0	87.9	88.4
					SSLT	71.8	88.4	88.4
			A490	N		71.8	95.7	119.6
				X		71.8	95.7	119.6
				SC Class A	STD	71.8	85.8	85.8
					OVS	66.0	72.7	72.7
					SSLT	71.8	72.7	72.7
				SC Class B	STD	71.8	95.7	119.6
					OVS	66.0	87.9	109.9
					SSLT	71.8	95.7	110.5

Notes:
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	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	7	A325/ F1852	N		88.1	117.4	146.8
				X		88.1	117.4	146.8
				SC Class A	STD	83.4	83.4	83.4
					OVS	71.4	71.4	71.4
					SSLT	71.4	71.4	71.4
				SC Class B	STD	88.1	117.4	126.8
					OVS	80.9	107.9	108.5
					SSLT	88.1	108.5	108.5
			A490	N		88.1	117.4	146.8
				X		88.1	117.4	146.8
				SC Class A	STD	88.1	105.3	105.3
					OVS	80.9	89.2	89.2
					SSLT	88.1	89.2	89.2
				SC Class B	STD	88.1	117.4	146.8
					OVS	80.9	107.9	134.9
					SSLT	88.1	117.4	135.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	7	A325/ F1852	N		104.5	139.3	174.2
				X		104.5	139.3	174.2
				SC Class A	STD	99.0	99.0	99.0
					OVS	84.7	84.7	84.7
					SSLT	84.7	84.7	84.7
				SC Class B	STD	104.5	139.3	150.5
					OVS	96.0	128.1	128.7
					SSLT	104.5	128.7	128.7
			A490	N		104.5	139.3	174.2
				X		104.5	139.3	174.2
				SC Class A	STD	104.5	125.0	125.0
					OVS	96.0	105.9	105.9
					SSLT	104.5	105.9	105.9
				SC Class B	STD	104.5	139.3	174.2
					OVS	96.0	128.1	160.1
					SSLT	104.5	139.3	160.9

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	7	A325/ F1852	N		121.1	161.5	201.9
				X		121.1	161.5	201.9
				SC Class A	STD	114.8	114.8	114.8
					OVS	98.2	98.2	98.2
					SSLT	98.2	98.2	98.2
				SC Class B	STD	121.1	161.5	174.5
					OVS	111.3	148.5	149.2
					SSLT	121.1	149.2	149.2
			A490	N		121.1	161.5	201.9
				X		121.1	161.5	201.9
				SC Class A	STD	121.1	144.9	144.9
					OVS	111.3	122.7	122.7
					SSLT	121.1	122.7	122.7
				SC Class B	STD	121.1	161.5	201.9
					OVS	111.3	148.5	185.6
					SSLT	121.1	161.5	186.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	7	A325/ F1852	N		138.8	185.1	231.3
				X		138.8	185.1	231.3
				SC Class A	STD	131.6	131.6	131.6
					OVS	112.5	112.5	112.5
					SSLT	112.5	112.5	112.5
				SC Class B	STD	138.8	185.1	200.0
					OVS	127.6	170.1	171.0
					SSLT	138.8	171.0	171.0
			A490	N		138.8	185.1	231.3
				X		138.8	185.1	231.3
				SC Class A	STD	138.8	166.0	166.0
					OVS	127.6	140.6	140.6
					SSLT	138.8	140.6	140.6
				SC Class B	STD	138.8	185.1	231.3
					OVS	127.6	170.1	212.6
					SSLT	138.8	185.1	213.7

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	7	A325/ F1852	N		154.1	205.4	256.8
				X		154.1	205.4	256.8
				SC Class A	STD	146.0	146.0	146.0
					OVS	124.9	124.9	124.9
					SSLT	124.9	124.9	124.9
				SC Class B	STD	154.1	205.4	221.9
					OVS	141.6	188.8	189.8
					SSLT	154.1	189.8	189.8
			A490	N		154.1	205.4	256.8
				X		154.1	205.4	256.8
				SC Class A	STD	154.1	184.3	184.3
					OVS	141.6	156.1	156.1
					SSLT	154.1	156.1	156.1
				SC Class B	STD	154.1	205.4	256.8
					OVS	141.6	188.8	236.0
					SSLT	154.1	205.4	237.2

Notes:
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	8	A325/ F1852	N		6.6	8.8	11.0
				X		6.6	8.8	11.0
				SC Class A	STD	6.3	6.3	6.3
					OVS	5.4	5.4	5.4
					SSLT	5.4	5.4	5.4
				SC Class B	STD	6.6	8.8	9.5
					OVS	6.1	8.1	8.2
					SSLT	6.6	8.2	8.2
			A490	N		6.6	8.8	11.0
				X		6.6	8.8	11.0
				SC Class A	STD	6.6	7.9	7.9
					OVS	6.1	6.7	6.7
					SSLT	6.6	6.7	6.7
				SC Class B	STD	6.6	8.8	11.0
					OVS	6.1	8.1	10.2
					SSLT	6.6	8.8	10.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	8	A325/ F1852	N		13.4	17.9	22.3
				X		13.4	17.9	22.3
				SC Class A	STD	12.7	12.7	12.7
					OVS	10.9	10.9	10.9
					SSLT	10.9	10.9	10.9
				SC Class B	STD	13.4	17.9	19.3
					OVS	12.3	16.4	16.5
					SSLT	13.4	16.5	16.5
			A490	N		13.4	17.9	22.3
				X		13.4	17.9	22.3
				SC Class A	STD	13.4	16.0	16.0
					OVS	12.3	13.6	13.6
					SSLT	13.4	13.6	13.6
				SC Class B	STD	13.4	17.9	22.3
					OVS	12.3	16.4	20.5
					SSLT	13.4	17.9	20.6

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	8	A325/ F1852	N		24.2	32.3	40.4
				X		24.2	32.3	40.4
				SC Class A	STD	22.9	22.9	22.9
					OVS	19.6	19.6	19.6
					SSLT	19.6	19.6	19.6
				SC Class B	STD	24.2	32.3	34.9
					OVS	22.3	29.7	29.8
					SSLT	24.2	29.8	29.8
			A490	N		24.2	32.3	40.4
				X		24.2	32.3	40.4
				SC Class A	STD	24.2	29.0	29.0
					OVS	22.3	24.5	24.5
					SSLT	24.2	24.5	24.5
				SC Class B	STD	24.2	32.3	40.4
					OVS	22.3	29.7	37.1
					SSLT	24.2	32.3	37.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	8	A325/ F1852	N		36.4	48.6	60.7
				X		36.4	48.6	60.7
				SC Class A	STD	34.5	34.5	34.5
					OVS	29.5	29.5	29.5
					SSLT	29.5	29.5	29.5
				SC Class B	STD	36.4	48.6	52.5
					OVS	33.5	44.7	44.9
					SSLT	36.4	44.9	44.9
			A490	N		36.4	48.6	60.7
				X		36.4	48.6	60.7
				SC Class A	STD	36.4	43.6	43.6
					OVS	33.5	36.9	36.9
					SSLT	36.4	36.9	36.9
				SC Class B	STD	36.4	48.6	60.7
					OVS	33.5	44.7	55.8
					SSLT	36.4	48.6	56.1

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	8	A325/ F1852	N		50.4	67.2	84.0
				X		50.4	67.2	84.0
				SC Class A	STD	47.8	47.8	47.8
					OVS	40.9	40.9	40.9
					SSLT	40.9	40.9	40.9
				SC Class B	STD	50.4	67.2	72.6
					OVS	46.3	61.8	62.1
					SSLT	50.4	62.1	62.1
			A490	N		50.4	67.2	84.0
				X		50.4	67.2	84.0
				SC Class A	STD	50.4	60.3	60.3
					OVS	46.3	51.1	51.1
					SSLT	50.4	51.1	51.1
				SC Class B	STD	50.4	67.2	84.0
					OVS	46.3	61.8	77.2
					SSLT	50.4	67.2	77.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	8	A325/ F1852	N		65.4	87.2	109.0
				X		65.4	87.2	109.0
				SC Class A	STD	62.0	62.0	62.0
					OVS	53.0	53.0	53.0
					SSLT	53.0	53.0	53.0
				SC Class B	STD	65.4	87.2	94.2
					OVS	60.1	80.2	80.6
					SSLT	65.4	80.6	80.6
			A490	N		65.4	87.2	109.0
				X		65.4	87.2	109.0
				SC Class A	STD	65.4	78.2	78.2
					OVS	60.1	66.3	66.3
					SSLT	65.4	66.3	66.3
				SC Class B	STD	65.4	87.2	109.0
					OVS	60.1	80.2	100.2
					SSLT	65.4	87.2	100.7

Notes:
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	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	8	A325/ F1852	N		81.2	108.3	135.4
				X		81.2	108.3	135.4
				SC Class A	STD	77.0	77.0	77.0
					OVS	65.8	65.8	65.8
					SSLT	65.8	65.8	65.8
				SC Class B	STD	81.2	108.3	117.0
					OVS	74.6	99.5	100.1
					SSLT	81.2	100.1	100.1
			A490	N		81.2	108.3	135.4
				X		81.2	108.3	135.4
				SC Class A	STD	81.2	97.1	97.1
					OVS	74.6	82.3	82.3
					SSLT	81.2	82.3	82.3
				SC Class B	STD	81.2	108.3	135.4
					OVS	74.6	99.5	124.4
					SSLT	81.2	108.3	125.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	8	A325/ F1852	N		97.4	129.8	162.3
				X		97.4	129.8	162.3
				SC Class A	STD	92.3	92.3	92.3
					OVS	78.9	78.9	78.9
					SSLT	78.9	78.9	78.9
				SC Class B	STD	97.4	129.8	140.3
					OVS	89.5	119.3	120.0
					SSLT	97.4	120.0	120.0
			A490	N		97.4	129.8	162.3
				X		97.4	129.8	162.3
				SC Class A	STD	97.4	116.5	116.5
					OVS	89.5	98.7	98.7
					SSLT	97.4	98.7	98.7
				SC Class B	STD	97.4	129.8	162.3
					OVS	89.5	119.3	149.2
					SSLT	97.4	129.8	150.0

Notes:
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	8	A325/ F1852	N		114.0	151.9	189.9
				X		114.0	151.9	189.9
				SC Class A	STD	108.0	108.0	108.0
					OVS	92.4	92.4	92.4
					SSLT	92.4	92.4	92.4
				SC Class B	STD	114.0	151.9	164.2
					OVS	104.7	139.7	140.4
					SSLT	114.0	140.4	140.4
			A490	N		114.0	151.9	189.9
				X		114.0	151.9	189.9
				SC Class A	STD	114.0	136.3	136.3
					OVS	104.7	115.4	115.4
					SSLT	114.0	115.4	115.4
				SC Class B	STD	114.0	151.9	189.9
					OVS	104.7	139.7	174.6
					SSLT	114.0	151.9	175.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	8	A325/ F1852	N		130.5	174.0	217.5
				X		130.5	174.0	217.5
				SC Class A	STD	123.7	123.7	123.7
					OVS	105.8	105.8	105.8
					SSLT	105.8	105.8	105.8
				SC Class B	STD	130.5	174.0	188.0
					OVS	119.9	159.9	160.7
					SSLT	130.5	160.7	160.7
			A490	N		130.5	174.0	217.5
				X		130.5	174.0	217.5
				SC Class A	STD	130.5	156.1	156.1
					OVS	119.9	132.2	132.2
					SSLT	130.5	132.2	132.2
				SC Class B	STD	130.5	174.0	217.5
					OVS	119.9	159.9	199.9
					SSLT	130.5	174.0	200.9

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	8	A325/ F1852	N		147.1	196.1	245.1
				X		147.1	196.1	245.1
				SC Class A	STD	139.4	139.4	139.4
					OVS	119.2	119.2	119.2
					SSLT	119.2	119.2	119.2
				SC Class B	STD	147.1	196.1	211.8
					OVS	135.2	180.2	181.2
					SSLT	147.1	181.2	181.2
			A490	N		147.1	196.1	245.1
				X		147.1	196.1	245.1
				SC Class A	STD	147.1	175.9	175.9
					OVS	135.2	149.0	149.0
					SSLT	147.1	149.0	149.0
				SC Class B	STD	147.1	196.1	245.1
					OVS	135.2	180.2	225.3
					SSLT	147.1	196.1	226.4

Notes:
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	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	9	A325/ F1852	N		5.0	6.6	8.3
				X		5.0	6.6	8.3
				SC Class A	STD	4.7	4.7	4.7
					OVS	4.0	4.0	4.0
					SSLT	4.0	4.0	4.0
				SC Class B	STD	5.0	6.6	7.2
					OVS	4.6	6.1	6.1
					SSLT	5.0	6.1	6.1
			A490	N		5.0	6.6	8.3
				X		5.0	6.6	8.3
				SC Class A	STD	5.0	5.9	5.9
					OVS	4.6	5.0	5.0
					SSLT	5.0	5.0	5.0
				SC Class B	STD	5.0	6.6	8.3
					OVS	4.6	6.1	7.6
					SSLT	5.0	6.6	7.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	9	A325/ F1852	N		11.6	15.4	19.3
				X		11.6	15.4	19.3
				SC Class A	STD	10.9	10.9	10.9
					OVS	9.4	9.4	9.4
					SSLT	9.4	9.4	9.4
				SC Class B	STD	11.6	15.4	16.6
					OVS	10.6	14.2	14.2
					SSLT	11.6	14.2	14.2
			A490	N		11.6	15.4	19.3
				X		11.6	15.4	19.3
				SC Class A	STD	11.6	13.8	13.8
					OVS	10.6	11.7	11.7
					SSLT	11.6	11.7	11.7
				SC Class B	STD	11.6	15.4	19.3
					OVS	10.6	14.2	17.7
					SSLT	11.6	15.4	17.8

Notes:
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	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	9	A325/ F1852	N		21.2	28.2	35.3
				X		21.2	28.2	35.3
				SC Class A	STD	20.0	20.0	20.0
					OVS	17.1	17.1	17.1
					SSLT	17.1	17.1	17.1
				SC Class B	STD	21.2	28.2	30.5
					OVS	19.4	25.9	26.1
					SSLT	21.2	26.1	26.1
			A490	N		21.2	28.2	35.3
				X		21.2	28.2	35.3
				SC Class A	STD	21.2	25.3	25.3
					OVS	19.4	21.4	21.4
					SSLT	21.2	21.4	21.4
				SC Class B	STD	21.2	28.2	35.3
					OVS	19.4	25.9	32.4
					SSLT	21.2	28.2	32.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	9	A325/ F1852	N		32.1	42.8	53.6
				X		32.1	42.8	53.6
				SC Class A	STD	30.5	30.5	30.5
					OVS	26.0	26.0	26.0
					SSLT	26.0	26.0	26.0
				SC Class B	STD	32.1	42.8	46.3
					OVS	29.5	39.4	39.6
					SSLT	32.1	39.6	39.6
			A490	N		32.1	42.8	53.6
				X		32.1	42.8	53.6
				SC Class A	STD	32.1	38.4	38.4
					OVS	29.5	32.6	32.6
					SSLT	32.1	32.6	32.6
				SC Class B	STD	32.1	42.8	53.6
					OVS	29.5	39.4	49.2
					SSLT	32.1	42.8	49.5

Notes:
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	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	9	A325/ F1852	N		44.8	59.8	74.7
				X		44.8	59.8	74.7
				SC Class A	STD	42.5	42.5	42.5
					OVS	36.3	36.3	36.3
					SSLT	36.3	36.3	36.3
				SC Class B	STD	44.8	59.8	64.6
					OVS	41.2	54.9	55.2
					SSLT	44.8	55.2	55.2
			A490	N		44.8	59.8	74.7
				X		44.8	59.8	74.7
				SC Class A	STD	44.8	53.6	53.6
					OVS	41.2	45.4	45.4
					SSLT	44.8	45.4	45.4
				SC Class B	STD	44.8	59.8	74.7
					OVS	41.2	54.9	68.7
					SSLT	44.8	59.8	69.0

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	9	A325/ F1852	N		58.8	78.4	98.0
				X		58.8	78.4	98.0
				SC Class A	STD	55.8	55.8	55.8
					OVS	47.7	47.7	47.7
					SSLT	47.7	47.7	47.7
				SC Class B	STD	58.8	78.4	84.7
					OVS	54.1	72.1	72.5
					SSLT	58.8	72.5	72.5
			A490	N		58.8	78.4	98.0
				X		58.8	78.4	98.0
				SC Class A	STD	58.8	70.4	70.4
					OVS	54.1	59.6	59.6
					SSLT	58.8	59.6	59.6
				SC Class B	STD	58.8	78.4	98.0
					OVS	54.1	72.1	90.1
					SSLT	58.8	78.4	90.6

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	9	A325/ F1852	N		73.9	98.5	123.1
				X		73.9	98.5	123.1
				SC Class A	STD	70.0	70.0	70.0
					OVS	59.9	59.9	59.9
					SSLT	59.9	59.9	59.9
				SC Class B	STD	73.9	98.5	106.4
					OVS	67.9	90.5	91.0
					SSLT	73.9	91.0	91.0
			A490	N		73.9	98.5	123.1
				X		73.9	98.5	123.1
				SC Class A	STD	73.9	88.3	88.3
					OVS	67.9	74.8	74.8
					SSLT	73.9	74.8	74.8
				SC Class B	STD	73.9	98.5	123.1
					OVS	67.9	90.5	113.1
					SSLT	73.9	98.5	113.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	9	A325/ F1852	N		89.5	119.3	149.1
				X		89.5	119.3	149.1
				SC Class A	STD	84.8	84.8	84.8
					OVS	72.5	72.5	72.5
					SSLT	72.5	72.5	72.5
				SC Class B	STD	89.5	119.3	128.9
					OVS	82.2	109.6	110.2
					SSLT	89.5	110.2	110.2
			A490	N		89.5	119.3	149.1
				X		89.5	119.3	149.1
				SC Class A	STD	89.5	107.0	107.0
					OVS	82.2	90.6	90.6
					SSLT	89.5	90.6	90.6
				SC Class B	STD	89.5	119.3	149.1
					OVS	82.2	109.6	137.1
					SSLT	89.5	119.3	137.8

Notes:
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	9	A325/ F1852	N		105.6	140.9	176.1
				X		105.6	140.9	176.1
				SC Class A	STD	100.1	100.1	100.1
					OVS	85.6	85.6	85.6
					SSLT	85.6	85.6	85.6
				SC Class B	STD	105.6	140.9	152.2
					OVS	97.1	129.5	130.1
					SSLT	105.6	130.1	130.1
			A490	N		105.6	140.9	176.1
				X		105.6	140.9	176.1
				SC Class A	STD	105.6	126.4	126.4
					OVS	97.1	107.0	107.0
					SSLT	105.6	107.0	107.0
				SC Class B	STD	105.6	140.9	176.1
					OVS	97.1	129.5	161.8
					SSLT	105.6	140.9	162.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	9	A325/ F1852	N		122.1	162.7	203.4
				X		122.1	162.7	203.4
				SC Class A	STD	115.7	115.7	115.7
					OVS	98.9	98.9	98.9
					SSLT	98.9	98.9	98.9
				SC Class B	STD	122.1	162.7	175.8
					OVS	112.2	149.6	150.4
					SSLT	122.1	150.4	150.4
			A490	N		122.1	162.7	203.4
				X		122.1	162.7	203.4
				SC Class A	STD	122.1	146.0	146.0
					OVS	112.2	123.7	123.7
					SSLT	122.1	123.7	123.7
				SC Class B	STD	122.1	162.7	203.4
					OVS	112.2	149.6	187.0
					SSLT	122.1	162.7	187.9

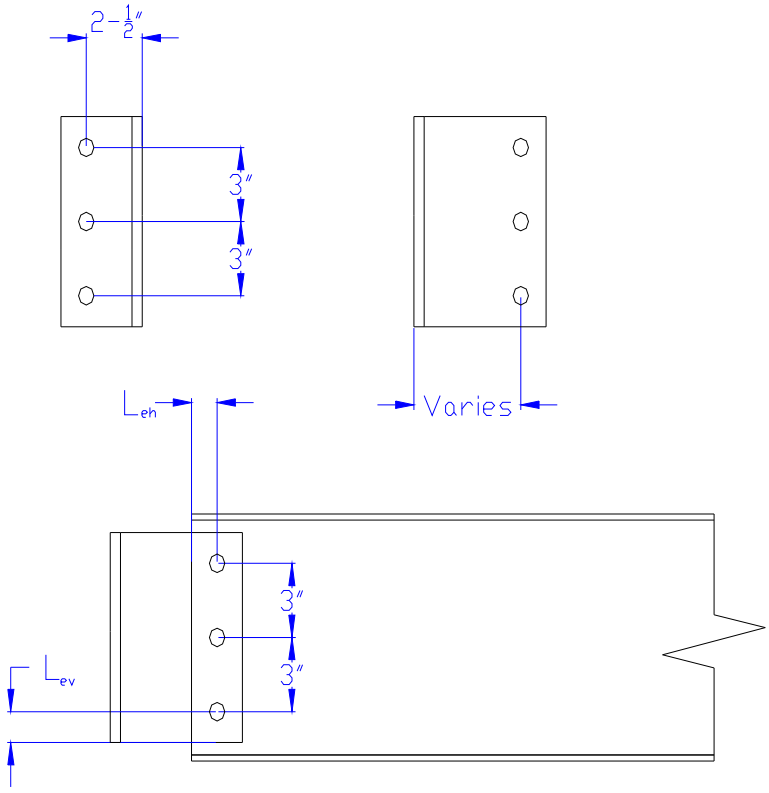
Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	9	A325/ F1852	N		138.6	184.8	231.0
				X		138.6	184.8	231.0
				SC Class A	STD	131.3	131.3	131.3
					OVS	112.3	112.3	112.3
					SSLT	112.3	112.3	112.3
				SC Class B	STD	138.6	184.8	199.6
					OVS	127.4	169.8	170.7
					SSLT	138.6	170.7	170.7
			A490	N		138.6	184.8	231.0
				X		138.6	184.8	231.0
				SC Class A	STD	138.6	165.8	165.8
					OVS	127.4	140.4	140.4
					SSLT	138.6	140.4	140.4
				SC Class B	STD	138.6	184.8	231.0
					OVS	127.4	169.8	212.3
					SSLT	138.6	184.8	213.4

APPENDIX I
1-INCH DIAMETER ALL-BOLTED A36 STEEL SINGLE ANGLE CONNECTIONS

The tables given in Appendix A are all-bolted single angle connections. The angles are A36 angles using either A325/F1852 or A490 1-inch diameter bolts.



Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	6	A325/ F1852	N		7.6	10.2	12.7
				X		7.6	10.2	12.7
				SC Class A	STD	7.6	10.2	10.3
					OVS	6.6	8.8	8.8
					SSLT	7.6	8.8	8.8
				SC Class B	STD	7.6	10.2	12.7
					OVS	6.6	8.8	11.1
					SSLT	7.6	10.2	12.7
			A490	N		7.6	10.2	12.7
				X		7.6	10.2	12.7
				SC Class A	STD	7.6	10.2	12.7
					OVS	6.6	8.8	11.0
					SSLT	7.6	10.2	11.0
				SC Class B	STD	7.6	10.2	12.7
					OVS	6.6	8.8	11.1
					SSLT	7.6	10.2	12.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	6	A325/ F1852	N		17.1	22.7	28.4
				X		17.1	22.7	28.4
				SC Class A	STD	17.1	22.7	23.0
					OVS	14.8	19.6	19.6
					SSLT	17.1	19.6	19.6
				SC Class B	STD	17.1	22.7	28.4
					OVS	14.8	19.8	24.7
					SSLT	17.1	22.7	28.4
			A490	N		17.1	22.7	28.4
				X		17.1	22.7	28.4
				SC Class A	STD	17.1	22.7	28.4
					OVS	14.8	19.8	24.6
					SSLT	17.1	22.7	24.6
				SC Class B	STD	17.1	22.7	28.4
					OVS	14.8	19.8	24.7
					SSLT	17.1	22.7	28.4

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	6	A325/ F1852	N		29.5	39.3	49.2
				X		29.5	39.3	49.2
				SC Class A	STD	29.5	39.3	39.9
					OVS	25.6	34.0	34.0
					SSLT	29.5	34.0	34.0
				SC Class B	STD	29.5	39.3	49.2
					OVS	25.6	34.2	42.7
					SSLT	29.5	39.3	49.2
			A490	N		29.5	39.3	49.2
				X		29.5	39.3	49.2
				SC Class A	STD	29.5	39.3	49.2
					OVS	25.6	34.2	42.6
					SSLT	29.5	39.3	42.6
				SC Class B	STD	29.5	39.3	49.2
					OVS	25.6	34.2	42.7
					SSLT	29.5	39.3	49.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	6	A325/ F1852	N		43.2	57.6	72.0
				X		43.2	57.6	72.0
				SC Class A	STD	43.2	57.6	58.3
					OVS	37.5	49.7	49.7
					SSLT	43.2	49.7	49.7
				SC Class B	STD	43.2	57.6	72.0
					OVS	37.5	50.0	62.6
					SSLT	43.2	57.6	72.0
			A490	N		43.2	57.6	72.0
				X		43.2	57.6	72.0
				SC Class A	STD	43.2	57.6	72.0
					OVS	37.5	50.0	62.3
					SSLT	43.2	57.6	62.3
				SC Class B	STD	43.2	57.6	72.0
					OVS	37.5	50.0	62.6
					SSLT	43.2	57.6	72.0

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	6	A325/ F1852	N		57.7	76.9	96.2
				X		57.7	76.9	96.2
				SC Class A	STD	57.7	76.9	77.9
					OVS	50.2	66.5	66.5
					SSLT	57.7	66.5	66.5
				SC Class B	STD	57.7	76.9	96.2
					OVS	50.2	66.9	83.6
					SSLT	57.7	76.9	96.2
			A490	N		57.7	76.9	96.2
				X		57.7	76.9	96.2
				SC Class A	STD	57.7	76.9	96.2
					OVS	50.2	66.9	83.3
					SSLT	57.7	76.9	83.3
				SC Class B	STD	57.7	76.9	96.2
					OVS	50.2	66.9	83.6
					SSLT	57.7	76.9	96.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	6	A325/ F1852	N		72.9	97.2	121.5
				X		72.9	97.2	121.5
				SC Class A	STD	72.9	97.2	98.5
					OVS	63.4	84.0	84.0
					SSLT	72.9	84.0	84.0
				SC Class B	STD	72.9	97.2	121.5
					OVS	63.4	84.5	105.6
					SSLT	72.9	97.2	121.5
			A490	N		72.9	97.2	121.5
				X		72.9	97.2	121.5
				SC Class A	STD	72.9	97.2	121.5
					OVS	63.4	84.5	105.3
					SSLT	72.9	97.2	105.3
				SC Class B	STD	72.9	97.2	121.5
					OVS	63.4	84.5	105.6
					SSLT	72.9	97.2	121.5

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	6	A325/ F1852	N		88.0	117.3	146.7
				X		88.0	117.3	146.7
				SC Class A	STD	88.0	117.3	118.9
					OVS	76.5	101.4	101.4
					SSLT	88.0	101.4	101.4
				SC Class B	STD	88.0	117.3	146.7
					OVS	76.5	102.0	127.5
					SSLT	88.0	117.3	146.7
			A490	N		88.0	117.3	146.7
				X		88.0	117.3	146.7
				SC Class A	STD	88.0	117.3	146.7
					OVS	76.5	102.0	127.0
					SSLT	88.0	117.3	127.0
				SC Class B	STD	88.0	117.3	146.7
					OVS	76.5	102.0	127.5
					SSLT	88.0	117.3	146.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	6	A325/ F1852	N		103.3	137.7	172.1
				X		103.3	137.7	172.1
				SC Class A	STD	103.3	137.7	139.6
					OVS	89.8	119.0	119.0
					SSLT	103.3	119.0	119.0
				SC Class B	STD	103.3	137.7	172.1
					OVS	89.8	119.7	149.7
					SSLT	103.3	137.7	172.1
			A490	N		103.3	137.7	172.1
				X		103.3	137.7	172.1
				SC Class A	STD	103.3	137.7	172.1
					OVS	89.8	119.7	149.1
					SSLT	103.3	137.7	149.1
				SC Class B	STD	103.3	137.7	172.1
					OVS	89.8	119.7	149.7
					SSLT	103.3	137.7	172.1

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	6	A325/ F1852	N		118.4	157.9	197.3
				X		118.4	157.9	197.3
				SC Class A	STD	118.4	157.9	160.0
					OVS	102.9	136.4	136.4
					SSLT	118.4	136.4	136.4
				SC Class B	STD	118.4	157.9	197.3
					OVS	102.9	137.2	171.6
					SSLT	118.4	157.9	197.3
			A490	N		118.4	157.9	197.3
				X		118.4	157.9	197.3
				SC Class A	STD	118.4	157.9	197.3
					OVS	102.9	137.2	170.9
					SSLT	118.4	157.9	170.9
				SC Class B	STD	118.4	157.9	197.3
					OVS	102.9	137.2	171.6
					SSLT	118.4	157.9	197.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	6	A325/ F1852	N		133.5	178.0	222.5
				X		133.5	178.0	222.5
				SC Class A	STD	133.5	178.0	180.4
					OVS	116.1	153.8	153.8
					SSLT	133.5	153.8	153.8
				SC Class B	STD	133.5	178.0	222.5
					OVS	116.1	154.8	193.5
					SSLT	133.5	178.0	222.5
			A490	N		133.5	178.0	222.5
				X		133.5	178.0	222.5
				SC Class A	STD	133.5	178.0	222.5
					OVS	116.1	154.8	192.7
					SSLT	133.5	178.0	192.7
				SC Class B	STD	133.5	178.0	222.5
					OVS	116.1	154.8	193.5
					SSLT	133.5	178.0	222.5

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	6	A325/ F1852	N		148.0	197.3	246.7
				X		148.0	197.3	246.7
				SC Class A	STD	148.0	197.3	200.0
					OVS	128.7	170.5	170.5
					SSLT	148.0	170.5	170.5
				SC Class B	STD	148.0	197.3	246.7
					OVS	128.7	171.6	214.4
					SSLT	148.0	197.3	246.7
			A490	N		148.0	197.3	246.7
				X		148.0	197.3	246.7
				SC Class A	STD	148.0	197.3	246.7
					OVS	128.7	171.6	213.7
					SSLT	148.0	197.3	213.7
				SC Class B	STD	148.0	197.3	246.7
					OVS	128.7	171.6	214.4
					SSLT	148.0	197.3	246.7

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	7	A325/ F1852	N		7.0	9.4	11.7
				X		7.0	9.4	11.7
				SC Class A	STD	7.0	9.4	9.5
					OVS	6.1	8.1	8.1
					SSLT	7.0	8.1	8.1
				SC Class B	STD	7.0	9.4	11.7
					OVS	6.1	8.2	10.2
					SSLT	7.0	9.4	11.7
			A490	N		7.0	9.4	11.7
				X		7.0	9.4	11.7
				SC Class A	STD	7.0	9.4	11.7
					OVS	6.1	8.2	10.2
					SSLT	7.0	9.4	10.2
				SC Class B	STD	7.0	9.4	11.7
					OVS	6.1	8.2	10.2
					SSLT	7.0	9.4	11.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	7	A325/ F1852	N		14.3	19.0	23.8
				X		14.3	19.0	23.8
				SC Class A	STD	14.3	19.0	19.3
					OVS	12.4	16.4	16.4
					SSLT	14.3	16.4	16.4
				SC Class B	STD	14.3	19.0	23.8
					OVS	12.4	16.5	20.7
					SSLT	14.3	19.0	23.8
			A490	N		14.3	19.0	23.8
				X		14.3	19.0	23.8
				SC Class A	STD	14.3	19.0	23.8
					OVS	12.4	16.5	20.6
					SSLT	14.3	19.0	20.6
				SC Class B	STD	14.3	19.0	23.8
					OVS	12.4	16.5	20.7
					SSLT	14.3	19.0	23.8

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	7	A325/ F1852	N		25.6	34.2	42.7
				X		25.6	34.2	42.7
				SC Class A	STD	25.6	34.2	34.6
					OVS	22.3	29.5	29.5
					SSLT	25.6	29.5	29.5
				SC Class B	STD	25.6	34.2	42.7
					OVS	22.3	29.7	37.1
					SSLT	25.6	34.2	42.7
			A490	N		25.6	34.2	42.7
				X		25.6	34.2	42.7
				SC Class A	STD	25.6	34.2	42.7
					OVS	22.3	29.7	37.0
					SSLT	25.6	34.2	37.0
				SC Class B	STD	25.6	34.2	42.7
					OVS	22.3	29.7	37.1
					SSLT	25.6	34.2	42.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	7	A325/ F1852	N		37.7	50.3	62.9
				X		37.7	50.3	62.9
				SC Class A	STD	37.7	50.3	51.0
					OVS	32.8	43.5	43.5
					SSLT	37.7	43.5	43.5
				SC Class B	STD	37.7	50.3	62.9
					OVS	32.8	43.7	54.7
					SSLT	37.7	50.3	62.9
			A490	N		37.7	50.3	62.9
				X		37.7	50.3	62.9
				SC Class A	STD	37.7	50.3	62.9
					OVS	32.8	43.7	54.5
					SSLT	37.7	50.3	54.5
				SC Class B	STD	37.7	50.3	62.9
					OVS	32.8	43.7	54.7
					SSLT	37.7	50.3	62.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	7	A325/ F1852	N		51.4	68.6	85.7
				X		51.4	68.6	85.7
				SC Class A	STD	51.4	68.6	69.5
					OVS	44.7	59.3	59.3
					SSLT	51.4	59.3	59.3
				SC Class B	STD	51.4	68.6	85.7
					OVS	44.7	59.6	74.5
					SSLT	51.4	68.6	85.7
			A490	N		51.4	68.6	85.7
				X		51.4	68.6	85.7
				SC Class A	STD	51.4	68.6	85.7
					OVS	44.7	59.6	74.2
					SSLT	51.4	68.6	74.2
				SC Class B	STD	51.4	68.6	85.7
					OVS	44.7	59.6	74.5
					SSLT	51.4	68.6	85.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	7	A325/ F1852	N		66.0	87.9	109.9
				X		66.0	87.9	109.9
				SC Class A	STD	66.0	87.9	89.1
					OVS	57.3	76.0	76.0
					SSLT	66.0	76.0	76.0
				SC Class B	STD	66.0	87.9	109.9
					OVS	57.3	76.4	95.6
					SSLT	66.0	87.9	109.9
			A490	N		66.0	87.9	109.9
				X		66.0	87.9	109.9
				SC Class A	STD	66.0	87.9	109.9
					OVS	57.3	76.4	95.2
					SSLT	66.0	87.9	95.2
				SC Class B	STD	66.0	87.9	109.9
					OVS	57.3	76.4	95.6
					SSLT	66.0	87.9	109.9

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	7	A325/ F1852	N		80.9	107.9	134.9
				X		80.9	107.9	134.9
				SC Class A	STD	80.9	107.9	109.3
					OVS	70.4	93.2	93.2
					SSLT	80.9	93.2	93.2
				SC Class B	STD	80.9	107.9	134.9
					OVS	70.4	93.8	117.3
					SSLT	80.9	107.9	134.9
			A490	N		80.9	107.9	134.9
				X		80.9	107.9	134.9
				SC Class A	STD	80.9	107.9	134.9
					OVS	70.4	93.8	116.8
					SSLT	80.9	107.9	116.8
				SC Class B	STD	80.9	107.9	134.9
					OVS	70.4	93.8	117.3
					SSLT	80.9	107.9	134.9

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	7	A325/ F1852	N		96.0	128.1	160.1
				X		96.0	128.1	160.1
				SC Class A	STD	96.0	128.1	129.8
					OVS	83.5	110.6	110.6
					SSLT	96.0	110.6	110.6
				SC Class B	STD	96.0	128.1	160.1
					OVS	83.5	111.3	139.2
					SSLT	96.0	128.1	160.1
			A490	N		96.0	128.1	160.1
				X		96.0	128.1	160.1
				SC Class A	STD	96.0	128.1	160.1
					OVS	83.5	111.3	138.6
					SSLT	96.0	128.1	138.6
				SC Class B	STD	96.0	128.1	160.1
					OVS	83.5	111.3	139.2
					SSLT	96.0	128.1	160.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	7	A325/ F1852	N		111.3	148.5	185.6
				X		111.3	148.5	185.6
				SC Class A	STD	111.3	148.5	150.4
					OVS	96.8	128.3	128.3
					SSLT	111.3	128.3	128.3
				SC Class B	STD	111.3	148.5	185.6
					OVS	96.8	129.1	161.3
					SSLT	111.3	148.5	185.6
			A490	N		111.3	148.5	185.6
				X		111.3	148.5	185.6
				SC Class A	STD	111.3	148.5	185.6
					OVS	96.8	129.1	160.7
					SSLT	111.3	148.5	160.7
				SC Class B	STD	111.3	148.5	185.6
					OVS	96.8	129.1	161.3
					SSLT	111.3	148.5	185.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	7	A325/ F1852	N		127.6	170.1	212.6
				X		127.6	170.1	212.6
				SC Class A	STD	127.6	170.1	172.4
					OVS	110.9	147.0	147.0
					SSLT	127.6	147.0	147.0
				SC Class B	STD	127.6	170.1	212.6
					OVS	110.9	147.9	184.9
					SSLT	127.6	170.1	212.6
			A490	N		127.6	170.1	212.6
				X		127.6	170.1	212.6
				SC Class A	STD	127.6	170.1	212.6
					OVS	110.9	147.9	184.2
					SSLT	127.6	170.1	184.2
				SC Class B	STD	127.6	170.1	212.6
					OVS	110.9	147.9	184.9
					SSLT	127.6	170.1	212.6

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	7	A325/ F1852	N		141.6	188.8	236.0
				X		141.6	188.8	236.0
				SC Class A	STD	141.6	188.8	191.3
					OVS	123.1	163.1	163.1
					SSLT	141.6	163.1	163.1
				SC Class B	STD	141.6	188.8	236.0
					OVS	123.1	164.1	205.2
					SSLT	141.6	188.8	236.0
			A490	N		141.6	188.8	236.0
				X		141.6	188.8	236.0
				SC Class A	STD	141.6	188.8	236.0
					OVS	123.1	164.1	204.4
					SSLT	141.6	188.8	204.4
				SC Class B	STD	141.6	188.8	236.0
					OVS	123.1	164.1	205.2
					SSLT	141.6	188.8	236.0

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	8	A325/ F1852	N		6.1	8.1	10.2
				X		6.1	8.1	10.2
				SC Class A	STD	6.1	8.1	8.2
					OVS	5.3	7.0	7.0
					SSLT	6.1	7.0	7.0
				SC Class B	STD	6.1	8.1	10.2
					OVS	5.3	7.1	8.8
					SSLT	6.1	8.1	10.2
			A490	N		6.1	8.1	10.2
				X		6.1	8.1	10.2
				SC Class A	STD	6.1	8.1	10.2
					OVS	5.3	7.1	8.8
					SSLT	6.1	8.1	8.8
				SC Class B	STD	6.1	8.1	10.2
					OVS	5.3	7.1	8.8
					SSLT	6.1	8.1	10.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	8	A325/ F1852	N		12.3	16.4	20.5
				X		12.3	16.4	20.5
				SC Class A	STD	12.3	16.4	16.6
					OVS	10.7	14.2	14.2
					SSLT	12.3	14.2	14.2
				SC Class B	STD	12.3	16.4	20.5
					OVS	10.7	14.3	17.9
					SSLT	12.3	16.4	20.5
			A490	N		12.3	16.4	20.5
				X		12.3	16.4	20.5
				SC Class A	STD	12.3	16.4	20.5
					OVS	10.7	14.3	17.8
					SSLT	12.3	16.4	17.8
				SC Class B	STD	12.3	16.4	20.5
					OVS	10.7	14.3	17.9
					SSLT	12.3	16.4	20.5

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	8	A325/ F1852	N		22.3	29.7	37.1
				X		22.3	29.7	37.1
				SC Class A	STD	22.3	29.7	30.1
					OVS	19.3	25.6	25.6
					SSLT	22.3	25.6	25.6
				SC Class B	STD	22.3	29.7	37.1
					OVS	19.3	25.8	32.2
					SSLT	22.3	29.7	37.1
			A490	N		22.3	29.7	37.1
				X		22.3	29.7	37.1
				SC Class A	STD	22.3	29.7	37.1
					OVS	19.3	25.8	32.1
					SSLT	22.3	29.7	32.1
				SC Class B	STD	22.3	29.7	37.1
					OVS	19.3	25.8	32.2
					SSLT	22.3	29.7	37.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	8	A325/ F1852	N		33.5	44.7	55.8
				X		33.5	44.7	55.8
				SC Class A	STD	33.5	44.7	45.3
					OVS	29.1	38.6	38.6
					SSLT	33.5	38.6	38.6
				SC Class B	STD	33.5	44.7	55.8
					OVS	29.1	38.8	48.5
					SSLT	33.5	44.7	55.8
			A490	N		33.5	44.7	55.8
				X		33.5	44.7	55.8
				SC Class A	STD	33.5	44.7	55.8
					OVS	29.1	38.8	48.4
					SSLT	33.5	44.7	48.4
				SC Class B	STD	33.5	44.7	55.8
					OVS	29.1	38.8	48.5
					SSLT	33.5	44.7	55.8

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	8	A325/ F1852	N		46.3	61.8	77.2
				X		46.3	61.8	77.2
				SC Class A	STD	46.3	61.8	62.6
					OVS	40.3	53.4	53.4
					SSLT	46.3	53.4	53.4
				SC Class B	STD	46.3	61.8	77.2
					OVS	40.3	53.7	67.1
					SSLT	46.3	61.8	77.2
			A490	N		46.3	61.8	77.2
				X		46.3	61.8	77.2
				SC Class A	STD	46.3	61.8	77.2
					OVS	40.3	53.7	66.9
					SSLT	46.3	61.8	66.9
				SC Class B	STD	46.3	61.8	77.2
					OVS	40.3	53.7	67.1
					SSLT	46.3	61.8	77.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	8	A325/ F1852	N		60.1	80.2	100.2
				X		60.1	80.2	100.2
				SC Class A	STD	60.1	80.2	81.2
					OVS	52.3	69.3	69.3
					SSLT	60.1	69.3	69.3
				SC Class B	STD	60.1	80.2	100.2
					OVS	52.3	69.7	87.1
					SSLT	60.1	80.2	100.2
			A490	N		60.1	80.2	100.2
				X		60.1	80.2	100.2
				SC Class A	STD	60.1	80.2	100.2
					OVS	52.3	69.7	86.8
					SSLT	60.1	80.2	86.8
				SC Class B	STD	60.1	80.2	100.2
					OVS	52.3	69.7	87.1
					SSLT	60.1	80.2	100.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	8	A325/ F1852	N		74.6	99.5	124.4
				X		74.6	99.5	124.4
				SC Class A	STD	74.6	99.5	100.9
					OVS	64.9	86.0	86.0
					SSLT	74.6	86.0	86.0
				SC Class B	STD	74.6	99.5	124.4
					OVS	64.9	86.5	108.2
					SSLT	74.6	99.5	124.4
			A490	N		74.6	99.5	124.4
				X		74.6	99.5	124.4
				SC Class A	STD	74.6	99.5	124.4
					OVS	64.9	86.5	107.8
					SSLT	74.6	99.5	107.8
				SC Class B	STD	74.6	99.5	124.4
					OVS	64.9	86.5	108.2
					SSLT	74.6	99.5	124.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	8	A325/ F1852	N		89.5	119.3	149.2
				X		89.5	119.3	149.2
				SC Class A	STD	89.5	119.3	120.9
					OVS	77.8	103.1	103.1
					SSLT	89.5	103.1	103.1
				SC Class B	STD	89.5	119.3	149.2
					OVS	77.8	103.7	129.7
					SSLT	89.5	119.3	149.2
			A490	N		89.5	119.3	149.2
				X		89.5	119.3	149.2
				SC Class A	STD	89.5	119.3	149.2
					OVS	77.8	103.7	129.2
					SSLT	89.5	119.3	129.2
				SC Class B	STD	89.5	119.3	149.2
					OVS	77.8	103.7	129.7
					SSLT	89.5	119.3	149.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	8	A325/ F1852	N		104.7	139.7	174.6
				X		104.7	139.7	174.6
				SC Class A	STD	104.7	139.7	141.5
					OVS	91.1	120.7	120.7
					SSLT	104.7	120.7	120.7
				SC Class B	STD	104.7	139.7	174.6
					OVS	91.1	121.4	151.8
					SSLT	104.7	139.7	174.6
			A490	N		104.7	139.7	174.6
				X		104.7	139.7	174.6
				SC Class A	STD	104.7	139.7	174.6
					OVS	91.1	121.4	151.2
					SSLT	104.7	139.7	151.2
				SC Class B	STD	104.7	139.7	174.6
					OVS	91.1	121.4	151.8
					SSLT	104.7	139.7	174.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	8	A325/ F1852	N		119.9	159.9	199.9
				X		119.9	159.9	199.9
				SC Class A	STD	119.9	159.9	162.0
					OVS	104.3	138.2	138.2
					SSLT	119.9	138.2	138.2
				SC Class B	STD	119.9	159.9	199.9
					OVS	104.3	139.0	173.8
					SSLT	119.9	159.9	199.9
			A490	N		119.9	159.9	199.9
				X		119.9	159.9	199.9
				SC Class A	STD	119.9	159.9	199.9
					OVS	104.3	139.0	173.1
					SSLT	119.9	159.9	173.1
				SC Class B	STD	119.9	159.9	199.9
					OVS	104.3	139.0	173.8
					SSLT	119.9	159.9	199.9

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	8	A325/ F1852	N		135.2	180.2	225.3
				X		135.2	180.2	225.3
				SC Class A	STD	135.2	180.2	182.6
					OVS	117.5	155.7	155.7
					SSLT	135.2	155.7	155.7
				SC Class B	STD	135.2	180.2	225.3
					OVS	117.5	156.7	195.8
					SSLT	135.2	180.2	225.3
			A490	N		135.2	180.2	225.3
				X		135.2	180.2	225.3
				SC Class A	STD	135.2	180.2	225.3
					OVS	117.5	156.7	195.1
					SSLT	135.2	180.2	195.1
				SC Class B	STD	135.2	180.2	225.3
					OVS	117.5	156.7	195.8
					SSLT	135.2	180.2	225.3

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	9	A325/ F1852	N		4.6	6.1	7.6
				X		4.6	6.1	7.6
				SC Class A	STD	4.6	6.1	6.2
					OVS	4.0	5.3	5.3
					SSLT	4.6	5.3	5.3
				SC Class B	STD	4.6	6.1	7.6
					OVS	4.0	5.3	6.6
					SSLT	4.6	6.1	7.6
			A490	N		4.6	6.1	7.6
				X		4.6	6.1	7.6
				SC Class A	STD	4.6	6.1	7.6
					OVS	4.0	5.3	6.6
					SSLT	4.6	6.1	6.6
				SC Class B	STD	4.6	6.1	7.6
					OVS	4.0	5.3	6.6
					SSLT	4.6	6.1	7.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	9	A325/ F1852	N		10.6	14.2	17.7
				X		10.6	14.2	17.7
				SC Class A	STD	10.6	14.2	14.3
					OVS	9.2	12.2	12.2
					SSLT	10.6	12.2	12.2
				SC Class B	STD	10.6	14.2	17.7
					OVS	9.2	12.3	15.4
					SSLT	10.6	14.2	17.7
			A490	N		10.6	14.2	17.7
				X		10.6	14.2	17.7
				SC Class A	STD	10.6	14.2	17.7
					OVS	9.2	12.3	15.3
					SSLT	10.6	14.2	15.3
				SC Class B	STD	10.6	14.2	17.7
					OVS	9.2	12.3	15.4
					SSLT	10.6	14.2	17.7

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	9	A325/ F1852	N		19.4	25.9	32.4
				X		19.4	25.9	32.4
				SC Class A	STD	19.4	25.9	26.3
					OVS	16.9	22.4	22.4
					SSLT	19.4	22.4	22.4
				SC Class B	STD	19.4	25.9	32.4
					OVS	16.9	22.5	28.2
					SSLT	19.4	25.9	32.4
			A490	N		19.4	25.9	32.4
				X		19.4	25.9	32.4
				SC Class A	STD	19.4	25.9	32.4
					OVS	16.9	22.5	28.1
					SSLT	19.4	25.9	28.1
				SC Class B	STD	19.4	25.9	32.4
					OVS	16.9	22.5	28.2
					SSLT	19.4	25.9	32.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	9	A325/ F1852	N		29.5	39.4	49.2
				X		29.5	39.4	49.2
				SC Class A	STD	29.5	39.4	39.9
					OVS	25.7	34.0	34.0
					SSLT	29.5	34.0	34.0
				SC Class B	STD	29.5	39.4	49.2
					OVS	25.7	34.2	42.8
					SSLT	29.5	39.4	49.2
			A490	N		29.5	39.4	49.2
				X		29.5	39.4	49.2
				SC Class A	STD	29.5	39.4	49.2
					OVS	25.7	34.2	42.6
					SSLT	29.5	39.4	42.6
				SC Class B	STD	29.5	39.4	49.2
					OVS	25.7	34.2	42.8
					SSLT	29.5	39.4	49.2

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	9	A325/ F1852	N		41.2	54.9	68.7
				X		41.2	54.9	68.7
				SC Class A	STD	41.2	54.9	55.7
					OVS	35.8	47.5	47.5
					SSLT	41.2	47.5	47.5
				SC Class B	STD	41.2	54.9	68.7
					OVS	35.8	47.8	59.7
					SSLT	41.2	54.9	68.7
			A490	N		41.2	54.9	68.7
				X		41.2	54.9	68.7
				SC Class A	STD	41.2	54.9	68.7
					OVS	35.8	47.8	59.5
					SSLT	41.2	54.9	59.5
				SC Class B	STD	41.2	54.9	68.7
					OVS	35.8	47.8	59.7
					SSLT	41.2	54.9	68.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	9	A325/ F1852	N		54.1	72.1	90.1
				X		54.1	72.1	90.1
				SC Class A	STD	54.1	72.1	73.1
					OVS	47.0	62.3	62.3
					SSLT	54.1	62.3	62.3
				SC Class B	STD	54.1	72.1	90.1
					OVS	47.0	62.7	78.3
					SSLT	54.1	72.1	90.1
			A490	N		54.1	72.1	90.1
				X		54.1	72.1	90.1
				SC Class A	STD	54.1	72.1	90.1
					OVS	47.0	62.7	78.1
					SSLT	54.1	72.1	78.1
				SC Class B	STD	54.1	72.1	90.1
					OVS	47.0	62.7	78.3
					SSLT	54.1	72.1	90.1

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	9	A325/ F1852	N		67.9	90.5	113.1
				X		67.9	90.5	113.1
				SC Class A	STD	67.9	90.5	91.7
					OVS	59.0	78.2	78.2
					SSLT	67.9	78.2	78.2
				SC Class B	STD	67.9	90.5	113.1
					OVS	59.0	78.7	98.4
					SSLT	67.9	90.5	113.1
			A490	N		67.9	90.5	113.1
				X		67.9	90.5	113.1
				SC Class A	STD	67.9	90.5	113.1
					OVS	59.0	78.7	98.0
					SSLT	67.9	90.5	98.0
				SC Class B	STD	67.9	90.5	113.1
					OVS	59.0	78.7	98.4
					SSLT	67.9	90.5	113.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	9	A325/ F1852	N		82.2	109.6	137.1
				X		82.2	109.6	137.1
				SC Class A	STD	82.2	109.6	111.1
					OVS	71.5	94.7	94.7
					SSLT	82.2	94.7	94.7
				SC Class B	STD	82.2	109.6	137.1
					OVS	71.5	95.3	119.1
					SSLT	82.2	109.6	137.1
			A490	N		82.2	109.6	137.1
				X		82.2	109.6	137.1
				SC Class A	STD	82.2	109.6	137.1
					OVS	71.5	95.3	118.7
					SSLT	82.2	109.6	118.7
				SC Class B	STD	82.2	109.6	137.1
					OVS	71.5	95.3	119.1
					SSLT	82.2	109.6	137.1

Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	9	A325/ F1852	N		97.1	129.5	161.8
				X		97.1	129.5	161.8
				SC Class A	STD	97.1	129.5	131.2
					OVS	84.4	111.9	111.9
					SSLT	97.1	111.9	111.9
				SC Class B	STD	97.1	129.5	161.8
					OVS	84.4	112.6	140.7
					SSLT	97.1	129.5	161.8
			A490	N		97.1	129.5	161.8
				X		97.1	129.5	161.8
				SC Class A	STD	97.1	129.5	161.8
					OVS	84.4	112.6	140.2
					SSLT	97.1	129.5	140.2
				SC Class B	STD	97.1	129.5	161.8
					OVS	84.4	112.6	140.7
					SSLT	97.1	129.5	161.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	9	A325/ F1852	N		112.2	149.6	187.0
				X		112.2	149.6	187.0
				SC Class A	STD	112.2	149.6	151.6
					OVS	97.5	129.2	129.2
					SSLT	112.2	129.2	129.2
				SC Class B	STD	112.2	149.6	187.0
					OVS	97.5	130.0	162.5
					SSLT	112.2	149.6	187.0
			A490	N		112.2	149.6	187.0
				X		112.2	149.6	187.0
				SC Class A	STD	112.2	149.6	187.0
					OVS	97.5	130.0	161.9
					SSLT	112.2	149.6	161.9
				SC Class B	STD	112.2	149.6	187.0
					OVS	97.5	130.0	162.5
					SSLT	112.2	149.6	187.0

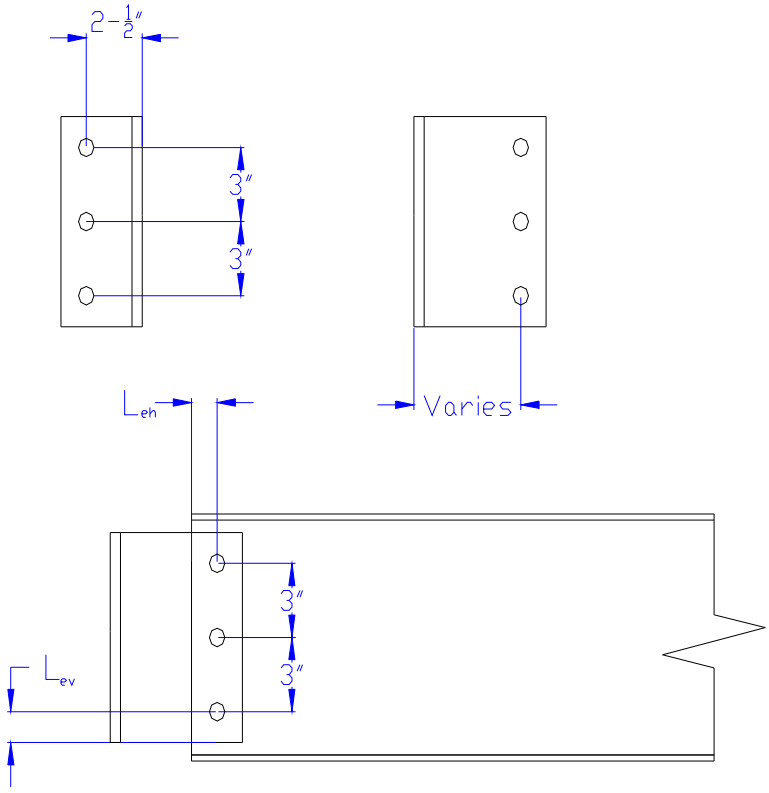
Notes:
Angles are assumed to be A36 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	9	A325/ F1852	N		127.4	169.8	212.3
				X		127.4	169.8	212.3
				SC Class A	STD	127.4	169.8	172.1
					OVS	110.7	146.7	146.7
					SSLT	127.4	146.7	146.7
				SC Class B	STD	127.4	169.8	212.3
					OVS	110.7	147.6	184.5
					SSLT	127.4	169.8	212.3
			A490	N		127.4	169.8	212.3
				X		127.4	169.8	212.3
				SC Class A	STD	127.4	169.8	212.3
					OVS	110.7	147.6	183.9
					SSLT	127.4	169.8	183.9
				SC Class B	STD	127.4	169.8	212.3
					OVS	110.7	147.6	184.5
					SSLT	127.4	169.8	212.3

APPENDIX J
3/4-INCH DIAMETER ALL-BOLTED A992 STEEL SINGLE ANGLE CONNECTIONS

The tables given in Appendix J are all-bolted single angle connections. The angles are A992 angles using either A325/F1852 or A490 3/4-inch diameter bolts.



Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	6	A325/ F1852	N		8.6	8.6	8.6
				X		10.0	10.8	10.8
				SC Class A	STD	5.6	5.6	5.6
					OVS	4.8	4.8	4.8
					SSLT	4.8	4.8	4.8
				SC Class B	STD	8.6	8.6	8.6
					OVS	7.3	7.3	7.3
					SSLT	7.3	7.3	7.3
			A490	N		10.0	10.8	10.8
				X		10.0	13.4	13.5
				SC Class A	STD	7.1	7.1	7.1
					OVS	6.0	6.0	6.0
					SSLT	6.0	6.0	6.0
				SC Class B	STD	10.0	10.8	10.8
					OVS	9.2	9.2	9.2
					SSLT	9.2	9.2	9.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	6	A325/ F1852	N		19.3	19.3	19.3
				X		22.5	24.1	24.1
				SC Class A	STD	12.6	12.6	12.6
					OVS	10.8	10.8	10.8
					SSLT	10.8	10.8	10.8
				SC Class B	STD	19.2	19.2	19.2
					OVS	16.4	16.4	16.4
					SSLT	16.4	16.4	16.4
			A490	N		22.5	24.1	24.1
				X		22.5	29.9	30.2
				SC Class A	STD	15.9	15.9	15.9
					OVS	13.5	13.5	13.5
					SSLT	13.5	13.5	13.5
				SC Class B	STD	22.5	24.1	24.1
					OVS	20.5	20.5	20.5
					SSLT	20.5	20.5	20.5

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	6	A325/ F1852	N		33.4	33.4	33.4
				X		38.9	41.7	41.7
				SC Class A	STD	21.8	21.8	21.8
					OVS	18.6	18.6	18.6
					SSLT	18.6	18.6	18.6
				SC Class B	STD	33.2	33.2	33.2
					OVS	28.3	28.3	28.3
					SSLT	28.3	28.3	28.3
			A490	N		38.9	41.7	41.7
				X		38.9	51.8	52.2
				SC Class A	STD	27.5	27.5	27.5
					OVS	23.3	23.3	23.3
					SSLT	23.3	23.3	23.3
				SC Class B	STD	38.9	41.8	41.8
					OVS	35.4	35.4	35.4
					SSLT	35.4	35.4	35.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	6	A325/ F1852	N		48.8	48.8	48.8
				X		56.9	61.1	61.1
				SC Class A	STD	31.9	31.9	31.9
					OVS	27.3	27.3	27.3
					SSLT	27.3	27.3	27.3
				SC Class B	STD	48.5	48.5	48.5
					OVS	41.4	41.4	41.4
					SSLT	41.4	41.4	41.4
			A490	N		56.9	61.1	61.1
				X		56.9	75.8	76.4
				SC Class A	STD	40.2	40.2	40.2
					OVS	34.1	34.1	34.1
					SSLT	34.1	34.1	34.1
				SC Class B	STD	56.9	61.1	61.1
					OVS	51.8	51.8	51.8
					SSLT	51.8	51.8	51.8

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

Represents a bolt bearing limit state
Represents a bolt shear limit state
Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	6	A325/ F1852	N		65.2	65.2	65.2
				X		76.0	81.6	81.6
				SC Class A	STD	42.7	42.7	42.7
					OVS	36.4	36.4	36.4
					SSLT	36.4	36.4	36.4
				SC Class B	STD	64.9	64.9	64.9
					OVS	55.4	55.4	55.4
					SSLT	55.4	55.4	55.4
			A490	N		76.0	81.6	81.6
				X		76.0	101.3	102.2
				SC Class A	STD	53.7	53.7	53.7
					OVS	45.5	45.5	45.5
					SSLT	45.5	45.5	45.5
				SC Class B	STD	76.0	81.7	81.7
					OVS	69.2	69.2	69.2
					SSLT	69.2	69.2	69.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	6	A325/ F1852	N		82.4	82.4	82.4
				X		96.1	103.2	103.2
				SC Class A	STD	53.9	53.9	53.9
					OVS	46.0	46.0	46.0
					SSLT	46.0	46.0	46.0
				SC Class B	STD	82.0	82.0	82.0
					OVS	70.0	70.0	70.0
					SSLT	70.0	70.0	70.0
			A490	N		96.1	103.2	103.2
				X		96.1	128.1	129.1
				SC Class A	STD	67.9	67.9	67.9
					OVS	57.6	57.6	57.6
					SSLT	57.6	57.6	57.6
				SC Class B	STD	96.1	103.2	103.2
					OVS	87.5	87.5	87.5
					SSLT	87.5	87.5	87.5

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	6	A325/ F1852	N		99.5	99.5	99.5
				X		115.9	124.5	124.5
				SC Class A	STD	65.1	65.1	65.1
					OVS	55.6	55.6	55.6
					SSLT	55.6	55.6	55.6
				SC Class B	STD	98.9	98.9	98.9
					OVS	84.5	84.5	84.5
					SSLT	84.5	84.5	84.5
			A490	N		115.9	124.5	124.5
				X		115.9	154.6	155.8
				SC Class A	STD	82.0	82.0	82.0
					OVS	69.5	69.5	69.5
					SSLT	69.5	69.5	69.5
				SC Class B	STD	115.9	124.6	124.6
					OVS	105.6	105.6	105.6
					SSLT	105.6	105.6	105.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	6	A325/ F1852	N		116.8	116.8	116.8
				X		136.1	146.2	146.2
				SC Class A	STD	76.4	76.4	76.4
					OVS	65.2	65.2	65.2
					SSLT	65.2	65.2	65.2
				SC Class B	STD	116.1	116.1	116.1
					OVS	99.1	99.1	99.1
					SSLT	99.1	99.1	99.1
			A490	N		136.1	146.2	146.2
				X		136.1	181.4	182.9
				SC Class A	STD	96.2	96.2	96.2
					OVS	81.5	81.5	81.5
					SSLT	81.5	81.5	81.5
				SC Class B	STD	136.1	146.3	146.3
					OVS	123.9	123.9	123.9
					SSLT	123.9	123.9	123.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	6	A325/ F1852	N		133.9	133.9	133.9
				X		156.0	167.6	167.6
				SC Class A	STD	87.6	87.6	87.6
					OVS	74.8	74.8	74.8
					SSLT	74.8	74.8	74.8
				SC Class B	STD	133.1	133.1	133.1
					OVS	113.6	113.6	113.6
					SSLT	113.6	113.6	113.6
			A490	N		156.0	167.6	167.6
				X		156.0	208.0	209.7
				SC Class A	STD	110.3	110.3	110.3
					OVS	93.5	93.5	93.5
					SSLT	93.5	93.5	93.5
				SC Class B	STD	156.0	167.7	167.7
					OVS	142.1	142.1	142.1
					SSLT	142.1	142.1	142.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	6	A325/ F1852	N		151.0	151.0	151.0
				X		175.9	189.0	189.0
				SC Class A	STD	98.7	98.7	98.7
					OVS	84.3	84.3	84.3
					SSLT	84.3	84.3	84.3
				SC Class B	STD	150.1	150.1	150.1
					OVS	128.2	128.2	128.2
					SSLT	128.2	128.2	128.2
			A490	N		175.9	189.0	189.0
				X		175.9	234.5	236.4
				SC Class A	STD	124.4	124.4	124.4
					OVS	105.4	105.4	105.4
					SSLT	105.4	105.4	105.4
				SC Class B	STD	175.9	189.1	189.1
					OVS	160.2	160.2	160.2
					SSLT	160.2	160.2	160.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Condition	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	6	A325/ F1852	N		167.3	167.3	167.3
				X		195.0	209.4	209.4
				SC Class A	STD	109.5	109.5	109.5
					OVS	93.5	93.5	93.5
					SSLT	93.5	93.5	93.5
				SC Class B	STD	166.4	166.4	166.4
					OVS	142.1	142.1	142.1
					SSLT	142.1	142.1	142.1
			A490	N		195.0	209.4	209.4
				X		195.0	260.0	262.1
				SC Class A	STD	137.9	137.9	137.9
					OVS	116.8	116.8	116.8
					SSLT	116.8	116.8	116.8
				SC Class B	STD	195.0	209.6	209.6
					OVS	177.6	177.6	177.6
					SSLT	177.6	177.6	177.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	7	A325/ F1852	N		8.0	8.0	8.0
				X		9.3	10.0	10.0
				SC Class A	STD	5.2	5.2	5.2
					OVS	4.4	4.4	4.4
					SSLT	4.4	4.4	4.4
				SC Class B	STD	7.9	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
			A490	N		9.3	10.0	10.0
				X		9.3	12.4	12.5
				SC Class A	STD	6.6	6.6	6.6
					OVS	5.6	5.6	5.6
					SSLT	5.6	5.6	5.6
				SC Class B	STD	9.3	10.0	10.0
					OVS	8.4	8.4	8.4
					SSLT	8.4	8.4	8.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	7	A325/ F1852	N		16.1	16.1	16.1
				X		18.8	20.2	20.2
				SC Class A	STD	10.6	10.6	10.6
					OVS	9.0	9.0	9.0
					SSLT	9.0	9.0	9.0
				SC Class B	STD	16.0	16.0	16.0
					OVS	13.7	13.7	13.7
					SSLT	13.7	13.7	13.7
			A490	N		18.8	20.2	20.2
				X		18.8	25.1	25.3
				SC Class A	STD	13.3	13.3	13.3
					OVS	11.3	11.3	11.3
					SSLT	11.3	11.3	11.3
				SC Class B	STD	18.8	20.2	20.2
					OVS	17.1	17.1	17.1
					SSLT	17.1	17.1	17.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	7	A325/ F1852	N		29.0	29.0	29.0
				X		33.8	36.3	36.3
				SC Class A	STD	19.0	19.0	19.0
					OVS	16.2	16.2	16.2
					SSLT	16.2	16.2	16.2
				SC Class B	STD	28.8	28.8	28.8
					OVS	24.6	24.6	24.6
					SSLT	24.6	24.6	24.6
			A490	N		33.8	36.3	36.3
				X		33.8	45.0	45.4
				SC Class A	STD	23.9	23.9	23.9
					OVS	20.2	20.2	20.2
					SSLT	20.2	20.2	20.2
				SC Class B	STD	33.8	36.3	36.3
					OVS	30.7	30.7	30.7
					SSLT	30.7	30.7	30.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	7	A325/ F1852	N		42.7	42.7	42.7
				X		49.7	53.4	53.4
				SC Class A	STD	27.9	27.9	27.9
					OVS	23.8	23.8	23.8
					SSLT	23.8	23.8	23.8
				SC Class B	STD	42.4	42.4	42.4
					OVS	36.2	36.2	36.2
					SSLT	36.2	36.2	36.2
			A490	N		49.7	53.4	53.4
				X		49.7	66.3	66.8
				SC Class A	STD	35.1	35.1	35.1
					OVS	29.8	29.8	29.8
					SSLT	29.8	29.8	29.8
				SC Class B	STD	49.7	53.4	53.4
					OVS	45.3	45.3	45.3
					SSLT	45.3	45.3	45.3

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	7	A325/ F1852	N		58.2	58.2	58.2
				X		67.8	72.8	72.8
				SC Class A	STD	38.0	38.0	38.0
					OVS	32.5	32.5	32.5
					SSLT	32.5	32.5	32.5
				SC Class B	STD	57.8	57.8	57.8
					OVS	49.4	49.4	49.4
					SSLT	49.4	49.4	49.4
			A490	N		67.8	72.8	72.8
				X		67.8	90.3	91.1
				SC Class A	STD	47.9	47.9	47.9
					OVS	40.6	40.6	40.6
					SSLT	40.6	40.6	40.6
				SC Class B	STD	67.8	72.8	72.8
					OVS	61.7	61.7	61.7
					SSLT	61.7	61.7	61.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	7	A325/ F1852	N		74.6	74.6	74.6
				X		86.9	93.3	93.3
				SC Class A	STD	48.8	48.8	48.8
					OVS	41.6	41.6	41.6
					SSLT	41.6	41.6	41.6
				SC Class B	STD	74.1	74.1	74.1
					OVS	63.3	63.3	63.3
					SSLT	63.3	63.3	63.3
			A490	N		86.9	93.3	93.3
				X		86.9	115.8	116.8
				SC Class A	STD	61.4	61.4	61.4
					OVS	52.1	52.1	52.1
					SSLT	52.1	52.1	52.1
				SC Class B	STD	86.9	93.4	93.4
					OVS	79.1	79.1	79.1
					SSLT	79.1	79.1	79.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	7	A325/ F1852	N		91.5	91.5	91.5
				X		106.6	114.5	114.5
				SC Class A	STD	59.9	59.9	59.9
					OVS	51.1	51.1	51.1
					SSLT	51.1	51.1	51.1
				SC Class B	STD	91.0	91.0	91.0
					OVS	77.7	77.7	77.7
					SSLT	77.7	77.7	77.7
			A490	N		106.6	114.5	114.5
				X		106.6	142.1	143.3
				SC Class A	STD	75.4	75.4	75.4
					OVS	63.9	63.9	63.9
					SSLT	63.9	63.9	63.9
				SC Class B	STD	106.6	114.6	114.6
					OVS	97.1	97.1	97.1
					SSLT	97.1	97.1	97.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	7	A325/ F1852	N		108.6	108.6	108.6
				X		126.5	135.9	135.9
				SC Class A	STD	71.0	71.0	71.0
					OVS	60.7	60.7	60.7
					SSLT	60.7	60.7	60.7
				SC Class B	STD	108.0	108.0	108.0
					OVS	92.2	92.2	92.2
					SSLT	92.2	92.2	92.2
			A490	N		126.5	135.9	135.9
				X		126.5	168.7	170.1
				SC Class A	STD	89.5	89.5	89.5
					OVS	75.8	75.8	75.8
					SSLT	75.8	75.8	75.8
				SC Class B	STD	126.5	136.0	136.0
					OVS	115.2	115.2	115.2
					SSLT	115.2	115.2	115.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	7	A325/ F1852	N		125.9	125.9	125.9
				X		146.7	157.6	157.6
				SC Class A	STD	82.3	82.3	82.3
					OVS	70.3	70.3	70.3
					SSLT	70.3	70.3	70.3
				SC Class B	STD	125.2	125.2	125.2
					OVS	106.9	106.9	106.9
					SSLT	106.9	106.9	106.9
			A490	N		146.7	157.6	157.6
				X		146.7	195.6	197.1
				SC Class A	STD	103.7	103.7	103.7
					OVS	87.9	87.9	87.9
					SSLT	87.9	87.9	87.9
				SC Class B	STD	146.7	157.7	157.7
					OVS	133.6	133.6	133.6
					SSLT	133.6	133.6	133.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	7	A325/ F1852	N		144.3	144.3	144.3
				X		168.1	180.5	180.5
				SC Class A	STD	94.4	94.4	94.4
					OVS	80.6	80.6	80.6
					SSLT	80.6	80.6	80.6
				SC Class B	STD	143.4	143.4	143.4
					OVS	122.5	122.5	122.5
					SSLT	122.5	122.5	122.5
			A490	N		168.1	180.5	180.5
				X		168.1	224.1	225.9
				SC Class A	STD	118.8	118.8	118.8
					OVS	100.7	100.7	100.7
					SSLT	100.7	100.7	100.7
				SC Class B	STD	168.1	180.7	180.7
					OVS	153.1	153.1	153.1
					SSLT	153.1	153.1	153.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	7	A325/ F1852	N		160.1	160.1	160.1
				X		186.5	200.4	200.4
				SC Class A	STD	104.7	104.7	104.7
					OVS	89.4	89.4	89.4
					SSLT	89.4	89.4	89.4
				SC Class B	STD	159.2	159.2	159.2
					OVS	135.9	135.9	135.9
					SSLT	135.9	135.9	135.9
			A490	N		186.5	200.4	200.4
				X		186.5	248.7	250.7
				SC Class A	STD	131.9	131.9	131.9
					OVS	111.8	111.8	111.8
					SSLT	111.8	111.8	111.8
				SC Class B	STD	186.5	200.5	200.5
					OVS	169.9	169.9	169.9
					SSLT	169.9	169.9	169.9

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	8	A325/ F1852	N		6.9	6.9	6.9
				X		8.0	8.6	8.6
				SC Class A	STD	4.5	4.5	4.5
					OVS	3.8	3.8	3.8
					SSLT	3.8	3.8	3.8
				SC Class B	STD	6.8	6.8	6.8
					OVS	5.8	5.8	5.8
					SSLT	5.8	5.8	5.8
			A490	N		8.0	8.6	8.6
				X		8.0	10.7	10.8
				SC Class A	STD	5.7	5.7	5.7
					OVS	4.8	4.8	4.8
					SSLT	4.8	4.8	4.8
				SC Class B	STD	8.0	8.6	8.6
					OVS	7.3	7.3	7.3
					SSLT	7.3	7.3	7.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	8	A325/ F1852	N		13.9	13.9	13.9
				X		16.2	17.4	17.4
				SC Class A	STD	9.1	9.1	9.1
					OVS	7.8	7.8	7.8
					SSLT	7.8	7.8	7.8
				SC Class B	STD	13.9	13.9	13.9
					OVS	11.8	11.8	11.8
					SSLT	11.8	11.8	11.8
			A490	N		16.2	17.4	17.4
				X		16.2	21.6	21.8
				SC Class A	STD	11.5	11.5	11.5
					OVS	9.7	9.7	9.7
					SSLT	9.7	9.7	9.7
				SC Class B	STD	16.2	17.4	17.4
					OVS	14.8	14.8	14.8
					SSLT	14.8	14.8	14.8

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	8	A325/ F1852	N		25.2	25.2	25.2
				X		29.3	31.5	31.5
				SC Class A	STD	16.5	16.5	16.5
					OVS	14.1	14.1	14.1
					SSLT	14.1	14.1	14.1
				SC Class B	STD	25.0	25.0	25.0
					OVS	21.4	21.4	21.4
					SSLT	21.4	21.4	21.4
			A490	N		29.3	31.5	31.5
				X		29.3	39.1	39.4
				SC Class A	STD	20.7	20.7	20.7
					OVS	17.6	17.6	17.6
					SSLT	17.6	17.6	17.6
				SC Class B	STD	29.3	31.5	31.5
					OVS	26.7	26.7	26.7
					SSLT	26.7	26.7	26.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	8	A325/ F1852	N		37.9	37.9	37.9
				X		44.1	47.4	47.4
				SC Class A	STD	24.8	24.8	24.8
					OVS	21.2	21.2	21.2
					SSLT	21.2	21.2	21.2
				SC Class B	STD	37.7	37.7	37.7
					OVS	32.2	32.2	32.2
					SSLT	32.2	32.2	32.2
			A490	N		44.1	47.4	47.4
				X		44.1	58.8	59.3
				SC Class A	STD	31.2	31.2	31.2
					OVS	26.4	26.4	26.4
					SSLT	26.4	26.4	26.4
				SC Class B	STD	44.1	47.4	47.4
					OVS	40.2	40.2	40.2
					SSLT	40.2	40.2	40.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	8	A325/ F1852	N		52.4	52.4	52.4
				X		61.0	65.6	65.6
				SC Class A	STD	34.3	34.3	34.3
					OVS	29.3	29.3	29.3
					SSLT	29.3	29.3	29.3
				SC Class B	STD	52.1	52.1	52.1
					OVS	44.5	44.5	44.5
					SSLT	44.5	44.5	44.5
			A490	N		61.0	65.6	65.6
				X		61.0	81.4	82.1
				SC Class A	STD	43.2	43.2	43.2
					OVS	36.6	36.6	36.6
					SSLT	36.6	36.6	36.6
				SC Class B	STD	61.0	65.6	65.6
					OVS	55.6	55.6	55.6
					SSLT	55.6	55.6	55.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	8	A325/ F1852	N		68.0	68.0	68.0
				X		79.2	85.1	85.1
				SC Class A	STD	44.5	44.5	44.5
					OVS	38.0	38.0	38.0
					SSLT	38.0	38.0	38.0
				SC Class B	STD	67.6	67.6	67.6
					OVS	57.7	57.7	57.7
					SSLT	57.7	57.7	57.7
			A490	N		79.2	85.1	85.1
				X		79.2	105.6	106.5
				SC Class A	STD	56.0	56.0	56.0
					OVS	47.5	47.5	47.5
					SSLT	47.5	47.5	47.5
				SC Class B	STD	79.2	85.1	85.1
					OVS	72.1	72.1	72.1
					SSLT	72.1	72.1	72.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	8	A325/ F1852	N		84.4	84.4	84.4
				X		98.3	105.6	105.6
				SC Class A	STD	55.2	55.2	55.2
					OVS	47.1	47.1	47.1
					SSLT	47.1	47.1	47.1
				SC Class B	STD	83.9	83.9	83.9
					OVS	71.7	71.7	71.7
					SSLT	71.7	71.7	71.7
			A490	N		98.3	105.6	105.6
				X		98.3	131.1	132.2
				SC Class A	STD	69.5	69.5	69.5
					OVS	58.9	58.9	58.9
					SSLT	58.9	58.9	58.9
				SC Class B	STD	98.3	105.7	105.7
					OVS	89.6	89.6	89.6
					SSLT	89.6	89.6	89.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	8	A325/ F1852	N		101.2	101.2	101.2
				X		117.9	126.7	126.7
				SC Class A	STD	66.2	66.2	66.2
					OVS	56.5	56.5	56.5
					SSLT	56.5	56.5	56.5
				SC Class B	STD	100.6	100.6	100.6
					OVS	85.9	85.9	85.9
					SSLT	85.9	85.9	85.9
			A490	N		117.9	126.7	126.7
				X		117.9	157.2	158.5
				SC Class A	STD	83.4	83.4	83.4
					OVS	70.7	70.7	70.7
					SSLT	70.7	70.7	70.7
				SC Class B	STD	117.9	126.7	126.7
					OVS	107.4	107.4	107.4
					SSLT	107.4	107.4	107.4

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	8	A325/ F1852	N		118.4	118.4	118.4
				X		138.0	148.2	148.2
				SC Class A	STD	77.5	77.5	77.5
					OVS	66.1	66.1	66.1
					SSLT	66.1	66.1	66.1
				SC Class B	STD	117.7	117.7	117.7
					OVS	100.5	100.5	100.5
					SSLT	100.5	100.5	100.5
			A490	N		138.0	148.2	148.2
				X		138.0	184.0	185.5
				SC Class A	STD	97.6	97.6	97.6
					OVS	82.7	82.7	82.7
					SSLT	82.7	82.7	82.7
				SC Class B	STD	138.0	148.3	148.3
					OVS	125.7	125.7	125.7
					SSLT	125.7	125.7	125.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	8	A325/ F1852	N		135.6	135.6	135.6
				X		158.0	169.7	169.7
				SC Class A	STD	88.7	88.7	88.7
					OVS	75.7	75.7	75.7
					SSLT	75.7	75.7	75.7
				SC Class B	STD	134.8	134.8	134.8
					OVS	115.1	115.1	115.1
					SSLT	115.1	115.1	115.1
			A490	N		158.0	169.7	169.7
				X		158.0	210.6	212.4
				SC Class A	STD	111.7	111.7	111.7
					OVS	94.7	94.7	94.7
					SSLT	94.7	94.7	94.7
				SC Class B	STD	158.0	169.8	169.8
					OVS	143.9	143.9	143.9
					SSLT	143.9	143.9	143.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	8	A325/ F1852	N		152.8	152.8	152.8
				X		178.1	191.3	191.3
				SC Class A	STD	100.0	100.0	100.0
					OVS	85.4	85.4	85.4
					SSLT	85.4	85.4	85.4
				SC Class B	STD	151.9	151.9	151.9
					OVS	129.7	129.7	129.7
					SSLT	129.7	129.7	129.7
			A490	N		178.1	191.3	191.3
				X		178.1	237.4	239.3
				SC Class A	STD	125.9	125.9	125.9
					OVS	106.7	106.7	106.7
					SSLT	106.7	106.7	106.7
				SC Class B	STD	178.1	191.4	191.4
					OVS	162.2	162.2	162.2
					SSLT	162.2	162.2	162.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	3/4	9	A325/ F1852	N		5.2	5.2	5.2
				X		6.0	6.5	6.5
				SC Class A	STD	3.4	3.4	3.4
					OVS	2.9	2.9	2.9
					SSLT	2.9	2.9	2.9
				SC Class B	STD	5.1	5.1	5.1
					OVS	4.4	4.4	4.4
					SSLT	4.4	4.4	4.4
			A490	N		6.0	6.5	6.5
				X		6.0	8.0	8.1
				SC Class A	STD	4.3	4.3	4.3
					OVS	3.6	3.6	3.6
					SSLT	3.6	3.6	3.6
				SC Class B	STD	6.0	6.5	6.5
					OVS	5.5	5.5	5.5
					SSLT	5.5	5.5	5.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	3/4	9	A325/ F1852	N		12.0	12.0	12.0
				X		14.0	15.0	15.0
				SC Class A	STD	7.9	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
				SC Class B	STD	11.9	11.9	11.9
					OVS	10.2	10.2	10.2
					SSLT	10.2	10.2	10.2
			A490	N		14.0	15.0	15.0
				X		14.0	18.6	18.8
				SC Class A	STD	9.9	9.9	9.9
					OVS	8.4	8.4	8.4
					SSLT	8.4	8.4	8.4
				SC Class B	STD	14.0	15.0	15.0
					OVS	12.7	12.7	12.7
					SSLT	12.7	12.7	12.7

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	3/4	9	A325/ F1852	N		22.0	22.0	22.0
				X		25.6	27.5	27.5
				SC Class A	STD	14.4	14.4	14.4
					OVS	12.3	12.3	12.3
					SSLT	12.3	12.3	12.3
				SC Class B	STD	21.9	21.9	21.9
					OVS	18.7	18.7	18.7
					SSLT	18.7	18.7	18.7
			A490	N		25.6	27.5	27.5
				X		25.6	34.1	34.4
				SC Class A	STD	18.1	18.1	18.1
					OVS	15.3	15.3	15.3
					SSLT	15.3	15.3	15.3
				SC Class B	STD	25.6	27.5	27.5
					OVS	23.3	23.3	23.3
					SSLT	23.3	23.3	23.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	3/4	9	A325/ F1852	N		33.4	33.4	33.4
				X		38.9	41.8	41.8
				SC Class A	STD	21.8	21.8	21.8
					OVS	18.6	18.6	18.6
					SSLT	18.6	18.6	18.6
				SC Class B	STD	33.2	33.2	33.2
					OVS	28.3	28.3	28.3
					SSLT	28.3	28.3	28.3
			A490	N		38.9	41.8	41.8
				X		38.9	51.9	52.3
				SC Class A	STD	27.5	27.5	27.5
					OVS	23.3	23.3	23.3
					SSLT	23.3	23.3	23.3
				SC Class B	STD	38.9	41.8	41.8
					OVS	35.4	35.4	35.4
					SSLT	35.4	35.4	35.4

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	3/4	9	A325/ F1852	N		46.6	46.6	46.6
				X		54.3	58.3	58.3
				SC Class A	STD	30.5	30.5	30.5
					OVS	26.0	26.0	26.0
					SSLT	26.0	26.0	26.0
				SC Class B	STD	46.3	46.3	46.3
					OVS	39.5	39.5	39.5
					SSLT	39.5	39.5	39.5
			A490	N		54.3	58.3	58.3
				X		54.3	72.4	73.0
				SC Class A	STD	38.4	38.4	38.4
					OVS	32.5	32.5	32.5
					SSLT	32.5	32.5	32.5
				SC Class B	STD	54.3	58.3	58.3
					OVS	49.4	49.4	49.4
					SSLT	49.4	49.4	49.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	3/4	9	A325/ F1852	N		61.1	61.1	61.1
				X		71.2	76.5	76.5
				SC Class A	STD	40.0	40.0	40.0
					OVS	34.1	34.1	34.1
					SSLT	34.1	34.1	34.1
				SC Class B	STD	60.8	60.8	60.8
					OVS	51.9	51.9	51.9
					SSLT	51.9	51.9	51.9
			A490	N		71.2	76.5	76.5
				X		71.2	95.0	95.7
				SC Class A	STD	50.4	50.4	50.4
					OVS	42.7	42.7	42.7
					SSLT	42.7	42.7	42.7
				SC Class B	STD	71.2	76.6	76.6
					OVS	64.9	64.9	64.9
					SSLT	64.9	64.9	64.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	3/4	9	A325/ F1852	N		76.8	76.8	76.8
				X		89.4	96.1	96.1
				SC Class A	STD	50.2	50.2	50.2
					OVS	42.9	42.9	42.9
					SSLT	42.9	42.9	42.9
				SC Class B	STD	76.3	76.3	76.3
					OVS	65.2	65.2	65.2
					SSLT	65.2	65.2	65.2
			A490	N		89.4	96.1	96.1
				X		89.4	119.2	120.2
				SC Class A	STD	63.2	63.2	63.2
					OVS	53.6	53.6	53.6
					SSLT	53.6	53.6	53.6
				SC Class B	STD	89.4	96.1	96.1
					OVS	81.4	81.4	81.4
					SSLT	81.4	81.4	81.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	3/4	9	A325/ F1852	N		93.0	93.0	93.0
				X		108.3	116.4	116.4
				SC Class A	STD	60.8	60.8	60.8
					OVS	51.9	51.9	51.9
					SSLT	51.9	51.9	51.9
				SC Class B	STD	92.4	92.4	92.4
					OVS	78.9	78.9	78.9
					SSLT	78.9	78.9	78.9
			A490	N		108.3	116.4	116.4
				X		108.3	144.4	145.6
				SC Class A	STD	76.6	76.6	76.6
					OVS	64.9	64.9	64.9
					SSLT	64.9	64.9	64.9
				SC Class B	STD	108.3	116.4	116.4
					OVS	98.7	98.7	98.7
					SSLT	98.7	98.7	98.7

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	3/4	9	A325/ F1852	N		109.8	109.8	109.8
				X		127.9	137.4	137.4
				SC Class A	STD	71.8	71.8	71.8
					OVS	61.3	61.3	61.3
					SSLT	61.3	61.3	61.3
				SC Class B	STD	109.2	109.2	109.2
					OVS	93.2	93.2	93.2
					SSLT	93.2	93.2	93.2
			A490	N		127.9	137.4	137.4
				X		127.9	170.6	171.9
				SC Class A	STD	90.5	90.5	90.5
					OVS	76.6	76.6	76.6
					SSLT	76.6	76.6	76.6
				SC Class B	STD	127.9	137.5	137.5
					OVS	116.5	116.5	116.5
					SSLT	116.5	116.5	116.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	3/4	9	A325/ F1852	N		126.8	126.8	126.8
				X		147.8	158.8	158.8
				SC Class A	STD	83.0	83.0	83.0
					OVS	70.8	70.8	70.8
					SSLT	70.8	70.8	70.8
				SC Class B	STD	126.1	126.1	126.1
					OVS	107.7	107.7	107.7
					SSLT	107.7	107.7	107.7
			A490	N		147.8	158.8	158.8
				X		147.8	197.0	198.6
				SC Class A	STD	104.5	104.5	104.5
					OVS	88.6	88.6	88.6
					SSLT	88.6	88.6	88.6
				SC Class B	STD	147.8	158.8	158.8
					OVS	134.6	134.6	134.6
					SSLT	134.6	134.6	134.6

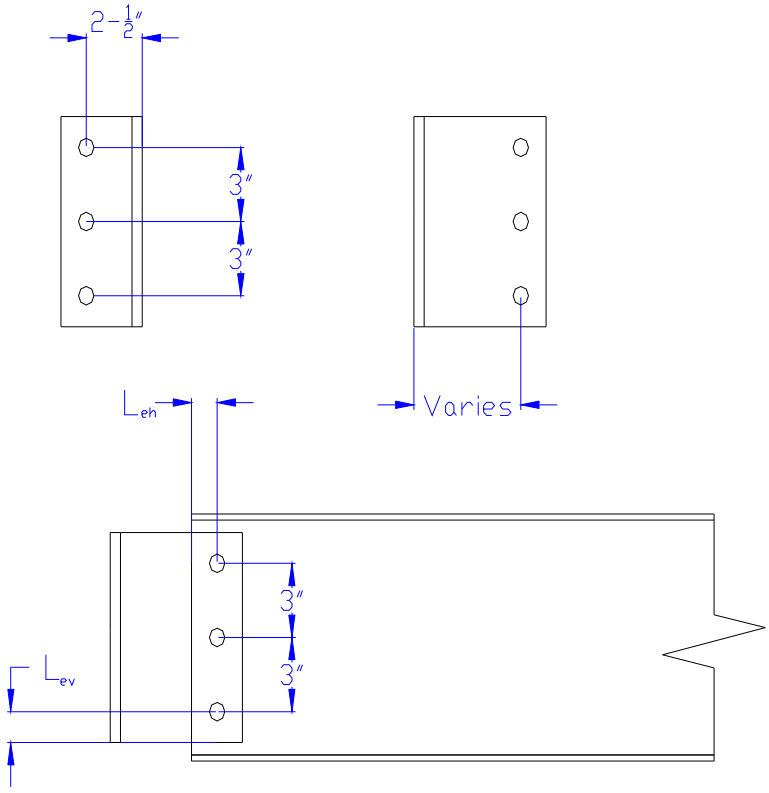
Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	3/4	9	A325/ F1852	N		144.0	144.0	144.0
				X		167.8	180.2	180.2
				SC Class A	STD	94.2	94.2	94.2
					OVS	80.4	80.4	80.4
					SSLT	80.4	80.4	80.4
				SC Class B	STD	143.2	143.2	143.2
					OVS	122.3	122.3	122.3
					SSLT	122.3	122.3	122.3
			A490	N		167.8	180.2	180.2
				X		167.8	223.7	225.5
				SC Class A	STD	118.7	118.7	118.7
					OVS	100.5	100.5	100.5
					SSLT	100.5	100.5	100.5
				SC Class B	STD	167.8	180.4	180.4
					OVS	152.8	152.8	152.8
					SSLT	152.8	152.8	152.8

APPENDIX K
7/8-INCH DIAMETER ALL-BOLTED A992 STEEL SINGLE ANGLE CONNECTIONS

The tables given in Appendix K are all-bolted single angle connections. The angles are A992 angles using either A325/F1852 or A490 7/8-inch diameter bolts.



Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

Represents a bolt bearing limit state
Represents a bolt shear limit state
Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	6	A325/ F1852	N		9.3	11.7	11.7
				X		9.3	12.4	14.7
				SC Class A	STD	7.9	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
				SC Class B	STD	9.3	12.0	12.0
					OVS	8.5	10.2	10.2
					SSLT	9.3	10.2	10.2
			A490	N		9.3	12.4	14.7
				X		9.3	12.4	15.5
				SC Class A	STD	9.3	9.9	9.9
					OVS	8.4	8.4	8.4
					SSLT	8.4	8.4	8.4
				SC Class B	STD	9.3	12.4	15.1
					OVS	8.5	11.4	12.8
					SSLT	9.3	12.4	12.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	6	A325/ F1852	N		20.8	26.2	26.2
				X		20.8	27.7	32.9
				SC Class A	STD	17.6	17.6	17.6
					OVS	15.0	15.0	15.0
					SSLT	15.0	15.0	15.0
				SC Class B	STD	20.8	26.7	26.7
					OVS	19.1	22.9	22.9
					SSLT	20.8	22.9	22.9
			A490	N		20.8	27.7	32.9
				X		20.8	27.7	34.6
				SC Class A	STD	20.8	22.2	22.2
					OVS	18.8	18.8	18.8
					SSLT	18.8	18.8	18.8
				SC Class B	STD	20.8	27.7	33.7
					OVS	19.1	25.5	28.6
					SSLT	20.8	27.7	28.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	6	A325/ F1852	N		35.9	45.3	45.3
				X		35.9	48.0	56.8
				SC Class A	STD	30.4	30.4	30.4
					OVS	26.0	26.0	26.0
					SSLT	26.0	26.0	26.0
				SC Class B	STD	35.9	46.2	46.2
					OVS	33.0	39.5	39.5
					SSLT	35.9	39.5	39.5
			A490	N		35.9	47.9	56.8
				X		35.9	47.9	59.9
				SC Class A	STD	35.9	38.4	38.4
					OVS	32.5	32.5	32.5
					SSLT	32.5	32.5	32.5
				SC Class B	STD	35.9	47.9	58.3
					OVS	33.0	44.0	49.4
					SSLT	35.9	47.9	49.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	6	A325/ F1852	N		52.6	66.3	66.3
				X		52.6	70.2	83.2
				SC Class A	STD	44.5	44.5	44.5
					OVS	38.1	38.1	38.1
					SSLT	38.1	38.1	38.1
				SC Class B	STD	52.6	67.7	67.7
					OVS	48.4	57.9	57.9
					SSLT	52.6	57.9	57.9
			A490	N		52.6	70.1	83.2
				X		52.6	70.1	87.7
				SC Class A	STD	52.6	56.2	56.2
					OVS	47.6	47.6	47.6
					SSLT	47.6	47.6	47.6
				SC Class B	STD	52.6	70.1	85.4
					OVS	48.4	64.5	72.3
					SSLT	52.6	70.1	72.3

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	6	A325/ F1852	N		70.3	88.6	88.6
				X		70.3	93.8	111.2
				SC Class A	STD	59.5	59.5	59.5
					OVS	50.9	50.9	50.9
					SSLT	50.9	50.9	50.9
				SC Class B	STD	70.3	90.4	90.4
					OVS	64.6	77.3	77.3
					SSLT	70.3	77.3	77.3
			A490	N		70.3	93.7	111.2
				X		70.3	93.7	117.2
				SC Class A	STD	70.3	75.1	75.1
					OVS	63.6	63.6	63.6
					SSLT	63.6	63.6	63.6
				SC Class B	STD	70.3	93.7	114.1
					OVS	64.6	86.2	96.7
					SSLT	70.3	93.7	96.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	6	A325/ F1852	N		88.9	112.0	112.0
				X		88.9	118.6	140.5
				SC Class A	STD	75.2	75.2	75.2
					OVS	64.3	64.3	64.3
					SSLT	64.3	64.3	64.3
				SC Class B	STD	88.9	114.3	114.3
					OVS	81.7	97.7	97.7
					SSLT	88.9	97.7	97.7
			A490	N		88.9	118.5	140.5
				X		88.9	118.5	148.1
				SC Class A	STD	88.9	94.9	94.9
					OVS	80.4	80.4	80.4
					SSLT	80.4	80.4	80.4
				SC Class B	STD	88.9	118.5	144.2
					OVS	81.7	108.9	122.2
					SSLT	88.9	118.5	122.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	6	A325/ F1852	N		107.2	135.2	135.2
				X		107.2	143.1	169.6
				SC Class A	STD	90.7	90.7	90.7
					OVS	77.6	77.6	77.6
					SSLT	77.6	77.6	77.6
				SC Class B	STD	107.2	137.9	137.9
					OVS	98.6	117.9	117.9
					SSLT	107.2	117.9	117.9
			A490	N		107.2	143.0	169.6
				X		107.2	143.0	178.7
				SC Class A	STD	107.2	114.5	114.5
					OVS	97.0	97.0	97.0
					SSLT	97.0	97.0	97.0
				SC Class B	STD	107.2	143.0	174.1
					OVS	98.6	131.4	147.4
					SSLT	107.2	143.0	147.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	6	A325/ F1852	N		125.9	158.7	158.7
				X		125.9	168.0	199.0
				SC Class A	STD	106.5	106.5	106.5
					OVS	91.1	91.1	91.1
					SSLT	91.1	91.1	91.1
				SC Class B	STD	125.9	161.9	161.9
					OVS	115.7	138.4	138.4
					SSLT	125.9	138.4	138.4
			A490	N		125.9	167.8	199.0
				X		125.9	167.8	209.8
				SC Class A	STD	125.9	134.4	134.4
					OVS	113.8	113.8	113.8
					SSLT	113.8	113.8	113.8
				SC Class B	STD	125.9	167.8	204.3
					OVS	115.7	154.2	173.0
					SSLT	125.9	167.8	173.0

Notes:
Angles are assumed to be A992 Steel
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	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	6	A325/ F1852	N		144.3	181.9	181.9
				X		144.3	192.6	228.2
				SC Class A	STD	122.1	122.1	122.1
					OVS	104.4	104.4	104.4
					SSLT	104.4	104.4	104.4
				SC Class B	STD	144.3	185.6	185.6
					OVS	132.6	158.7	158.7
					SSLT	144.3	158.7	158.7
			A490	N		144.3	192.4	228.2
				X		144.3	192.4	240.5
				SC Class A	STD	144.3	154.1	154.1
					OVS	130.5	130.5	130.5
					SSLT	130.5	130.5	130.5
				SC Class B	STD	144.3	192.4	234.2
					OVS	132.6	176.8	198.4
					SSLT	144.3	192.4	198.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	6	A325/ F1852	N		162.7	205.1	205.1
				X		162.7	217.2	257.3
				SC Class A	STD	137.7	137.7	137.7
					OVS	117.7	117.7	117.7
					SSLT	117.7	117.7	117.7
				SC Class B	STD	162.7	209.3	209.3
					OVS	149.5	179.0	179.0
					SSLT	162.7	179.0	179.0
			A490	N		162.7	217.0	257.3
				X		162.7	217.0	271.2
				SC Class A	STD	162.7	173.8	173.8
					OVS	147.2	147.2	147.2
					SSLT	147.2	147.2	147.2
				SC Class B	STD	162.7	217.0	264.1
					OVS	149.5	199.4	223.7
					SSLT	162.7	217.0	223.7

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	6	A325/ F1852	N		180.4	227.3	227.3
				X		180.4	240.8	285.2
				SC Class A	STD	152.6	152.6	152.6
					OVS	130.5	130.5	130.5
					SSLT	130.5	130.5	130.5
				SC Class B	STD	180.4	232.0	232.0
					OVS	165.8	198.4	198.4
					SSLT	180.4	198.4	198.4
			A490	N		180.4	240.5	285.2
				X		180.4	240.5	300.6
				SC Class A	STD	180.4	192.6	192.6
					OVS	163.1	163.1	163.1
					SSLT	163.1	163.1	163.1
				SC Class B	STD	180.4	240.5	292.8
					OVS	165.8	221.0	248.0
					SSLT	180.4	240.5	248.0

Notes:
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	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	7	A325/ F1852	N		8.6	10.8	10.8
				X		8.6	11.4	13.6
				SC Class A	STD	7.3	7.3	7.3
					OVS	6.2	6.2	6.2
					SSLT	6.2	6.2	6.2
				SC Class B	STD	8.6	11.0	11.0
					OVS	7.9	9.4	9.4
					SSLT	8.6	9.4	9.4
			A490	N		8.6	11.4	13.6
				X		8.6	11.4	14.3
				SC Class A	STD	8.6	9.2	9.2
					OVS	7.8	7.8	7.8
					SSLT	7.8	7.8	7.8
				SC Class B	STD	8.6	11.4	13.9
					OVS	7.9	10.5	11.8
					SSLT	8.6	11.4	11.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	7	A325/ F1852	N		17.4	21.9	21.9
				X		17.4	23.2	27.5
				SC Class A	STD	14.7	14.7	14.7
					OVS	12.6	12.6	12.6
					SSLT	12.6	12.6	12.6
				SC Class B	STD	17.4	22.4	22.4
					OVS	16.0	19.1	19.1
					SSLT	17.4	19.1	19.1
			A490	N		17.4	23.2	27.5
				X		17.4	23.2	29.0
				SC Class A	STD	17.4	18.6	18.6
					OVS	15.7	15.7	15.7
					SSLT	15.7	15.7	15.7
				SC Class B	STD	17.4	23.2	28.2
					OVS	16.0	21.3	23.9
					SSLT	17.4	23.2	23.9

Notes:
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	Represents a bolt bearing limit state
	Represents a bolt shear limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	7	A325/ F1852	N		31.2	39.4	39.4
				X		31.2	41.7	49.4
				SC Class A	STD	26.4	26.4	26.4
					OVS	22.6	22.6	22.6
					SSLT	22.6	22.6	22.6
				SC Class B	STD	31.2	40.2	40.2
					OVS	28.7	34.4	34.4
					SSLT	31.2	34.4	34.4
			A490	N		31.2	41.6	49.4
				X		31.2	41.6	52.1
				SC Class A	STD	31.2	33.4	33.4
					OVS	28.2	28.2	28.2
					SSLT	28.2	28.2	28.2
				SC Class B	STD	31.2	41.6	50.7
					OVS	28.7	38.3	42.9
					SSLT	31.2	41.6	42.9

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	7	A325/ F1852	N		46.0	57.9	57.9
				X		46.0	61.4	72.7
				SC Class A	STD	38.9	38.9	38.9
					OVS	33.3	33.3	33.3
					SSLT	33.3	33.3	33.3
				SC Class B	STD	46.0	59.1	59.1
					OVS	42.2	50.6	50.6
					SSLT	46.0	50.6	50.6
			A490	N		46.0	61.3	72.7
				X		46.0	61.3	76.6
				SC Class A	STD	46.0	49.1	49.1
					OVS	41.6	41.6	41.6
					SSLT	41.6	41.6	41.6
				SC Class B	STD	46.0	61.3	74.6
					OVS	42.2	56.3	63.2
					SSLT	46.0	61.3	63.2

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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	7	A325/ F1852	N		62.7	79.0	79.0
				X		62.7	83.7	99.1
				SC Class A	STD	53.0	53.0	53.0
					OVS	45.4	45.4	45.4
					SSLT	45.4	45.4	45.4
				SC Class B	STD	62.7	80.6	80.6
					OVS	57.6	68.9	68.9
					SSLT	62.7	68.9	68.9
			A490	N		62.7	83.6	99.1
				X		62.7	83.6	104.5
				SC Class A	STD	62.7	66.9	66.9
					OVS	56.7	56.7	56.7
					SSLT	56.7	56.7	56.7
				SC Class B	STD	62.7	83.6	101.7
					OVS	57.6	76.8	86.2
					SSLT	62.7	83.6	86.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	7	A325/ F1852	N		80.4	101.3	101.3
				X		80.4	107.3	127.1
				SC Class A	STD	68.0	68.0	68.0
					OVS	58.2	58.2	58.2
					SSLT	58.2	58.2	58.2
				SC Class B	STD	80.4	103.4	103.4
					OVS	73.9	88.4	88.4
					SSLT	80.4	88.4	88.4
			A490	N		80.4	107.2	127.1
				X		80.4	107.2	134.0
				SC Class A	STD	80.4	85.8	85.8
					OVS	72.7	72.7	72.7
					SSLT	72.7	72.7	72.7
				SC Class B	STD	80.4	107.2	130.5
					OVS	73.9	98.5	110.5
					SSLT	80.4	107.2	110.5

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	7	A325/ F1852	N		98.6	124.3	124.3
				X		98.6	131.6	156.0
				SC Class A	STD	83.4	83.4	83.4
					OVS	71.4	71.4	71.4
					SSLT	71.4	71.4	71.4
				SC Class B	STD	98.6	126.8	126.8
					OVS	90.6	108.5	108.5
					SSLT	98.6	108.5	108.5
			A490	N		98.6	131.5	156.0
				X		98.6	131.5	164.4
				SC Class A	STD	98.6	105.3	105.3
					OVS	89.2	89.2	89.2
					SSLT	89.2	89.2	89.2
				SC Class B	STD	98.6	131.5	160.1
					OVS	90.6	120.9	135.6
					SSLT	98.6	131.5	135.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	7	A325/ F1852	N		117.0	147.5	147.5
				X		117.0	156.2	185.1
				SC Class A	STD	99.0	99.0	99.0
					OVS	84.7	84.7	84.7
					SSLT	84.7	84.7	84.7
				SC Class B	STD	117.0	150.5	150.5
					OVS	107.6	128.7	128.7
					SSLT	117.0	128.7	128.7
			A490	N		117.0	156.1	185.1
				X		117.0	156.1	195.1
				SC Class A	STD	117.0	125.0	125.0
					OVS	105.9	105.9	105.9
					SSLT	105.9	105.9	105.9
				SC Class B	STD	117.0	156.1	190.0
					OVS	107.6	143.4	160.9
					SSLT	117.0	156.1	160.9

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	7	A325/ F1852	N		135.7	171.0	171.0
				X		135.7	181.1	214.6
				SC Class A	STD	114.8	114.8	114.8
					OVS	98.2	98.2	98.2
					SSLT	98.2	98.2	98.2
				SC Class B	STD	135.7	174.5	174.5
					OVS	124.7	149.2	149.2
					SSLT	135.7	149.2	149.2
			A490	N		135.7	180.9	214.6
				X		135.7	180.9	226.1
				SC Class A	STD	135.7	144.9	144.9
					OVS	122.7	122.7	122.7
					SSLT	122.7	122.7	122.7
				SC Class B	STD	135.7	180.9	220.2
					OVS	124.7	166.3	186.5
					SSLT	135.7	180.9	186.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	7	A325/ F1852	N		155.5	196.0	196.0
				X		155.5	207.5	245.9
				SC Class A	STD	131.6	131.6	131.6
					OVS	112.5	112.5	112.5
					SSLT	112.5	112.5	112.5
				SC Class B	STD	155.5	200.0	200.0
					OVS	142.9	171.0	171.0
					SSLT	155.5	171.0	171.0
			A490	N		155.5	207.3	245.9
				X		155.5	207.3	259.1
				SC Class A	STD	155.5	166.0	166.0
					OVS	140.6	140.6	140.6
					SSLT	140.6	140.6	140.6
				SC Class B	STD	155.5	207.3	252.4
					OVS	142.9	190.5	213.7
					SSLT	155.5	207.3	213.7

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	7	A325/ F1852	N		172.6	217.5	217.5
				X		172.6	230.4	272.9
				SC Class A	STD	146.0	146.0	146.0
					OVS	124.9	124.9	124.9
					SSLT	124.9	124.9	124.9
				SC Class B	STD	172.6	221.9	221.9
					OVS	158.6	189.8	189.8
					SSLT	172.6	189.8	189.8
			A490	N		172.6	230.1	272.9
				X		172.6	230.1	287.6
				SC Class A	STD	172.6	184.3	184.3
					OVS	156.1	156.1	156.1
					SSLT	156.1	156.1	156.1
				SC Class B	STD	172.6	230.1	280.1
					OVS	158.6	211.5	237.2
					SSLT	172.6	230.1	237.2

Notes:
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L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	8	A325/ F1852	N		7.4	9.4	9.4
				X		7.4	9.9	11.7
				SC Class A	STD	6.3	6.3	6.3
					OVS	5.4	5.4	5.4
					SSLT	5.4	5.4	5.4
				SC Class B	STD	7.4	9.5	9.5
					OVS	6.8	8.2	8.2
					SSLT	7.4	8.2	8.2
			A490	N		7.4	9.9	11.7
				X		7.4	9.9	12.4
				SC Class A	STD	7.4	7.9	7.9
					OVS	6.7	6.7	6.7
					SSLT	6.7	6.7	6.7
				SC Class B	STD	7.4	9.9	12.0
					OVS	6.8	9.1	10.2
					SSLT	7.4	9.9	10.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	8	A325/ F1852	N		15.0	18.9	18.9
				X		15.0	20.0	23.7
				SC Class A	STD	12.7	12.7	12.7
					OVS	10.9	10.9	10.9
					SSLT	10.9	10.9	10.9
				SC Class B	STD	15.0	19.3	19.3
					OVS	13.8	16.5	16.5
					SSLT	15.0	16.5	16.5
			A490	N		15.0	20.0	23.7
				X		15.0	20.0	25.0
				SC Class A	STD	15.0	16.0	16.0
					OVS	13.6	13.6	13.6
					SSLT	13.6	13.6	13.6
				SC Class B	STD	15.0	20.0	24.4
					OVS	13.8	18.4	20.6
					SSLT	15.0	20.0	20.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	8	A325/ F1852	N		27.1	34.2	34.2
				X		27.1	36.2	42.9
				SC Class A	STD	22.9	22.9	22.9
					OVS	19.6	19.6	19.6
					SSLT	19.6	19.6	19.6
				SC Class B	STD	27.1	34.9	34.9
					OVS	24.9	29.8	29.8
					SSLT	27.1	29.8	29.8
			A490	N		27.1	36.2	42.9
				X		27.1	36.2	45.2
				SC Class A	STD	27.1	29.0	29.0
					OVS	24.5	24.5	24.5
					SSLT	24.5	24.5	24.5
				SC Class B	STD	27.1	36.2	44.0
					OVS	24.9	33.2	37.3
					SSLT	27.1	36.2	37.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	8	A325/ F1852	N		40.8	51.5	51.5
				X		40.8	54.5	64.6
				SC Class A	STD	34.5	34.5	34.5
					OVS	29.5	29.5	29.5
					SSLT	29.5	29.5	29.5
				SC Class B	STD	40.8	52.5	52.5
					OVS	37.5	44.9	44.9
					SSLT	40.8	44.9	44.9
			A490	N		40.8	54.4	64.6
				X		40.8	54.4	68.0
				SC Class A	STD	40.8	43.6	43.6
					OVS	36.9	36.9	36.9
					SSLT	36.9	36.9	36.9
				SC Class B	STD	40.8	54.4	66.3
					OVS	37.5	50.0	56.1
					SSLT	40.8	54.4	56.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	8	A325/ F1852	N		56.5	71.2	71.2
				X		56.5	75.4	89.3
				SC Class A	STD	47.8	47.8	47.8
					OVS	40.9	40.9	40.9
					SSLT	40.9	40.9	40.9
				SC Class B	STD	56.5	72.6	72.6
					OVS	51.9	62.1	62.1
					SSLT	56.5	62.1	62.1
			A490	N		56.5	75.3	89.3
				X		56.5	75.3	94.1
				SC Class A	STD	56.5	60.3	60.3
					OVS	51.1	51.1	51.1
					SSLT	51.1	51.1	51.1
				SC Class B	STD	56.5	75.3	91.7
					OVS	51.9	69.2	77.6
					SSLT	56.5	75.3	77.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	8	A325/ F1852	N		73.3	92.3	92.3
				X		73.3	97.8	115.9
				SC Class A	STD	62.0	62.0	62.0
					OVS	53.0	53.0	53.0
					SSLT	53.0	53.0	53.0
				SC Class B	STD	73.3	94.2	94.2
					OVS	67.3	80.6	80.6
					SSLT	73.3	80.6	80.6
			A490	N		73.3	97.7	115.9
				X		73.3	97.7	122.1
				SC Class A	STD	73.3	78.2	78.2
					OVS	66.3	66.3	66.3
					SSLT	66.3	66.3	66.3
				SC Class B	STD	73.3	97.7	118.9
					OVS	67.3	89.8	100.7
					SSLT	73.3	97.7	100.7

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	8	A325/ F1852	N		91.0	114.7	114.7
				X		91.0	121.4	143.9
				SC Class A	STD	77.0	77.0	77.0
					OVS	65.8	65.8	65.8
					SSLT	65.8	65.8	65.8
				SC Class B	STD	91.0	117.0	117.0
					OVS	83.6	100.1	100.1
					SSLT	91.0	100.1	100.1
			A490	N		91.0	121.3	143.9
				X		91.0	121.3	151.6
				SC Class A	STD	91.0	97.1	97.1
					OVS	82.3	82.3	82.3
					SSLT	82.3	82.3	82.3
				SC Class B	STD	91.0	121.3	147.7
					OVS	83.6	111.5	125.1
					SSLT	91.0	121.3	125.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	8	A325/ F1852	N		109.1	137.5	137.5
				X		109.1	145.6	172.5
				SC Class A	STD	92.3	92.3	92.3
					OVS	78.9	78.9	78.9
					SSLT	78.9	78.9	78.9
				SC Class B	STD	109.1	140.3	140.3
					OVS	100.2	120.0	120.0
					SSLT	109.1	120.0	120.0
			A490	N		109.1	145.4	172.5
				X		109.1	145.4	181.8
				SC Class A	STD	109.1	116.5	116.5
					OVS	98.7	98.7	98.7
					SSLT	98.7	98.7	98.7
				SC Class B	STD	109.1	145.4	177.0
					OVS	100.2	133.7	150.0
					SSLT	109.1	145.4	150.0

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	8	A325/ F1852	N		127.6	160.9	160.9
				X		127.6	170.4	201.8
				SC Class A	STD	108.0	108.0	108.0
					OVS	92.4	92.4	92.4
					SSLT	92.4	92.4	92.4
				SC Class B	STD	127.6	164.2	164.2
					OVS	117.3	140.4	140.4
					SSLT	127.6	140.4	140.4
			A490	N		127.6	170.2	201.8
				X		127.6	170.2	212.7
				SC Class A	STD	127.6	136.3	136.3
					OVS	115.4	115.4	115.4
					SSLT	115.4	115.4	115.4
				SC Class B	STD	127.6	170.2	207.2
					OVS	117.3	156.4	175.5
					SSLT	127.6	170.2	175.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	8	A325/ F1852	N		146.2	184.2	184.2
				X		146.2	195.1	231.1
				SC Class A	STD	123.7	123.7	123.7
					OVS	105.8	105.8	105.8
					SSLT	105.8	105.8	105.8
				SC Class B	STD	146.2	188.0	188.0
					OVS	134.3	160.7	160.7
					SSLT	146.2	160.7	160.7
			A490	N		146.2	194.9	231.1
				X		146.2	194.9	243.6
				SC Class A	STD	146.2	156.1	156.1
					OVS	132.2	132.2	132.2
					SSLT	132.2	132.2	132.2
				SC Class B	STD	146.2	194.9	237.2
					OVS	134.3	179.1	200.9
					SSLT	146.2	194.9	200.9

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	8	A325/ F1852	N		164.7	207.6	207.6
				X		164.7	219.9	260.5
				SC Class A	STD	139.4	139.4	139.4
					OVS	119.2	119.2	119.2
					SSLT	119.2	119.2	119.2
				SC Class B	STD	164.7	211.8	211.8
					OVS	151.4	181.2	181.2
					SSLT	164.7	181.2	181.2
			A490	N		164.7	219.6	260.5
				X		164.7	219.6	274.5
				SC Class A	STD	164.7	175.9	175.9
					OVS	149.0	149.0	149.0
					SSLT	149.0	149.0	149.0
				SC Class B	STD	164.7	219.6	267.4
					OVS	151.4	201.8	226.4
					SSLT	164.7	219.6	226.4

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	7/8	9	A325/ F1852	N		5.6	7.0	7.0
				X		5.6	7.4	8.8
				SC Class A	STD	4.7	4.7	4.7
					OVS	4.0	4.0	4.0
					SSLT	4.0	4.0	4.0
				SC Class B	STD	5.6	7.2	7.2
					OVS	5.1	6.1	6.1
					SSLT	5.6	6.1	6.1
			A490	N		5.6	7.4	8.8
				X		5.6	7.4	9.3
				SC Class A	STD	5.6	5.9	5.9
					OVS	5.0	5.0	5.0
					SSLT	5.0	5.0	5.0
				SC Class B	STD	5.6	7.4	9.0
					OVS	5.1	6.8	7.7
					SSLT	5.6	7.4	7.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	7/8	9	A325/ F1852	N		12.9	16.3	16.3
				X		12.9	17.3	20.5
				SC Class A	STD	10.9	10.9	10.9
					OVS	9.4	9.4	9.4
					SSLT	9.4	9.4	9.4
				SC Class B	STD	12.9	16.6	16.6
					OVS	11.9	14.2	14.2
					SSLT	12.9	14.2	14.2
			A490	N		12.9	17.3	20.5
				X		12.9	17.3	21.6
				SC Class A	STD	12.9	13.8	13.8
					OVS	11.7	11.7	11.7
					SSLT	11.7	11.7	11.7
				SC Class B	STD	12.9	17.3	21.0
					OVS	11.9	15.9	17.8
					SSLT	12.9	17.3	17.8

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	7/8	9	A325/ F1852	N		23.7	29.9	29.9
				X		23.7	31.6	37.5
				SC Class A	STD	20.0	20.0	20.0
					OVS	17.1	17.1	17.1
					SSLT	17.1	17.1	17.1
				SC Class B	STD	23.7	30.5	30.5
					OVS	21.8	26.1	26.1
					SSLT	23.7	26.1	26.1
			A490	N		23.7	31.6	37.5
				X		23.7	31.6	39.5
				SC Class A	STD	23.7	25.3	25.3
					OVS	21.4	21.4	21.4
					SSLT	21.4	21.4	21.4
				SC Class B	STD	23.7	31.6	38.5
					OVS	21.8	29.0	32.6
					SSLT	23.7	31.6	32.6

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	7/8	9	A325/ F1852	N		36.0	45.4	45.4
				X		36.0	48.0	56.9
				SC Class A	STD	30.5	30.5	30.5
					OVS	26.0	26.0	26.0
					SSLT	26.0	26.0	26.0
				SC Class B	STD	36.0	46.3	46.3
					OVS	33.1	39.6	39.6
					SSLT	36.0	39.6	39.6
			A490	N		36.0	48.0	56.9
				X		36.0	48.0	60.0
				SC Class A	STD	36.0	38.4	38.4
					OVS	32.6	32.6	32.6
					SSLT	32.6	32.6	32.6
				SC Class B	STD	36.0	48.0	58.4
					OVS	33.1	44.1	49.5
					SSLT	36.0	48.0	49.5

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	7/8	9	A325/ F1852	N		50.2	63.3	63.3
				X		50.2	67.0	79.4
				SC Class A	STD	42.5	42.5	42.5
					OVS	36.3	36.3	36.3
					SSLT	36.3	36.3	36.3
				SC Class B	STD	50.2	64.6	64.6
					OVS	46.1	55.2	55.2
					SSLT	50.2	55.2	55.2
			A490	N		50.2	67.0	79.4
				X		50.2	67.0	83.7
				SC Class A	STD	50.2	53.6	53.6
					OVS	45.4	45.4	45.4
					SSLT	45.4	45.4	45.4
				SC Class B	STD	50.2	67.0	81.5
					OVS	46.1	61.5	69.0
					SSLT	50.2	67.0	69.0

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	7/8	9	A325/ F1852	N		65.9	83.1	83.1
				X		65.9	88.0	104.2
				SC Class A	STD	55.8	55.8	55.8
					OVS	47.7	47.7	47.7
					SSLT	47.7	47.7	47.7
				SC Class B	STD	65.9	84.7	84.7
					OVS	60.6	72.5	72.5
					SSLT	65.9	72.5	72.5
			A490	N		65.9	87.9	104.2
				X		65.9	87.9	109.8
				SC Class A	STD	65.9	70.4	70.4
					OVS	59.6	59.6	59.6
					SSLT	59.6	59.6	59.6
				SC Class B	STD	65.9	87.9	107.0
					OVS	60.6	80.7	90.6
					SSLT	65.9	87.9	90.6

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	7/8	9	A325/ F1852	N		82.7	104.3	104.3
				X		82.7	110.4	130.8
				SC Class A	STD	70.0	70.0	70.0
					OVS	59.9	59.9	59.9
					SSLT	59.9	59.9	59.9
				SC Class B	STD	82.7	106.4	106.4
					OVS	76.0	91.0	91.0
					SSLT	82.7	91.0	91.0
			A490	N		82.7	110.3	130.8
				X		82.7	110.3	137.9
				SC Class A	STD	82.7	88.3	88.3
					OVS	74.8	74.8	74.8
					SSLT	74.8	74.8	74.8
				SC Class B	STD	82.7	110.3	134.3
					OVS	76.0	101.4	113.7
					SSLT	82.7	110.3	113.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	7/8	9	A325/ F1852	N		100.2	126.3	126.3
				X		100.2	133.8	158.5
				SC Class A	STD	84.8	84.8	84.8
					OVS	72.5	72.5	72.5
					SSLT	72.5	72.5	72.5
				SC Class B	STD	100.2	128.9	128.9
					OVS	92.1	110.2	110.2
					SSLT	100.2	110.2	110.2
			A490	N		100.2	133.6	158.5
				X		100.2	133.6	167.0
				SC Class A	STD	100.2	107.0	107.0
					OVS	90.6	90.6	90.6
					SSLT	90.6	90.6	90.6
				SC Class B	STD	100.2	133.6	162.7
					OVS	92.1	122.8	137.8
					SSLT	100.2	133.6	137.8

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	7/8	9	A325/ F1852	N		118.3	149.1	149.1
				X		118.3	158.0	187.1
				SC Class A	STD	100.1	100.1	100.1
					OVS	85.6	85.6	85.6
					SSLT	85.6	85.6	85.6
				SC Class B	STD	118.3	152.2	152.2
					OVS	108.8	130.1	130.1
					SSLT	118.3	130.1	130.1
			A490	N		118.3	157.8	187.1
				X		118.3	157.8	197.2
				SC Class A	STD	118.3	126.4	126.4
					OVS	107.0	107.0	107.0
					SSLT	107.0	107.0	107.0
				SC Class B	STD	118.3	157.8	192.1
					OVS	108.8	145.0	162.7
					SSLT	118.3	157.8	162.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	7/8	9	A325/ F1852	N		136.7	172.3	172.3
				X		136.7	182.5	216.2
				SC Class A	STD	115.7	115.7	115.7
					OVS	98.9	98.9	98.9
					SSLT	98.9	98.9	98.9
				SC Class B	STD	136.7	175.8	175.8
					OVS	125.6	150.4	150.4
					SSLT	136.7	150.4	150.4
			A490	N		136.7	182.3	216.2
				X		136.7	182.3	227.9
				SC Class A	STD	136.7	146.0	146.0
					OVS	123.7	123.7	123.7
					SSLT	123.7	123.7	123.7
				SC Class B	STD	136.7	182.3	221.9
					OVS	125.6	167.5	187.9
					SSLT	136.7	182.3	187.9

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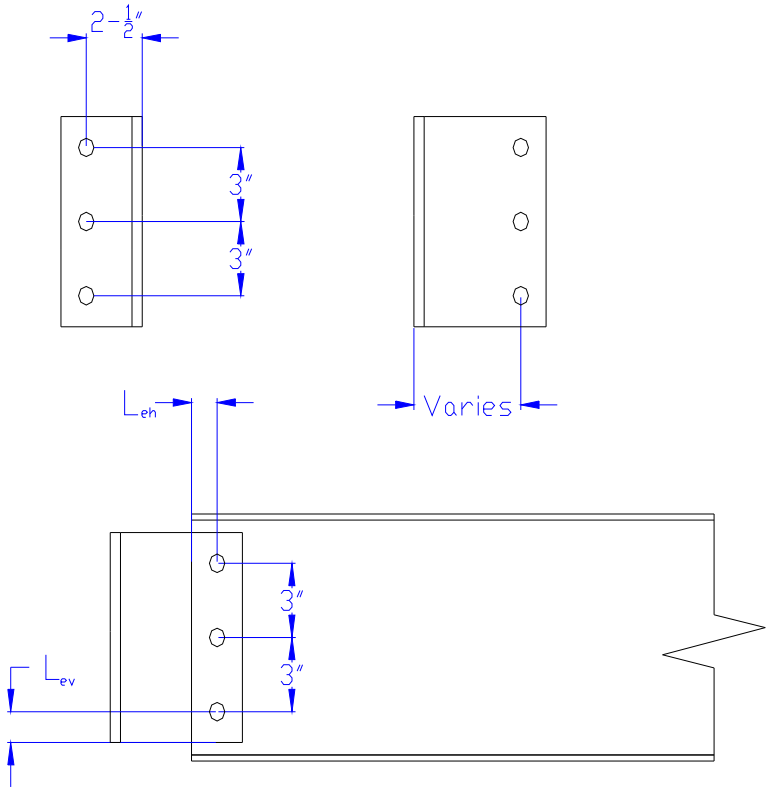
All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	7/8	9	A325/ F1852	N		155.2	195.6	195.6
				X		155.2	207.2	245.5
				SC Class A	STD	131.3	131.3	131.3
					OVS	112.3	112.3	112.3
					SSLT	112.3	112.3	112.3
				SC Class B	STD	155.2	199.6	199.6
					OVS	142.7	170.7	170.7
					SSLT	155.2	170.7	170.7
			A490	N		155.2	207.0	245.5
				X		155.2	207.0	258.7
				SC Class A	STD	155.2	165.8	165.8
					OVS	140.4	140.4	140.4
					SSLT	140.4	140.4	140.4
				SC Class B	STD	155.2	207.0	251.9
					OVS	142.7	190.2	213.4
					SSLT	155.2	207.0	213.4

APPENDIX L
1-INCH DIAMETER ALL-BOLTED A992 STEEL SINGLE ANGLE CONNECTIONS

The tables given in Appendix L are all-bolted single angle connections. The angles are A992 angles using either A325/F1852 or A490 1-inch diameter bolts.



Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	6	A325/ F1852	N		8.5	11.4	14.2
				X		8.5	11.4	14.2
				SC Class A	STD	8.5	10.3	10.3
					OVS	7.4	8.8	8.8
					SSLT	8.5	8.8	8.8
				SC Class B	STD	8.5	11.4	14.2
					OVS	7.4	9.9	12.4
					SSLT	8.5	11.4	13.4
			A490	N		8.5	11.4	14.2
				X		8.5	11.4	14.2
				SC Class A	STD	8.5	11.4	13.0
					OVS	7.4	9.9	11.0
					SSLT	8.5	11.0	11.0
				SC Class B	STD	8.5	11.4	14.2
					OVS	7.4	9.9	12.4
					SSLT	8.5	11.4	14.2

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	6	A325/ F1852	N		19.1	25.5	31.8
				X		19.1	25.5	31.8
				SC Class A	STD	19.1	23.0	23.0
					OVS	16.6	19.6	19.6
					SSLT	19.1	19.6	19.6
				SC Class B	STD	19.1	25.5	31.8
					OVS	16.6	22.2	27.7
					SSLT	19.1	25.5	29.9
			A490	N		19.1	25.5	31.8
				X		19.1	25.5	31.8
				SC Class A	STD	19.1	25.5	29.0
					OVS	16.6	22.2	24.6
					SSLT	19.1	24.6	24.6
				SC Class B	STD	19.1	25.5	31.8
					OVS	16.6	22.2	27.7
					SSLT	19.1	25.5	31.8

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	6	A325/ F1852	N		33.0	44.0	55.1
				X		33.0	44.0	55.1
				SC Class A	STD	33.0	39.9	39.9
					OVS	28.8	34.0	34.0
					SSLT	33.0	34.0	34.0
				SC Class B	STD	33.0	44.0	55.1
					OVS	28.8	38.4	48.0
					SSLT	33.0	44.0	51.6
			A490	N		33.0	44.0	55.1
				X		33.0	44.0	55.1
				SC Class A	STD	33.0	44.0	50.1
					OVS	28.8	38.4	42.6
					SSLT	33.0	42.6	42.6
				SC Class B	STD	33.0	44.0	55.1
					OVS	28.8	38.4	48.0
					SSLT	33.0	44.0	55.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	6	A325/ F1852	N		48.4	64.5	80.6
				X		48.4	64.5	80.6
				SC Class A	STD	48.4	58.3	58.3
					OVS	42.1	49.7	49.7
					SSLT	48.4	49.7	49.7
				SC Class B	STD	48.4	64.5	80.6
					OVS	42.1	56.2	70.2
					SSLT	48.4	64.5	75.6
			A490	N		48.4	64.5	80.6
				X		48.4	64.5	80.6
				SC Class A	STD	48.4	64.5	73.4
					OVS	42.1	56.2	62.3
					SSLT	48.4	62.3	62.3
				SC Class B	STD	48.4	64.5	80.6
					OVS	42.1	56.2	70.2
					SSLT	48.4	64.5	80.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	6	A325/ F1852	N		64.6	86.2	107.7
				X		64.6	86.2	107.7
				SC Class A	STD	64.6	77.9	77.9
					OVS	56.3	66.5	66.5
					SSLT	64.6	66.5	66.5
				SC Class B	STD	64.6	86.2	107.7
					OVS	56.3	75.1	93.8
					SSLT	64.6	86.2	101.0
			A490	N		64.6	86.2	107.7
				X		64.6	86.2	107.7
				SC Class A	STD	64.6	86.2	98.0
					OVS	56.3	75.1	83.3
					SSLT	64.6	83.3	83.3
				SC Class B	STD	64.6	86.2	107.7
					OVS	56.3	75.1	93.8
					SSLT	64.6	86.2	107.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	6	A325/ F1852	N		81.7	108.9	136.1
				X		81.7	108.9	136.1
				SC Class A	STD	81.7	98.5	98.5
					OVS	71.2	84.0	84.0
					SSLT	81.7	84.0	84.0
				SC Class B	STD	81.7	108.9	136.1
					OVS	71.2	94.9	118.6
					SSLT	81.7	108.9	127.7
			A490	N		81.7	108.9	136.1
				X		81.7	108.9	136.1
				SC Class A	STD	81.7	108.9	123.9
					OVS	71.2	94.9	105.3
					SSLT	81.7	105.3	105.3
				SC Class B	STD	81.7	108.9	136.1
					OVS	71.2	94.9	118.6
					SSLT	81.7	108.9	136.1

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	6	A325/ F1852	N		98.6	131.4	164.3
				X		98.6	131.4	164.3
				SC Class A	STD	98.6	118.9	118.9
					OVS	85.9	101.4	101.4
					SSLT	98.6	101.4	101.4
				SC Class B	STD	98.6	131.4	164.3
					OVS	85.9	114.5	143.1
					SSLT	98.6	131.4	154.1
			A490	N		98.6	131.4	164.3
				X		98.6	131.4	164.3
				SC Class A	STD	98.6	131.4	149.6
					OVS	85.9	114.5	127.0
					SSLT	98.6	127.0	127.0
				SC Class B	STD	98.6	131.4	164.3
					OVS	85.9	114.5	143.1
					SSLT	98.6	131.4	164.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	6	A325/ F1852	N		115.7	154.2	192.8
				X		115.7	154.2	192.8
				SC Class A	STD	115.7	139.6	139.6
					OVS	100.8	119.0	119.0
					SSLT	115.7	119.0	119.0
				SC Class B	STD	115.7	154.2	192.8
					OVS	100.8	134.4	168.0
					SSLT	115.7	154.2	180.9
			A490	N		115.7	154.2	192.8
				X		115.7	154.2	192.8
				SC Class A	STD	115.7	154.2	175.5
					OVS	100.8	134.4	149.1
					SSLT	115.7	149.1	149.1
				SC Class B	STD	115.7	154.2	192.8
					OVS	100.8	134.4	168.0
					SSLT	115.7	154.2	192.8

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	6	A325/ F1852	N		132.6	176.8	221.0
				X		132.6	176.8	221.0
				SC Class A	STD	132.6	160.0	160.0
					OVS	115.6	136.4	136.4
					SSLT	132.6	136.4	136.4
				SC Class B	STD	132.6	176.8	221.0
					OVS	115.6	154.1	192.6
					SSLT	132.6	176.8	207.3
			A490	N		132.6	176.8	221.0
				X		132.6	176.8	221.0
				SC Class A	STD	132.6	176.8	201.2
					OVS	115.6	154.1	170.9
					SSLT	132.6	170.9	170.9
				SC Class B	STD	132.6	176.8	221.0
					OVS	115.6	154.1	192.6
					SSLT	132.6	176.8	221.0

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	6	A325/ F1852	N		149.5	199.4	249.2
				X		149.5	199.4	249.2
				SC Class A	STD	149.5	180.4	180.4
					OVS	130.3	153.8	153.8
					SSLT	149.5	153.8	153.8
				SC Class B	STD	149.5	199.4	249.2
					OVS	130.3	173.8	217.2
					SSLT	149.5	199.4	233.8
			A490	N		149.5	199.4	249.2
				X		149.5	199.4	249.2
				SC Class A	STD	149.5	199.4	226.9
					OVS	130.3	173.8	192.7
					SSLT	149.5	192.7	192.7
				SC Class B	STD	149.5	199.4	249.2
					OVS	130.3	173.8	217.2
					SSLT	149.5	199.4	249.2

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	6	A325/ F1852	N		165.8	221.0	276.3
				X		165.8	221.0	276.3
				SC Class A	STD	165.8	200.0	200.0
					OVS	144.5	170.5	170.5
					SSLT	165.8	170.5	170.5
				SC Class B	STD	165.8	221.0	276.3
					OVS	144.5	192.6	240.8
					SSLT	165.8	221.0	259.2
			A490	N		165.8	221.0	276.3
				X		165.8	221.0	276.3
				SC Class A	STD	165.8	221.0	251.5
					OVS	144.5	192.6	213.7
					SSLT	165.8	213.7	213.7
				SC Class B	STD	165.8	221.0	276.3
					OVS	144.5	192.6	240.8
					SSLT	165.8	221.0	276.3

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	7	A325/ F1852	N		7.9	10.5	13.1
				X		7.9	10.5	13.1
				SC Class A	STD	7.9	9.5	9.5
					OVS	6.9	8.1	8.1
					SSLT	7.9	8.1	8.1
				SC Class B	STD	7.9	10.5	13.1
					OVS	6.9	9.2	11.4
					SSLT	7.9	10.5	12.3
			A490	N		7.9	10.5	13.1
				X		7.9	10.5	13.1
				SC Class A	STD	7.9	10.5	12.0
					OVS	6.9	9.2	10.2
					SSLT	7.9	10.2	10.2
				SC Class B	STD	7.9	10.5	13.1
					OVS	6.9	9.2	11.4
					SSLT	7.9	10.5	13.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	7	A325/ F1852	N		16.0	21.3	26.6
				X		16.0	21.3	26.6
				SC Class A	STD	16.0	19.3	19.3
					OVS	13.9	16.4	16.4
					SSLT	16.0	16.4	16.4
				SC Class B	STD	16.0	21.3	26.6
					OVS	13.9	18.6	23.2
					SSLT	16.0	21.3	25.0
			A490	N		16.0	21.3	26.6
				X		16.0	21.3	26.6
				SC Class A	STD	16.0	21.3	24.3
					OVS	13.9	18.6	20.6
					SSLT	16.0	20.6	20.6
				SC Class B	STD	16.0	21.3	26.6
					OVS	13.9	18.6	23.2
					SSLT	16.0	21.3	26.6

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	7	A325/ F1852	N		28.7	38.3	47.8
				X		28.7	38.3	47.8
				SC Class A	STD	28.7	34.6	34.6
					OVS	25.0	29.5	29.5
					SSLT	28.7	29.5	29.5
				SC Class B	STD	28.7	38.3	47.8
					OVS	25.0	33.4	41.7
					SSLT	28.7	38.3	44.9
			A490	N		28.7	38.3	47.8
				X		28.7	38.3	47.8
				SC Class A	STD	28.7	38.3	43.6
					OVS	25.0	33.4	37.0
					SSLT	28.7	37.0	37.0
				SC Class B	STD	28.7	38.3	47.8
					OVS	25.0	33.4	41.7
					SSLT	28.7	38.3	47.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	7	A325/ F1852	N		42.2	56.3	70.4
				X		42.2	56.3	70.4
				SC Class A	STD	42.2	51.0	51.0
					OVS	36.8	43.5	43.5
					SSLT	42.2	43.5	43.5
				SC Class B	STD	42.2	56.3	70.4
					OVS	36.8	49.1	61.4
					SSLT	42.2	56.3	66.1
			A490	N		42.2	56.3	70.4
				X		42.2	56.3	70.4
				SC Class A	STD	42.2	56.3	64.1
					OVS	36.8	49.1	54.5
					SSLT	42.2	54.5	54.5
				SC Class B	STD	42.2	56.3	70.4
					OVS	36.8	49.1	61.4
					SSLT	42.2	56.3	70.4

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	7	A325/ F1852	N		57.6	76.8	96.0
				X		57.6	76.8	96.0
				SC Class A	STD	57.6	69.5	69.5
					OVS	50.2	59.3	59.3
					SSLT	57.6	59.3	59.3
				SC Class B	STD	57.6	76.8	96.0
					OVS	50.2	66.9	83.7
					SSLT	57.6	76.8	90.1
			A490	N		57.6	76.8	96.0
				X		57.6	76.8	96.0
				SC Class A	STD	57.6	76.8	87.4
					OVS	50.2	66.9	74.2
					SSLT	57.6	74.2	74.2
				SC Class B	STD	57.6	76.8	96.0
					OVS	50.2	66.9	83.7
					SSLT	57.6	76.8	96.0

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	7	A325/ F1852	N		73.9	98.5	123.1
				X		73.9	98.5	123.1
				SC Class A	STD	73.9	89.1	89.1
					OVS	64.4	76.0	76.0
					SSLT	73.9	76.0	76.0
				SC Class B	STD	73.9	98.5	123.1
					OVS	64.4	85.8	107.3
					SSLT	73.9	98.5	115.5
			A490	N		73.9	98.5	123.1
				X		73.9	98.5	123.1
				SC Class A	STD	73.9	98.5	112.1
					OVS	64.4	85.8	95.2
					SSLT	73.9	95.2	95.2
				SC Class B	STD	73.9	98.5	123.1
					OVS	64.4	85.8	107.3
					SSLT	73.9	98.5	123.1

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	7	A325/ F1852	N		90.6	120.9	151.1
				X		90.6	120.9	151.1
				SC Class A	STD	90.6	109.3	109.3
					OVS	79.0	93.2	93.2
					SSLT	90.6	93.2	93.2
				SC Class B	STD	90.6	120.9	151.1
					OVS	79.0	105.3	131.6
					SSLT	90.6	120.9	141.7
			A490	N		90.6	120.9	151.1
				X		90.6	120.9	151.1
				SC Class A	STD	90.6	120.9	137.5
					OVS	79.0	105.3	116.8
					SSLT	90.6	116.8	116.8
				SC Class B	STD	90.6	120.9	151.1
					OVS	79.0	105.3	131.6
					SSLT	90.6	120.9	151.1

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	7	A325/ F1852	N		107.6	143.4	179.3
				X		107.6	143.4	179.3
				SC Class A	STD	107.6	129.8	129.8
					OVS	93.7	110.6	110.6
					SSLT	107.6	110.6	110.6
				SC Class B	STD	107.6	143.4	179.3
					OVS	93.7	125.0	156.2
					SSLT	107.6	143.4	168.2
			A490	N		107.6	143.4	179.3
				X		107.6	143.4	179.3
				SC Class A	STD	107.6	143.4	163.2
					OVS	93.7	125.0	138.6
					SSLT	107.6	138.6	138.6
				SC Class B	STD	107.6	143.4	179.3
					OVS	93.7	125.0	156.2
					SSLT	107.6	143.4	179.3

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	7	A325/ F1852	N		124.7	166.3	207.8
				X		124.7	166.3	207.8
				SC Class A	STD	124.7	150.4	150.4
					OVS	108.7	128.3	128.3
					SSLT	124.7	128.3	128.3
				SC Class B	STD	124.7	166.3	207.8
					OVS	108.7	144.9	181.1
					SSLT	124.7	166.3	195.0
			A490	N		124.7	166.3	207.8
				X		124.7	166.3	207.8
				SC Class A	STD	124.7	166.3	189.2
					OVS	108.7	144.9	160.7
					SSLT	124.7	160.7	160.7
				SC Class B	STD	124.7	166.3	207.8
					OVS	108.7	144.9	181.1
					SSLT	124.7	166.3	207.8

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	7	A325/ F1852	N		142.9	190.5	238.2
				X		142.9	190.5	238.2
				SC Class A	STD	142.9	172.4	172.4
					OVS	124.5	147.0	147.0
					SSLT	142.9	147.0	147.0
				SC Class B	STD	142.9	190.5	238.2
					OVS	124.5	166.0	207.5
					SSLT	142.9	190.5	223.4
			A490	N		142.9	190.5	238.2
				X		142.9	190.5	238.2
				SC Class A	STD	142.9	190.5	216.8
					OVS	124.5	166.0	184.2
					SSLT	142.9	184.2	184.2
				SC Class B	STD	142.9	190.5	238.2
					OVS	124.5	166.0	207.5
					SSLT	142.9	190.5	238.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	7	A325/ F1852	N		158.6	211.5	264.3
				X		158.6	211.5	264.3
				SC Class A	STD	158.6	191.3	191.3
					OVS	138.2	163.1	163.1
					SSLT	158.6	163.1	163.1
				SC Class B	STD	158.6	211.5	264.3
					OVS	138.2	184.3	230.4
					SSLT	158.6	211.5	248.0
			A490	N		158.6	211.5	264.3
				X		158.6	211.5	264.3
				SC Class A	STD	158.6	211.5	240.7
					OVS	138.2	184.3	204.4
					SSLT	158.6	204.4	204.4
				SC Class B	STD	158.6	211.5	264.3
					OVS	138.2	184.3	230.4
					SSLT	158.6	211.5	264.3

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	8	A325/ F1852	N		6.8	9.1	11.4
				X		6.8	9.1	11.4
				SC Class A	STD	6.8	8.2	8.2
					OVS	5.9	7.0	7.0
					SSLT	6.8	7.0	7.0
				SC Class B	STD	6.8	9.1	11.4
					OVS	5.9	7.9	9.9
					SSLT	6.8	9.1	10.7
			A490	N		6.8	9.1	11.4
				X		6.8	9.1	11.4
				SC Class A	STD	6.8	9.1	10.4
					OVS	5.9	7.9	8.8
					SSLT	6.8	8.8	8.8
				SC Class B	STD	6.8	9.1	11.4
					OVS	5.9	7.9	9.9
					SSLT	6.8	9.1	11.4

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	8	A325/ F1852	N		13.8	18.4	23.0
				X		13.8	18.4	23.0
				SC Class A	STD	13.8	16.6	16.6
					OVS	12.0	14.2	14.2
					SSLT	13.8	14.2	14.2
				SC Class B	STD	13.8	18.4	23.0
					OVS	12.0	16.0	20.0
					SSLT	13.8	18.4	21.6
			A490	N		13.8	18.4	23.0
				X		13.8	18.4	23.0
				SC Class A	STD	13.8	18.4	20.9
					OVS	12.0	16.0	17.8
					SSLT	13.8	17.8	17.8
				SC Class B	STD	13.8	18.4	23.0
					OVS	12.0	16.0	20.0
					SSLT	13.8	18.4	23.0

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	8	A325/ F1852	N		24.9	33.2	41.5
				X		24.9	33.2	41.5
				SC Class A	STD	24.9	30.1	30.1
					OVS	21.7	25.6	25.6
					SSLT	24.9	25.6	25.6
				SC Class B	STD	24.9	33.2	41.5
					OVS	21.7	29.0	36.2
					SSLT	24.9	33.2	39.0
			A490	N		24.9	33.2	41.5
				X		24.9	33.2	41.5
				SC Class A	STD	24.9	33.2	37.8
					OVS	21.7	29.0	32.1
					SSLT	24.9	32.1	32.1
				SC Class B	STD	24.9	33.2	41.5
					OVS	21.7	29.0	36.2
					SSLT	24.9	33.2	41.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	8	A325/ F1852	N		37.5	50.0	62.5
				X		37.5	50.0	62.5
				SC Class A	STD	37.5	45.3	45.3
					OVS	32.7	38.6	38.6
					SSLT	37.5	38.6	38.6
				SC Class B	STD	37.5	50.0	62.5
					OVS	32.7	43.6	54.5
					SSLT	37.5	50.0	58.7
			A490	N		37.5	50.0	62.5
				X		37.5	50.0	62.5
				SC Class A	STD	37.5	50.0	56.9
					OVS	32.7	43.6	48.4
					SSLT	37.5	48.4	48.4
				SC Class B	STD	37.5	50.0	62.5
					OVS	32.7	43.6	54.5
					SSLT	37.5	50.0	62.5

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	8	A325/ F1852	N		51.9	69.2	86.5
				X		51.9	69.2	86.5
				SC Class A	STD	51.9	62.6	62.6
					OVS	45.2	53.4	53.4
					SSLT	51.9	53.4	53.4
				SC Class B	STD	51.9	69.2	86.5
					OVS	45.2	60.3	75.4
					SSLT	51.9	69.2	81.1
			A490	N		51.9	69.2	86.5
				X		51.9	69.2	86.5
				SC Class A	STD	51.9	69.2	78.8
					OVS	45.2	60.3	66.9
					SSLT	51.9	66.9	66.9
				SC Class B	STD	51.9	69.2	86.5
					OVS	45.2	60.3	75.4
					SSLT	51.9	69.2	86.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	8	A325/ F1852	N		67.3	89.8	112.2
				X		67.3	89.8	112.2
				SC Class A	STD	67.3	81.2	81.2
					OVS	58.7	69.3	69.3
					SSLT	67.3	69.3	69.3
				SC Class B	STD	67.3	89.8	112.2
					OVS	58.7	78.2	97.8
					SSLT	67.3	89.8	105.3
			A490	N		67.3	89.8	112.2
				X		67.3	89.8	112.2
				SC Class A	STD	67.3	89.8	102.2
					OVS	58.7	78.2	86.8
					SSLT	67.3	86.8	86.8
				SC Class B	STD	67.3	89.8	112.2
					OVS	58.7	78.2	97.8
					SSLT	67.3	89.8	112.2

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	8	A325/ F1852	N		83.6	111.5	139.3
				X		83.6	111.5	139.3
				SC Class A	STD	83.6	100.9	100.9
					OVS	72.9	86.0	86.0
					SSLT	83.6	86.0	86.0
				SC Class B	STD	83.6	111.5	139.3
					OVS	72.9	97.1	121.4
					SSLT	83.6	111.5	130.7
			A490	N		83.6	111.5	139.3
				X		83.6	111.5	139.3
				SC Class A	STD	83.6	111.5	126.9
					OVS	72.9	97.1	107.8
					SSLT	83.6	107.8	107.8
				SC Class B	STD	83.6	111.5	139.3
					OVS	72.9	97.1	121.4
					SSLT	83.6	111.5	139.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	8	A325/ F1852	N		100.2	133.7	167.1
				X		100.2	133.7	167.1
				SC Class A	STD	100.2	120.9	120.9
					OVS	87.4	103.1	103.1
					SSLT	100.2	103.1	103.1
				SC Class B	STD	100.2	133.7	167.1
					OVS	87.4	116.5	145.6
					SSLT	100.2	133.7	156.7
			A490	N		100.2	133.7	167.1
				X		100.2	133.7	167.1
				SC Class A	STD	100.2	133.7	152.1
					OVS	87.4	116.5	129.2
					SSLT	100.2	129.2	129.2
				SC Class B	STD	100.2	133.7	167.1
					OVS	87.4	116.5	145.6
					SSLT	100.2	133.7	167.1

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	8	A325/ F1852	N		117.3	156.4	195.5
				X		117.3	156.4	195.5
				SC Class A	STD	117.3	141.5	141.5
					OVS	102.2	120.7	120.7
					SSLT	117.3	120.7	120.7
				SC Class B	STD	117.3	156.4	195.5
					OVS	102.2	136.3	170.4
					SSLT	117.3	156.4	183.4
			A490	N		117.3	156.4	195.5
				X		117.3	156.4	195.5
				SC Class A	STD	117.3	156.4	178.0
					OVS	102.2	136.3	151.2
					SSLT	117.3	151.2	151.2
				SC Class B	STD	117.3	156.4	195.5
					OVS	102.2	136.3	170.4
					SSLT	117.3	156.4	195.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	8	A325/ F1852	N		134.3	179.1	223.9
				X		134.3	179.1	223.9
				SC Class A	STD	134.3	162.0	162.0
					OVS	117.1	138.2	138.2
					SSLT	134.3	138.2	138.2
				SC Class B	STD	134.3	179.1	223.9
					OVS	117.1	156.1	195.1
					SSLT	134.3	179.1	210.0
			A490	N		134.3	179.1	223.9
				X		134.3	179.1	223.9
				SC Class A	STD	134.3	179.1	203.8
					OVS	117.1	156.1	173.1
					SSLT	134.3	173.1	173.1
				SC Class B	STD	134.3	179.1	223.9
					OVS	117.1	156.1	195.1
					SSLT	134.3	179.1	223.9

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L_{eh} is assumed to be 1.25 in.

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	8	A325/ F1852	N		151.4	201.8	252.3
				X		151.4	201.8	252.3
				SC Class A	STD	151.4	182.6	182.6
					OVS	131.9	155.7	155.7
					SSLT	151.4	155.7	155.7
				SC Class B	STD	151.4	201.8	252.3
					OVS	131.9	175.9	219.9
					SSLT	151.4	201.8	236.7
			A490	N		151.4	201.8	252.3
				X		151.4	201.8	252.3
				SC Class A	STD	151.4	201.8	229.7
					OVS	131.9	175.9	195.1
					SSLT	151.4	195.1	195.1
				SC Class B	STD	151.4	201.8	252.3
					OVS	131.9	175.9	219.9
					SSLT	151.4	201.8	252.3

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
2	1	9	A325/ F1852	N		5.1	6.8	8.5
				X		5.1	6.8	8.5
				SC Class A	STD	5.1	6.2	6.2
					OVS	4.5	5.3	5.3
					SSLT	5.1	5.3	5.3
				SC Class B	STD	5.1	6.8	8.5
					OVS	4.5	5.9	7.4
					SSLT	5.1	6.8	8.0
			A490	N		5.1	6.8	8.5
				X		5.1	6.8	8.5
				SC Class A	STD	5.1	6.8	7.8
					OVS	4.5	5.9	6.6
					SSLT	5.1	6.6	6.6
				SC Class B	STD	5.1	6.8	8.5
					OVS	4.5	5.9	7.4
					SSLT	5.1	6.8	8.5

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
3	1	9	A325/ F1852	N		11.9	15.9	19.8
				X		11.9	15.9	19.8
				SC Class A	STD	11.9	14.3	14.3
					OVS	10.4	12.2	12.2
					SSLT	11.9	12.2	12.2
				SC Class B	STD	11.9	15.9	19.8
					OVS	10.4	13.8	17.3
					SSLT	11.9	15.9	18.6
			A490	N		11.9	15.9	19.8
				X		11.9	15.9	19.8
				SC Class A	STD	11.9	15.9	18.0
					OVS	10.4	13.8	15.3
					SSLT	11.9	15.3	15.3
				SC Class B	STD	11.9	15.9	19.8
					OVS	10.4	13.8	17.3
					SSLT	11.9	15.9	19.8

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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
4	1	9	A325/ F1852	N		21.8	29.0	36.3
				X		21.8	29.0	36.3
				SC Class A	STD	21.8	26.3	26.3
					OVS	19.0	22.4	22.4
					SSLT	21.8	22.4	22.4
				SC Class B	STD	21.8	29.0	36.3
					OVS	19.0	25.3	31.6
					SSLT	21.8	29.0	34.0
			A490	N		21.8	29.0	36.3
				X		21.8	29.0	36.3
				SC Class A	STD	21.8	29.0	33.0
					OVS	19.0	25.3	28.1
					SSLT	21.8	28.1	28.1
				SC Class B	STD	21.8	29.0	36.3
					OVS	19.0	25.3	31.6
					SSLT	21.8	29.0	36.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
5	1	9	A325/ F1852	N		33.1	44.1	55.1
				X		33.1	44.1	55.1
				SC Class A	STD	33.1	39.9	39.9
					OVS	28.8	34.0	34.0
					SSLT	33.1	34.0	34.0
				SC Class B	STD	33.1	44.1	55.1
					OVS	28.8	38.4	48.0
					SSLT	33.1	44.1	51.7
			A490	N		33.1	44.1	55.1
				X		33.1	44.1	55.1
				SC Class A	STD	33.1	44.1	50.2
					OVS	28.8	38.4	42.6
					SSLT	33.1	42.6	42.6
				SC Class B	STD	33.1	44.1	55.1
					OVS	28.8	38.4	48.0
					SSLT	33.1	44.1	55.1

Notes:
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All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
6	1	9	A325/ F1852	N		46.1	61.5	76.9
				X		46.1	61.5	76.9
				SC Class A	STD	46.1	55.7	55.7
					OVS	40.2	47.5	47.5
					SSLT	46.1	47.5	47.5
				SC Class B	STD	46.1	61.5	76.9
					OVS	40.2	53.6	67.0
					SSLT	46.1	61.5	72.1
			A490	N		46.1	61.5	76.9
				X		46.1	61.5	76.9
				SC Class A	STD	46.1	61.5	70.0
					OVS	40.2	53.6	59.5
					SSLT	46.1	59.5	59.5
				SC Class B	STD	46.1	61.5	76.9
					OVS	40.2	53.6	67.0
					SSLT	46.1	61.5	76.9

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
7	1	9	A325/ F1852	N		60.6	80.7	100.9
				X		60.6	80.7	100.9
				SC Class A	STD	60.6	73.1	73.1
					OVS	52.8	62.3	62.3
					SSLT	60.6	62.3	62.3
				SC Class B	STD	60.6	80.7	100.9
					OVS	52.8	70.4	88.0
					SSLT	60.6	80.7	94.7
			A490	N		60.6	80.7	100.9
				X		60.6	80.7	100.9
				SC Class A	STD	60.6	80.7	91.9
					OVS	52.8	70.4	78.1
					SSLT	60.6	78.1	78.1
				SC Class B	STD	60.6	80.7	100.9
					OVS	52.8	70.4	88.0
					SSLT	60.6	80.7	100.9

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
8	1	9	A325/ F1852	N		76.0	101.4	126.7
				X		76.0	101.4	126.7
				SC Class A	STD	76.0	91.7	91.7
					OVS	66.3	78.2	78.2
					SSLT	76.0	78.2	78.2
				SC Class B	STD	76.0	101.4	126.7
					OVS	66.3	88.3	110.4
					SSLT	76.0	101.4	118.9
			A490	N		76.0	101.4	126.7
				X		76.0	101.4	126.7
				SC Class A	STD	76.0	101.4	115.4
					OVS	66.3	88.3	98.0
					SSLT	76.0	98.0	98.0
				SC Class B	STD	76.0	101.4	126.7
					OVS	66.3	88.3	110.4
					SSLT	76.0	101.4	126.7

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
9	1	9	A325/ F1852	N		92.1	122.8	153.5
				X		92.1	122.8	153.5
				SC Class A	STD	92.1	111.1	111.1
					OVS	80.3	94.7	94.7
					SSLT	92.1	94.7	94.7
				SC Class B	STD	92.1	122.8	153.5
					OVS	80.3	107.0	133.8
					SSLT	92.1	122.8	144.0
			A490	N		92.1	122.8	153.5
				X		92.1	122.8	153.5
				SC Class A	STD	92.1	122.8	139.8
					OVS	80.3	107.0	118.7
					SSLT	92.1	118.7	118.7
				SC Class B	STD	92.1	122.8	153.5
					OVS	80.3	107.0	133.8
					SSLT	92.1	122.8	153.5

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
10	1	9	A325/ F1852	N		108.8	145.0	181.3
				X		108.8	145.0	181.3
				SC Class A	STD	108.8	131.2	131.2
					OVS	94.8	111.9	111.9
					SSLT	108.8	111.9	111.9
				SC Class B	STD	108.8	145.0	181.3
					OVS	94.8	126.4	158.0
					SSLT	108.8	145.0	170.0
			A490	N		108.8	145.0	181.3
				X		108.8	145.0	181.3
				SC Class A	STD	108.8	145.0	165.0
					OVS	94.8	126.4	140.2
					SSLT	108.8	140.2	140.2
				SC Class B	STD	108.8	145.0	181.3
					OVS	94.8	126.4	158.0
					SSLT	108.8	145.0	181.3

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
11	1	9	A325/ F1852	N		125.6	167.5	209.4
				X		125.6	167.5	209.4
				SC Class A	STD	125.6	151.6	151.6
					OVS	109.5	129.2	129.2
					SSLT	125.6	129.2	129.2
				SC Class B	STD	125.6	167.5	209.4
					OVS	109.5	146.0	182.5
					SSLT	125.6	167.5	196.4
			A490	N		125.6	167.5	209.4
				X		125.6	167.5	209.4
				SC Class A	STD	125.6	167.5	190.7
					OVS	109.5	146.0	161.9
					SSLT	125.6	161.9	161.9
				SC Class B	STD	125.6	167.5	209.4
					OVS	109.5	146.0	182.5
					SSLT	125.6	167.5	209.4

Notes:
Angles are assumed to be A992 Steel
Supporting and supported members are assumed to be A992 Steel
L_{eh} is assumed to be 1.25 in.

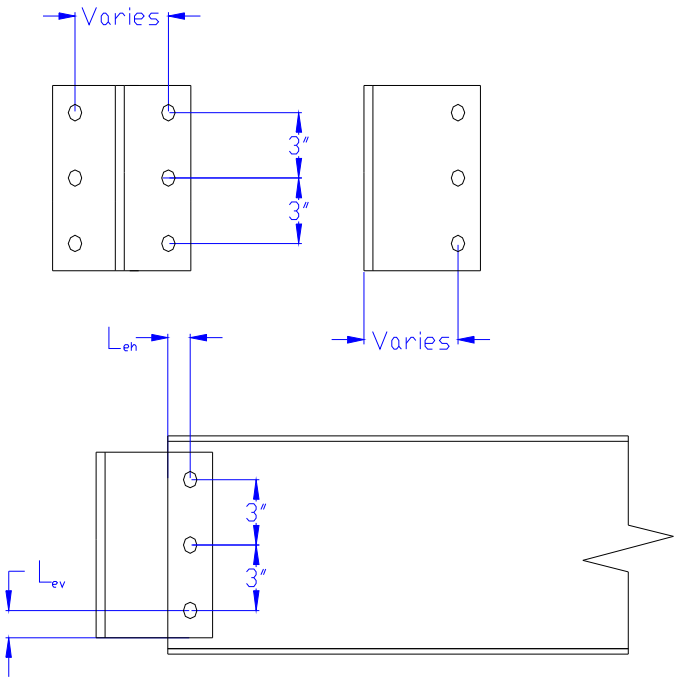
	Represents a bolt bearing limit state
	Represents a bolt shear limit state
	Represents a slip-critical limit state

All-Bolted Extended Single-Angle Connections								
N (# of Bolts)	Bolt Diameter	Angle Outstanding Leg	ASTM Desig.	Thread Cond.	Hole Type	Angle Thickness		
						3/8	1/2	5/8
12	1	9	A325/ F1852	N		142.7	190.2	237.8
				X		142.7	190.2	237.8
				SC Class A	STD	142.7	172.1	172.1
					OVS	124.3	146.7	146.7
					SSLT	142.7	146.7	146.7
				SC Class B	STD	142.7	190.2	237.8
					OVS	124.3	165.8	207.2
					SSLT	142.7	190.2	223.0
			A490	N		142.7	190.2	237.8
				X		142.7	190.2	237.8
				SC Class A	STD	142.7	190.2	216.5
					OVS	124.3	165.8	183.9
					SSLT	142.7	183.9	183.9
				SC Class B	STD	142.7	190.2	237.8
					OVS	124.3	165.8	207.2
					SSLT	142.7	190.2	237.8

APPENDIX M
3/4-INCH DIAMETER ALL-BOLTED A992 STEEL TEE CONNECTIONS

The tables given in Appendix M are all-bolted tee connections. The tees are A992 tees using either A325/F1852 or A490 3/4-inch diameter bolts. The edge distance, L_{eh}, is assumed to be 1.25 inches. Tees with a stem thickness less than the limiting thickness use the first row for the appropriate connection type. The value given in the first row is in units of kips per inch of stem thickness. The design capacity is the stem thickness times the value given. Tees with a stem thickness greater than the limiting thickness use the second row for the appropriate connection type. The value given in the second row is in units of kips. The design capacity is the value given.

* Does not meet the ductility requirements of Part 9 in the AISC Manual.



N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
2	3/4	A325/ F1852	N	0.36		t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	8.9	7.6	6.5	5.7	5.1	4.6	4.2	3.8
			X	0.45*		t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	11.1	9.6	8.2	7.2	6.4	5.8	5.3	4.8
			SC Class A	0.24	STD	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	5.8	5.0	4.3	3.7	3.3	3.0	2.8	2.5
				0.22	OVS	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	5.0	4.3	3.6	3.2	2.8	2.6	2.4	2.1
				0.20	SSLT	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	5.0	4.3	3.6	3.2	2.8	2.6	2.4	2.1
			SC Class B	0.36	STD	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	8.9	7.6	6.5	5.7	5.1	4.6	4.2	3.8
				0.33	OVS	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	7.6	6.5	5.5	4.9	4.3	3.9	3.6	3.2
				0.31	SSLT	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	7.6	6.5	5.5	4.9	4.3	3.9	3.6	3.2
		A490	N	0.45*		t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	11.1	9.6	8.2	7.2	6.4	5.8	5.3	4.8
			X	0.56*		t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	13.9	12.0	10.2	9.0	8.0	7.2	6.6	6.0
			SC Class A	0.30	STD	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	7.3	6.3	5.4	4.7	4.2	3.8	3.5	3.1
				0.27	OVS	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	6.2	5.3	4.6	4.0	3.6	3.2	2.9	2.7
				0.25	SSLT	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	6.2	5.3	4.6	4.0	3.6	3.2	2.9	2.7
			SC Class B	0.45*	STD	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	11.2	9.6	8.2	7.2	6.4	5.8	5.3	4.8
				0.41	OVS	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	9.4	8.1	6.9	6.1	5.4	4.9	4.5	4.0
				0.38	SSLT	t = limit	24.6	21.1	18.0	15.8	14.1	12.8	11.7	10.6
						t > limit	9.4	8.1	6.9	6.1	5.4	4.9	4.5	4.0

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
3	3/4	A325/ F1852	N	0.36		t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	18.3	15.4	13.2	11.6	10.3	9.4	8.6	7.8
			X	0.45*		t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	22.9	19.3	16.5	14.5	12.9	11.7	10.7	9.8
			SC Class A	0.24	STD	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	12.0	10.1	8.6	7.6	6.8	6.1	5.6	5.1
				0.22	OVS	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	10.2	8.6	7.4	6.5	5.8	5.2	4.8	4.4
				0.20	SSLT	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	10.2	8.6	7.4	6.5	5.8	5.2	4.8	4.4
			SC Class B	0.36	STD	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	18.2	15.3	13.1	11.5	10.3	9.3	8.5	7.7
				0.33	OVS	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	15.5	13.1	11.2	9.9	8.8	8.0	7.3	6.6
				0.31	SSLT	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	15.5	13.1	11.2	9.9	8.8	8.0	7.3	6.6
		A490	N	0.45*		t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	22.9	19.3	16.5	14.5	12.9	11.7	10.7	9.8
			X	0.56*		t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	28.6	24.2	20.7	18.2	16.2	14.7	13.4	12.2
			SC Class A	0.30	STD	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	15.1	12.7	10.9	9.6	8.5	7.7	7.1	6.4
				0.27	OVS	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	12.8	10.8	9.2	8.1	7.2	6.5	6.0	5.4
				0.25	SSLT	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	12.8	10.8	9.2	8.1	7.2	6.5	6.0	5.4
			SC Class B	0.45*	STD	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	22.9	19.3	16.5	14.5	12.9	11.7	10.8	9.8
				0.41	OVS	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	19.4	16.4	14.0	12.3	11.0	10.0	9.1	8.3
				0.38	SSLT	t = limit	50.6	42.7	36.5	32.1	28.6	26.0	23.8	21.6
						t > limit	19.4	16.4	14.0	12.3	11.0	10.0	9.1	8.3

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
4	3/4	A325/ F1852	N	0.36		t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	32.0	27.5	24.0	21.3	19.2	17.3	16.0	14.6
			X	0.45*		t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	40.0	34.4	30.0	26.7	24.1	21.7	20.0	18.3
			SC Class A	0.24	STD	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	20.9	18.0	15.7	13.9	12.6	11.3	10.5	9.6
				0.22	OVS	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	17.8	15.4	13.4	11.9	10.7	9.7	8.9	8.2
				0.20	SSLT	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	17.8	15.4	13.4	11.9	10.7	9.7	8.9	8.2
			SC Class B	0.36	STD	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	31.8	27.3	23.9	21.2	19.1	17.2	15.9	14.5
				0.33	OVS	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	27.1	23.4	20.4	18.1	16.3	14.7	13.6	12.4
				0.31	SSLT	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	27.1	23.4	20.4	18.1	16.3	14.7	13.6	12.4
		A490	N	0.45*		t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	40.0	34.4	30.0	26.7	24.1	21.7	20.0	18.3
			X	0.56*		t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	50.0	43.1	37.6	33.4	30.1	27.1	25.0	22.9
			SC Class A	0.30	STD	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	26.3	22.7	19.8	17.6	15.9	14.3	13.2	12.1
				0.27	OVS	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	22.3	19.2	16.8	14.9	13.4	12.1	11.2	10.2
				0.25	SSLT	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	22.3	19.2	16.8	14.9	13.4	12.1	11.2	10.2
			SC Class B	0.45*	STD	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	40.0	34.4	30.1	26.7	24.1	21.7	20.0	18.3
				0.41	OVS	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	33.9	29.2	25.5	22.6	20.4	18.4	17.0	15.5
				0.38	SSLT	t = limit	88.4	76.1	66.4	59.0	53.2	48.0	44.2	40.5
						t > limit	33.9	29.2	25.5	22.6	20.4	18.4	17.0	15.5

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
5	3/4	A325/ F1852	N	0.36		t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	47.1	41.2	36.3	32.4	29.1	26.4	24.3	22.3
			X	0.45*		t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	58.9	51.5	45.4	40.6	36.4	33.0	30.4	27.9
			SC Class A	0.24	STD	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	30.8	26.9	23.7	21.2	19.0	17.3	15.9	14.6
				0.22	OVS	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	26.3	23.0	20.2	18.1	16.3	14.7	13.6	12.4
				0.20	SSLT	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	26.3	23.0	20.2	18.1	16.3	14.7	13.6	12.4
			SC Class B	0.36	STD	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	46.8	40.9	36.0	32.2	28.9	26.2	24.2	22.1
				0.33	OVS	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	40.0	35.0	30.8	27.5	24.7	22.4	20.7	18.9
				0.31	SSLT	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	40.0	35.0	30.8	27.5	24.7	22.4	20.7	18.9
		A490	N	0.45*		t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	58.9	51.5	45.4	40.6	36.4	33.0	30.4	27.9
			X	0.56*		t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	73.7	64.5	56.8	50.8	45.6	41.3	38.1	34.9
			SC Class A	0.30	STD	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	38.8	33.9	29.9	26.7	24.0	21.7	20.0	18.3
				0.27	OVS	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	32.9	28.7	25.3	22.6	20.3	18.4	17.0	15.5
				0.25	SSLT	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	32.9	28.7	25.3	22.6	20.3	18.4	17.0	15.5
			SC Class B	0.45*	STD	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	58.9	51.6	45.4	40.6	36.4	33.1	30.5	27.9
				0.41	OVS	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	49.9	43.7	38.5	34.4	30.9	28.0	25.8	23.6
				0.38	SSLT	t = limit	130.2	114.0	100.3	89.8	80.5	73.0	67.3	61.6
						t > limit	49.9	43.7	38.5	34.4	30.9	28.0	25.8	23.6

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
6	3/4	A325/ F1852	N	0.36		t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	63.3	56.4	50.4	45.3	41.2	37.5	34.7	31.8
			X	0.45*		t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	79.2	70.6	63.1	56.7	51.5	47.0	43.4	39.8
			SC Class A	0.24	STD	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	41.4	36.9	33.0	29.6	26.9	24.5	22.7	20.8
				0.22	OVS	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	35.3	31.5	28.1	25.3	23.0	21.0	19.4	17.8
				0.20	SSLT	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	35.3	31.5	28.1	25.3	23.0	21.0	19.4	17.8
			SC Class B	0.36	STD	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	62.9	56.1	50.1	45.1	40.9	37.3	34.5	31.6
				0.33	OVS	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	53.7	47.9	42.8	38.5	35.0	31.9	29.4	27.0
				0.31	SSLT	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	53.7	47.9	42.8	38.5	35.0	31.9	29.4	27.0
		A490	N	0.45*		t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	79.2	70.6	63.1	56.7	51.5	47.0	43.4	39.8
			X	0.56*		t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	99.1	88.4	78.9	71.0	64.5	58.8	54.3	49.8
			SC Class A	0.30	STD	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	52.1	46.5	41.5	37.3	33.9	30.9	28.6	26.2
				0.27	OVS	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	44.2	39.4	35.2	31.6	28.7	26.2	24.2	22.2
				0.25	SSLT	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	44.2	39.4	35.2	31.6	28.7	26.2	24.2	22.2
			SC Class B	0.45*	STD	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	79.2	70.7	63.1	56.7	51.6	47.0	43.4	39.8
				0.41	OVS	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	67.2	59.9	53.5	48.1	43.7	39.8	36.8	33.7
				0.38	SSLT	t = limit	175.1	156.2	139.5	125.4	114.0	103.8	95.9	88.0
						t > limit	67.2	59.9	53.5	48.1	43.7	39.8	36.8	33.7

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
7	3/4	A325/ F1852	N	0.36		t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	80.3	72.7	65.7	59.6	54.4	49.9	46.3	42.6
			X	0.45*		t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	100.5	90.9	82.2	74.6	68.1	62.5	57.9	53.3
			SC Class A	0.24	STD	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	52.5	47.5	43.0	39.0	35.6	32.7	30.3	27.9
				0.22	OVS	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	44.8	40.6	36.7	33.3	30.4	27.9	25.8	23.8
				0.20	SSLT	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	44.8	40.6	36.7	33.3	30.4	27.9	25.8	23.8
			SC Class B	0.36	STD	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	79.8	72.2	65.3	59.3	54.1	49.6	46.0	42.4
				0.33	OVS	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	68.2	61.7	55.7	50.6	46.2	42.4	39.3	36.2
				0.31	SSLT	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	68.2	61.7	55.7	50.6	46.2	42.4	39.3	36.2
		A490	N	0.45*		t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	100.5	90.9	82.2	74.6	68.1	62.5	57.9	53.3
			X	0.56*		t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	125.7	113.8	102.8	93.4	85.2	78.2	72.5	66.7
			SC Class A	0.30	STD	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	66.2	59.9	54.1	49.1	44.8	41.1	38.1	35.1
				0.27	OVS	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	56.1	50.7	45.8	41.6	38.0	34.9	32.3	29.7
				0.25	SSLT	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	56.1	50.7	45.8	41.6	38.0	34.9	32.3	29.7
			SC Class B	0.45*	STD	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	100.6	91.0	82.2	74.7	68.1	62.5	57.9	53.4
				0.41	OVS	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	85.2	77.1	69.7	63.3	57.7	53.0	49.1	45.2
				0.38	SSLT	t = limit	222.2	201.1	181.7	165.0	150.5	138.2	128.0	117.9
						t > limit	85.2	77.1	69.7	63.3	57.7	53.0	49.1	45.2

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
8	3/4	A325/ F1852	N	0.36		t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	97.5	89.5	81.9	75.0	69.0	63.6	59.1	54.7
			X	0.45*		t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	122.0	112.0	102.5	93.9	86.4	79.6	74.0	68.5
			SC Class A	0.24	STD	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	63.8	58.6	53.6	49.1	45.1	41.6	38.7	35.8
				0.22	OVS	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	54.4	50.0	45.7	41.9	38.5	35.5	33.0	30.5
				0.20	SSLT	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	54.4	50.0	45.7	41.9	38.5	35.5	33.0	30.5
			SC Class B	0.36	STD	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	96.9	89.0	81.4	74.6	68.6	63.2	58.8	54.4
				0.33	OVS	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	82.7	76.0	69.5	63.7	58.6	54.0	50.2	46.4
				0.31	SSLT	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	82.7	76.0	69.5	63.7	58.6	54.0	50.2	46.4
		A490	N	0.45*		t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	122.0	112.0	102.5	93.9	86.4	79.6	74.0	68.5
			X	0.56*		t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	152.6	140.2	128.2	117.5	108.1	99.6	92.6	85.7
			SC Class A	0.30	STD	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	80.3	73.8	67.5	61.8	56.9	52.4	48.7	45.1
				0.27	OVS	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	68.0	62.5	57.2	52.4	48.2	44.4	41.3	38.2
				0.25	SSLT	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	68.0	62.5	57.2	52.4	48.2	44.4	41.3	38.2
			SC Class B	0.45*	STD	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	122.1	112.1	102.5	94.0	86.4	79.6	74.1	68.5
				0.41	OVS	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	103.4	95.0	86.9	79.6	73.2	67.5	62.8	58.0
				0.38	SSLT	t = limit	269.7	247.7	226.6	207.7	191.0	176.0	163.7	151.4
						t > limit	103.4	95.0	86.9	79.6	73.2	67.5	62.8	58.0

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
9	3/4	A325/ F1852	N	0.36		t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	114.8	106.5	98.6	91.1	84.4	78.2	73.1	67.9
			X	0.45*		t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	143.7	133.3	123.4	114.0	105.7	97.9	91.4	85.0
			SC Class A	0.24	STD	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	75.1	69.7	64.5	59.6	55.2	51.2	47.8	44.4
				0.22	OVS	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	64.1	59.5	55.1	50.9	47.2	43.7	40.8	37.9
				0.20	SSLT	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	64.1	59.5	55.1	50.9	47.2	43.7	40.8	37.9
			SC Class B	0.36	STD	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	114.1	105.9	98.0	90.6	83.9	77.8	72.6	67.5
				0.33	OVS	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	97.5	90.4	83.7	77.3	71.7	66.4	62.0	57.6
				0.31	SSLT	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	97.5	90.4	83.7	77.3	71.7	66.4	62.0	57.6
		A490	N	0.45*		t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	143.7	133.3	123.4	114.0	105.7	97.9	91.4	85.0
			X	0.56*		t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	179.8	166.8	154.4	142.7	132.2	122.5	114.4	106.3
			SC Class A	0.30	STD	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	94.6	87.8	81.2	75.1	69.6	64.5	60.2	55.9
				0.27	OVS	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	80.1	74.4	68.8	63.6	58.9	54.6	51.0	47.4
				0.25	SSLT	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	80.1	74.4	68.8	63.6	58.9	54.6	51.0	47.4
			SC Class B	0.45*	STD	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	143.8	133.4	123.5	114.1	105.7	98.0	91.5	85.0
				0.41	OVS	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	121.8	113.0	104.6	96.7	89.6	83.0	77.5	72.0
				0.38	SSLT	t = limit	317.7	294.8	272.8	252.1	233.6	216.5	202.2	187.9
						t > limit	121.8	113.0	104.6	96.7	89.6	83.0	77.5	72.0

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
10	3/4	A325/ F1852	N	0.36		t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	132.0	123.9	115.8	107.8	100.5	93.7	87.8	81.9
			X	0.45*		t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	165.2	155.0	144.9	134.9	125.8	117.2	109.8	102.5
			SC Class A	0.24	STD	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	86.3	81.0	75.7	70.5	65.7	61.3	57.4	53.6
				0.22	OVS	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	73.7	69.2	64.6	60.2	56.1	52.3	49.0	45.7
				0.20	SSLT	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	73.7	69.2	64.6	60.2	56.1	52.3	49.0	45.7
			SC Class B	0.36	STD	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	131.2	123.1	115.1	107.2	99.9	93.1	87.3	81.4
				0.33	OVS	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	112.0	105.1	98.3	91.5	85.3	79.5	74.5	69.5
				0.31	SSLT	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	112.0	105.1	98.3	91.5	85.3	79.5	74.5	69.5
		A490	N	0.45*		t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	165.2	155.0	144.9	134.9	125.8	117.2	109.8	102.5
			X	0.56*		t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	206.7	194.0	181.3	168.8	157.4	146.7	137.4	128.2
			SC Class A	0.30	STD	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	108.7	102.0	95.4	88.8	82.8	77.2	72.3	67.5
				0.27	OVS	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	92.1	86.5	80.8	75.3	70.2	65.4	61.3	57.2
				0.25	SSLT	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	92.1	86.5	80.8	75.3	70.2	65.4	61.3	57.2
			SC Class B	0.45*	STD	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	165.3	155.1	145.0	135.0	125.8	117.3	109.9	102.5
				0.41	OVS	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	140.0	131.4	122.8	114.4	106.6	99.4	93.1	86.9
				0.38	SSLT	t = limit	365.2	342.8	320.3	298.3	278.1	259.2	242.9	226.6
						t > limit	140.0	131.4	122.8	114.4	106.6	99.4	93.1	86.9

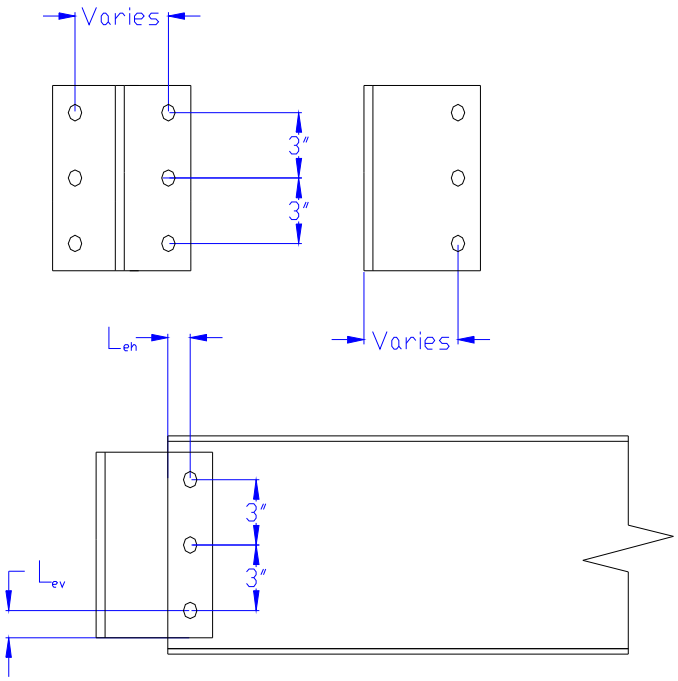
N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
11	3/4	A325/ F1852	N	0.36		t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	149.1	141.0	132.9	124.8	117.0	109.7	103.3	96.8
			X	0.45*		t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	186.7	176.5	166.4	156.2	146.5	137.3	129.3	121.2
			SC Class A	0.24	STD	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	97.6	92.2	86.9	81.6	76.5	71.8	67.5	63.3
				0.22	OVS	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	83.3	78.8	74.2	69.7	65.4	61.3	57.7	54.1
				0.20	SSLT	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	83.3	78.8	74.2	69.7	65.4	61.3	57.7	54.1
			SC Class B	0.36	STD	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	148.3	140.2	132.2	124.1	116.3	109.1	102.7	96.3
				0.33	OVS	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	126.6	119.7	112.8	106.0	99.3	93.1	87.7	82.2
				0.31	SSLT	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	126.6	119.7	112.8	106.0	99.3	93.1	87.7	82.2
		A490	N	0.45*		t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	186.7	176.5	166.4	156.2	146.5	137.3	129.3	121.2
			X	0.56*		t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	233.6	220.9	208.2	195.5	183.3	171.8	161.7	151.6
			SC Class A	0.30	STD	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	122.9	116.2	109.5	102.8	96.4	90.4	85.1	79.8
				0.27	OVS	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	104.1	98.5	92.8	87.1	81.7	76.6	72.1	67.6
				0.25	SSLT	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	104.1	98.5	92.8	87.1	81.7	76.6	72.1	67.6
			SC Class B	0.45*	STD	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	186.8	176.6	166.5	156.3	146.6	137.4	129.3	121.3
				0.41	OVS	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	158.3	149.7	141.0	132.4	124.2	116.4	109.6	102.8
				0.38	SSLT	t = limit	412.7	390.3	367.8	345.4	323.8	303.6	285.8	268.0
						t > limit	158.3	149.7	141.0	132.4	124.2	116.4	109.6	102.8

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
12	3/4	A325/ F1852	N	0.36		t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	165.4	158.4	150.1	142.0	133.9	126.2	119.3	112.3
			X	0.45*		t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	207.0	198.2	187.9	177.7	167.6	158.0	149.3	140.5
			SC Class A	0.24	STD	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	108.2	103.6	98.2	92.9	87.6	82.6	78.0	73.4
				0.22	OVS	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	92.4	88.4	83.8	79.3	74.8	70.5	66.6	62.7
				0.20	SSLT	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	92.4	88.4	83.8	79.3	74.8	70.5	66.6	62.7
			SC Class B	0.36	STD	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	164.4	157.4	149.2	141.2	133.1	125.5	118.6	111.6
				0.33	OVS	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	140.4	134.4	127.4	120.5	113.6	107.2	101.2	95.3
				0.31	SSLT	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	140.4	134.4	127.4	120.5	113.6	107.2	101.2	95.3
		A490	N	0.45*		t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	207.0	198.2	187.9	177.7	167.6	158.0	149.3	140.5
			X	0.56*		t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	259.0	248.0	235.1	222.4	209.7	197.7	186.8	175.8
			SC Class A	0.30	STD	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	136.2	130.5	123.7	117.0	110.3	104.0	98.3	92.5
				0.27	OVS	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	115.4	110.6	104.8	99.1	93.5	88.1	83.3	78.4
				0.25	SSLT	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	115.4	110.6	104.8	99.1	93.5	88.1	83.3	78.4
			SC Class B	0.45*	STD	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	207.1	198.3	188.0	177.8	167.7	158.1	149.3	140.6
				0.41	OVS	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	175.5	168.0	159.3	150.7	142.1	134.0	126.5	119.1
				0.38	SSLT	t = limit	457.6	438.2	415.4	392.9	370.5	349.4	330.0	310.6
						t > limit	175.5	168.0	159.3	150.7	142.1	134.0	126.5	119.1

APPENDIX N
7/8-INCH DIAMETER ALL-BOLTED A992 STEEL TEE CONNECTIONS

The tables given in Appendix N are all-bolted tee connections. The tees are A992 tees using either A325/F1852 or A490 7/8-inch diameter bolts. The edge distance, L_{eh}, is assumed to be 1.25 inches. Tees with a stem thickness less than the limiting thickness use the first row for the appropriate connection type. The value given in the first row is in units of kips per inch of stem thickness. The design capacity is the stem thickness times the value given. Tees with a stem thickness greater than the limiting thickness use the second row for the appropriate connection type. The value given in the second row is in units of kips. The design capacity is the value given.

* Does not meet the ductility requirements of Part 9 in the AISC Manual.



N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
2	7/8	A325/ F1852	N	0.49		t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	12.1	10.4	8.9	7.8	6.9	6.3	5.7	5.2
			X	0.66*		t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	15.2	13.0	11.1	9.8	8.7	7.9	7.2	6.5
			SC Class A	0.36	STD	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	8.1	7.0	5.9	5.2	4.6	4.2	3.8	3.5
				0.33	OVS	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	6.9	6.0	5.1	4.5	4.0	3.6	3.3	3.0
				0.30	SSLT	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	6.9	6.0	5.1	4.5	4.0	3.6	3.3	3.0
			SC Class B	0.54*	STD	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	8.9	7.6	6.5	5.7	5.1	4.6	4.2	3.8
				0.50*	OVS	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	7.6	6.5	5.5	4.9	4.3	3.9	3.6	3.2
				0.46	SSLT	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	7.6	6.5	5.5	4.9	4.3	3.9	3.6	3.2
		A490	N	0.66*		t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	15.2	13.0	11.1	9.8	8.7	7.9	7.2	6.5
			X	0.83*		t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	18.9	16.2	13.9	12.2	10.8	9.8	9.0	8.1
			SC Class A	0.45	STD	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	10.2	8.8	7.5	6.6	5.9	5.3	4.8	4.4
				0.41	OVS	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	8.7	7.4	6.4	5.6	5.0	4.5	4.1	3.7
				0.38	SSLT	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	8.7	7.4	6.4	5.6	5.0	4.5	4.1	3.7
			SC Class B	0.68*	STD	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	15.6	13.4	11.4	10.0	8.9	8.1	7.4	6.7
				0.63*	OVS	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	13.2	11.3	9.7	8.5	7.5	6.8	6.2	5.7
				0.58*	SSLT	t = limit	22.8	19.6	16.7	14.7	13.1	11.8	10.8	9.8
						t > limit	13.2	11.3	9.7	8.5	7.5	6.8	6.2	5.7

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
3	7/8	A325/ F1852	N	0.49		t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	24.8	21.0	17.9	15.8	14.0	12.7	11.7	10.6
			X	0.66*		t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	31.2	26.3	22.5	19.8	17.6	16.0	14.6	13.3
			SC Class A	0.36	STD	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	16.7	14.1	12.0	10.6	9.4	8.6	7.8	7.1
				0.33	OVS	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	14.3	12.0	10.3	9.1	8.1	7.3	6.7	6.1
				0.30	SSLT	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	14.3	12.0	10.3	9.1	8.1	7.3	6.7	6.1
			SC Class B	0.54*	STD	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	18.2	15.3	13.1	11.5	10.3	9.3	8.5	7.7
				0.50*	OVS	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	15.5	13.1	11.2	9.9	8.8	8.0	7.3	6.6
				0.46	SSLT	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	15.5	13.1	11.2	9.9	8.8	8.0	7.3	6.6
		A490	N	0.66*		t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	31.2	26.3	22.5	19.8	17.6	16.0	14.6	13.3
			X	0.83*		t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	38.9	32.8	28.1	24.7	22.0	19.9	18.3	16.6
			SC Class A	0.45	STD	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	21.0	17.8	15.2	13.4	11.9	10.8	9.9	9.0
				0.41	OVS	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	17.8	15.0	12.9	11.3	10.1	9.1	8.4	7.6
				0.38	SSLT	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	17.8	15.0	12.9	11.3	10.1	9.1	8.4	7.6
			SC Class B	0.68*	STD	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	32.0	27.0	23.1	20.3	18.1	16.4	15.0	13.6
				0.63*	OVS	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	27.1	22.9	19.6	17.2	15.3	13.9	12.7	11.5
				0.58*	SSLT	t = limit	46.9	39.6	33.9	29.8	26.5	24.1	22.0	20.0
						t > limit	27.1	22.9	19.6	17.2	15.3	13.9	12.7	11.5

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
4	7/8	A325/ F1852	N	0.49		t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	43.4	37.4	32.6	28.9	26.1	23.5	21.7	19.9
			X	0.66*		t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	54.5	46.9	40.9	36.3	32.8	29.5	27.2	24.9
			SC Class A	0.36	STD	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	29.1	25.1	21.9	19.4	17.5	15.8	14.6	13.3
				0.33	OVS	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	24.9	21.5	18.7	16.6	15.0	13.5	12.5	11.4
				0.30	SSLT	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	24.9	21.5	18.7	16.6	15.0	13.5	12.5	11.4
			SC Class B	0.54*	STD	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	31.8	27.3	23.9	21.2	19.1	17.2	15.9	14.5
				0.50*	OVS	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	27.1	23.4	20.4	18.1	16.3	14.7	13.6	12.4
				0.46	SSLT	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	27.1	23.4	20.4	18.1	16.3	14.7	13.6	12.4
		A490	N	0.66*		t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	54.5	46.9	40.9	36.3	32.8	29.5	27.2	24.9
			X	0.83*		t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	67.9	58.5	51.0	45.3	40.9	36.8	34.0	31.1
			SC Class A	0.45	STD	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	36.8	31.7	27.6	24.5	22.1	19.9	18.4	16.8
				0.41	OVS	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	31.2	26.8	23.4	20.8	18.8	16.9	15.6	14.3
				0.38	SSLT	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	31.2	26.8	23.4	20.8	18.8	16.9	15.6	14.3
			SC Class B	0.68*	STD	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	55.9	48.1	42.0	37.3	33.7	30.3	28.0	25.6
				0.63*	OVS	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	47.4	40.8	35.6	31.6	28.5	25.7	23.7	21.7
				0.58*	SSLT	t = limit	82.0	70.6	61.6	54.7	49.4	44.5	41.0	37.5
						t > limit	47.4	40.8	35.6	31.6	28.5	25.7	23.7	21.7

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
5	7/8	A325/ F1852	N	0.49		t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	63.9	55.9	49.2	44.1	39.5	35.9	33.0	30.2
			X	0.66*		t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	80.2	70.2	61.8	55.3	49.6	45.0	41.5	37.9
			SC Class A	0.36	STD	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	42.9	37.6	33.1	29.6	26.5	24.1	22.2	20.3
				0.33	OVS	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	36.7	32.1	28.3	25.3	22.7	20.6	19.0	17.4
				0.30	SSLT	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	36.7	32.1	28.3	25.3	22.7	20.6	19.0	17.4
			SC Class B	0.54*	STD	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	46.8	40.9	36.0	32.2	28.9	26.2	24.2	22.1
				0.50*	OVS	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	40.0	35.0	30.8	27.5	24.7	22.4	20.7	18.9
				0.46	SSLT	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	40.0	35.0	30.8	27.5	24.7	22.4	20.7	18.9
		A490	N	0.66*		t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	80.2	70.2	61.8	55.3	49.6	45.0	41.5	37.9
			X	0.83*		t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	100.0	87.5	77.1	69.0	61.9	56.1	51.7	47.3
			SC Class A	0.45	STD	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	54.2	47.4	41.7	37.3	33.5	30.4	28.0	25.6
				0.41	OVS	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	45.9	40.1	35.3	31.6	28.4	25.7	23.7	21.7
				0.38	SSLT	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	45.9	40.1	35.3	31.6	28.4	25.7	23.7	21.7
			SC Class B	0.68*	STD	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	82.3	72.0	63.4	56.7	50.9	46.2	42.6	38.9
				0.63*	OVS	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	69.7	61.0	53.7	48.1	43.1	39.1	36.0	33.0
				0.58*	SSLT	t = limit	120.8	105.7	93.0	83.2	74.7	67.7	62.4	57.1
						t > limit	69.7	61.0	53.7	48.1	43.1	39.1	36.0	33.0

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
6	7/8	A325/ F1852	N	0.49		t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	86.0	76.7	68.5	61.6	55.9	51.0	47.1	43.2
			X	0.66*		t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	107.9	96.2	85.9	77.2	70.2	64.0	59.1	54.2
			SC Class A	0.36	STD	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	57.7	51.5	46.0	41.3	37.6	34.2	31.6	29.0
				0.33	OVS	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	49.4	44.0	39.3	35.3	32.1	29.3	27.0	24.8
				0.30	SSLT	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	49.4	44.0	39.3	35.3	32.1	29.3	27.0	24.8
			SC Class B	0.54*	STD	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	62.9	56.1	50.1	45.1	40.9	37.3	34.5	31.6
				0.50*	OVS	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	53.7	47.9	42.8	38.5	35.0	31.9	29.4	27.0
				0.46	SSLT	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	53.7	47.9	42.8	38.5	35.0	31.9	29.4	27.0
		A490	N	0.66*		t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	107.9	96.2	85.9	77.2	70.2	64.0	59.1	54.2
			X	0.83*		t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	134.5	120.0	107.1	96.3	87.5	79.8	73.7	67.6
			SC Class A	0.45	STD	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	72.8	65.0	58.0	52.2	47.4	43.2	39.9	36.6
				0.41	OVS	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	61.7	55.0	49.1	44.2	40.1	36.6	33.8	31.0
				0.38	SSLT	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	61.7	55.0	49.1	44.2	40.1	36.6	33.8	31.0
			SC Class B	0.68*	STD	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	110.7	98.7	88.2	79.3	72.0	65.6	60.6	55.6
				0.63*	OVS	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	93.8	83.6	74.7	67.1	61.0	55.6	51.4	47.1
				0.58*	SSLT	t = limit	162.4	144.8	129.3	116.3	105.7	96.3	88.9	81.6
						t > limit	93.8	83.6	74.7	67.1	61.0	55.6	51.4	47.1

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
7	7/8	A325/ F1852	N	0.49		t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	109.1	98.7	89.2	81.0	73.9	67.8	62.9	57.9
			X	0.66*		t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	136.9	123.8	111.9	101.6	92.7	85.1	78.9	72.6
			SC Class A	0.36	STD	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	73.2	66.3	59.9	54.4	49.6	45.5	42.2	38.9
				0.33	OVS	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	62.6	56.7	51.2	46.5	42.4	38.9	36.1	33.2
				0.30	SSLT	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	62.6	56.7	51.2	46.5	42.4	38.9	36.1	33.2
			SC Class B	0.54*	STD	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	79.8	72.2	65.3	59.3	54.1	49.6	46.0	42.4
				0.50*	OVS	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	68.2	61.7	55.7	50.6	46.2	42.4	39.3	36.2
				0.46	SSLT	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	68.2	61.7	55.7	50.6	46.2	42.4	39.3	36.2
		A490	N	0.66*		t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	136.9	123.8	111.9	101.6	92.7	85.1	78.9	72.6
			X	0.83*		t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	170.7	154.5	139.6	126.8	115.6	106.1	98.4	90.6
			SC Class A	0.45	STD	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	92.4	83.6	75.6	68.6	62.6	57.5	53.3	49.0
				0.41	OVS	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	78.3	70.8	64.0	58.1	53.0	48.7	45.1	41.5
				0.38	SSLT	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	78.3	70.8	64.0	58.1	53.0	48.7	45.1	41.5
			SC Class B	0.68*	STD	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	140.5	127.1	114.9	104.3	95.1	87.3	80.9	74.5
				0.63*	OVS	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	119.0	107.7	97.3	88.4	80.6	74.0	68.6	63.1
				0.58*	SSLT	t = limit	206.0	186.5	168.5	153.0	139.5	128.1	118.7	109.3
						t > limit	119.0	107.7	97.3	88.4	80.6	74.0	68.6	63.1

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
8	7/8	A325/ F1852	N	0.49		t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	132.4	121.6	111.2	102.0	93.7	86.4	80.4	74.3
			X	0.66*		t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	166.1	152.6	139.6	127.9	117.6	108.4	100.8	93.2
			SC Class A	0.36	STD	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	88.9	81.6	74.7	68.4	62.9	58.0	53.9	49.9
				0.33	OVS	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	76.0	69.8	63.9	58.5	53.8	49.6	46.1	42.7
				0.30	SSLT	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	76.0	69.8	63.9	58.5	53.8	49.6	46.1	42.7
			SC Class B	0.54*	STD	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	96.9	89.0	81.4	74.6	68.6	63.2	58.8	54.4
				0.50*	OVS	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	82.7	76.0	69.5	63.7	58.6	54.0	50.2	46.4
				0.46	SSLT	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	82.7	76.0	69.5	63.7	58.6	54.0	50.2	46.4
		A490	N	0.66*		t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	166.1	152.6	139.6	127.9	117.6	108.4	100.8	93.2
			X	0.83*		t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	207.2	190.3	174.1	159.5	146.7	135.2	125.7	116.3
			SC Class A	0.45	STD	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	112.2	103.0	94.2	86.4	79.4	73.2	68.1	63.0
				0.41	OVS	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	95.0	87.3	79.8	73.2	67.3	62.0	57.7	53.3
				0.38	SSLT	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	95.0	87.3	79.8	73.2	67.3	62.0	57.7	53.3
			SC Class B	0.68*	STD	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	170.5	156.6	143.3	131.3	120.7	111.3	103.5	95.7
				0.63*	OVS	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	144.4	132.6	121.3	111.2	102.3	94.2	87.6	81.0
				0.58*	SSLT	t = limit	250.1	229.7	210.1	192.6	177.1	163.2	151.8	140.4
						t > limit	144.4	132.6	121.3	111.2	102.3	94.2	87.6	81.0

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
9	7/8	A325/ F1852	N	0.49		t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	156.0	144.7	133.9	123.8	114.7	106.3	99.3	92.2
			X	0.66*		t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	195.7	181.6	168.0	155.3	143.9	133.3	124.5	115.7
			SC Class A	0.36	STD	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	104.7	97.2	89.9	83.1	77.0	71.3	66.6	61.9
				0.33	OVS	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	89.5	83.1	76.9	71.1	65.8	61.0	57.0	52.9
				0.30	SSLT	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	89.5	83.1	76.9	71.1	65.8	61.0	57.0	52.9
			SC Class B	0.54*	STD	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	114.1	105.9	98.0	90.6	83.9	77.8	72.6	67.5
				0.50*	OVS	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	97.5	90.4	83.7	77.3	71.7	66.4	62.0	57.6
				0.46	SSLT	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	97.5	90.4	83.7	77.3	71.7	66.4	62.0	57.6
		A490	N	0.66*		t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	195.7	181.6	168.0	155.3	143.9	133.3	124.5	115.7
			X	0.83*		t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	244.0	226.5	209.6	193.7	179.5	166.3	155.3	144.3
			SC Class A	0.45	STD	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	132.1	122.6	113.5	104.9	97.2	90.0	84.1	78.1
				0.41	OVS	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	111.9	103.9	96.1	88.8	82.3	76.3	71.2	66.2
				0.38	SSLT	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	111.9	103.9	96.1	88.8	82.3	76.3	71.2	66.2
			SC Class B	0.68*	STD	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	200.8	186.4	172.5	159.4	147.7	136.9	127.8	118.8
				0.63*	OVS	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	170.1	157.9	146.1	135.0	125.1	115.9	108.3	100.6
				0.58*	SSLT	t = limit	294.6	273.4	253.0	233.8	216.6	200.7	187.5	174.2
						t > limit	170.1	157.9	146.1	135.0	125.1	115.9	108.3	100.6

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
10	7/8	A325/ F1852	N	0.49		t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	179.3	168.3	157.2	146.4	136.5	127.2	119.2	111.2
			X	0.66*		t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	224.9	211.1	197.3	183.7	171.3	159.6	149.6	139.6
			SC Class A	0.36	STD	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	120.4	113.0	105.6	98.3	91.6	85.4	80.0	74.7
				0.33	OVS	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	102.9	96.6	90.3	84.1	78.4	73.0	68.4	63.9
				0.30	SSLT	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	102.9	96.6	90.3	84.1	78.4	73.0	68.4	63.9
			SC Class B	0.54*	STD	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	131.2	123.1	115.1	107.2	99.9	93.1	87.3	81.4
				0.50*	OVS	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	112.0	105.1	98.3	91.5	85.3	79.5	74.5	69.5
				0.46	SSLT	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	112.0	105.1	98.3	91.5	85.3	79.5	74.5	69.5
		A490	N	0.66*		t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	224.9	211.1	197.3	183.7	171.3	159.6	149.6	139.6
			X	0.83*		t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	280.5	263.3	246.1	229.2	213.6	199.1	186.6	174.1
			SC Class A	0.45	STD	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	151.9	142.6	133.2	124.1	115.7	107.8	101.0	94.2
				0.41	OVS	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	128.7	120.7	112.8	105.1	98.0	91.3	85.6	79.8
				0.38	SSLT	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	128.7	120.7	112.8	105.1	98.0	91.3	85.6	79.8
			SC Class B	0.68*	STD	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	230.9	216.7	202.5	188.6	175.8	163.8	153.5	143.3
				0.63*	OVS	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	195.5	183.5	171.5	159.7	148.9	138.8	130.1	121.3
				0.58*	SSLT	t = limit	338.6	317.8	297.0	276.6	257.9	240.3	225.2	210.1
						t > limit	195.5	183.5	171.5	159.7	148.9	138.8	130.1	121.3

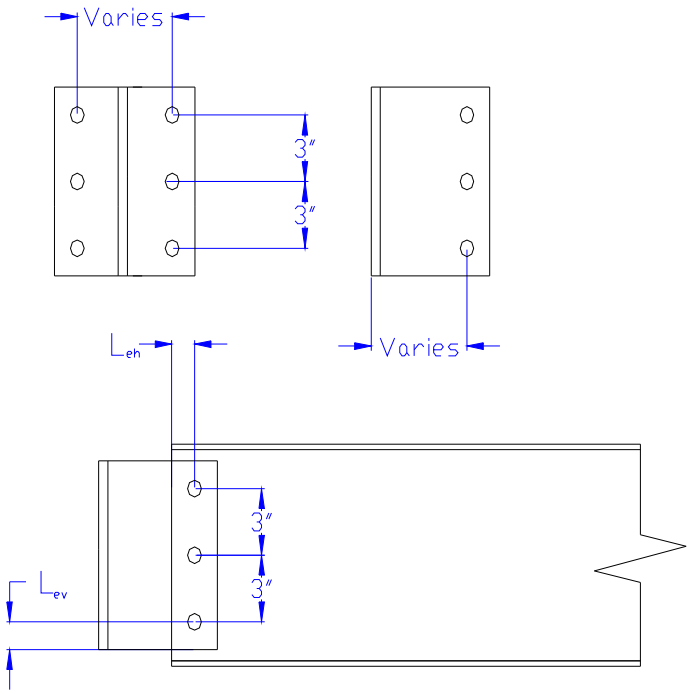
N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
11	7/8	A325/ F1852	N	0.49		t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	202.6	191.6	180.6	169.6	159.0	149.0	140.3	131.5
			X	0.66*		t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	254.2	240.4	226.6	212.7	199.5	187.0	176.0	165.0
			SC Class A	0.36	STD	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	136.0	128.6	121.2	113.8	106.7	100.1	94.2	88.3
				0.33	OVS	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	116.3	110.0	103.7	97.3	91.3	85.6	80.5	75.5
				0.30	SSLT	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	116.3	110.0	103.7	97.3	91.3	85.6	80.5	75.5
			SC Class B	0.54*	STD	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	148.3	140.2	132.2	124.1	116.3	109.1	102.7	96.3
				0.50*	OVS	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	126.6	119.7	112.8	106.0	99.3	93.1	87.7	82.2
				0.46	SSLT	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	126.6	119.7	112.8	106.0	99.3	93.1	87.7	82.2
		A490	N	0.66*		t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	254.2	240.4	226.6	212.7	199.5	187.0	176.0	165.0
			X	0.83*		t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	317.0	299.8	282.6	265.3	248.8	233.2	219.5	205.8
			SC Class A	0.45	STD	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	171.7	162.3	153.0	143.7	134.7	126.3	118.9	111.4
				0.41	OVS	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	145.4	137.5	129.6	121.7	114.1	107.0	100.7	94.4
				0.38	SSLT	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	145.4	137.5	129.6	121.7	114.1	107.0	100.7	94.4
			SC Class B	0.68*	STD	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	260.9	246.7	232.5	218.4	204.7	191.9	180.7	169.4
				0.63*	OVS	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	221.0	209.0	197.0	184.9	173.4	162.6	153.0	143.5
				0.58*	SSLT	t = limit	382.7	361.9	341.1	320.3	300.3	281.5	265.0	248.5
						t > limit	221.0	209.0	197.0	184.9	173.4	162.6	153.0	143.5

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
12	7/8	A325/ F1852	N	0.49		t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	224.6	215.1	203.9	192.9	181.9	171.5	162.0	152.5
			X	0.66*		t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	281.8	269.9	255.8	242.0	228.2	215.2	203.3	191.3
			SC Class A	0.36	STD	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	150.8	144.4	136.9	129.5	122.1	115.1	108.8	102.4
				0.33	OVS	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	129.0	123.5	117.1	110.7	104.4	98.5	93.0	87.5
				0.30	SSLT	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	129.0	123.5	117.1	110.7	104.4	98.5	93.0	87.5
			SC Class B	0.54*	STD	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	164.4	157.4	149.2	141.2	133.1	125.5	118.6	111.6
				0.50*	OVS	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	140.4	134.4	127.4	120.5	113.6	107.2	101.2	95.3
				0.46	SSLT	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	140.4	134.4	127.4	120.5	113.6	107.2	101.2	95.3
		A490	N	0.66*		t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	281.8	269.9	255.8	242.0	228.2	215.2	203.3	191.3
			X	0.83*		t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	351.5	336.6	319.1	301.8	284.6	268.4	253.5	238.6
			SC Class A	0.45	STD	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	190.3	182.3	172.8	163.4	154.1	145.3	137.3	129.2
				0.41	OVS	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	161.2	154.4	146.3	138.4	130.5	123.1	116.3	109.4
				0.38	SSLT	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	161.2	154.4	146.3	138.4	130.5	123.1	116.3	109.4
			SC Class B	0.68*	STD	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	289.3	277.0	262.6	248.4	234.2	220.9	208.6	196.4
				0.63*	OVS	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	245.0	234.7	222.4	210.4	198.4	187.1	176.7	166.3
				0.58*	SSLT	t = limit	424.3	406.4	385.2	364.3	343.5	324.0	306.0	288.0
						t > limit	245.0	234.7	222.4	210.4	198.4	187.1	176.7	166.3

APPENDIX O
1-INCH DIAMETER ALL-BOLTED A992 STEEL TEE CONNECTIONS

The tables given in Appendix O are all-bolted tee connections. The tees are A992 tees using either A325/F1852 or A490 1-inch diameter bolts. The edge distance, L_{eh}, is assumed to be 1.25 inches. Tees with a stem thickness less than the limiting thickness use the first row for the appropriate connection type. The value given in the first row is in units of kips per inch of stem thickness. The design capacity is the stem thickness times the value given. Tees with a stem thickness greater than the limiting thickness use the second row for the appropriate connection type. The value given in the second row is in units of kips. The design capacity is the value given.

* Does not meet the ductility requirements of Part 9 in the AISC Manual.



N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
2	1	A325/ F1852	N	0.75*		t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	15.8	13.6	11.6	10.2	9.1	8.2	7.5	6.8
			X	0.94*		t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	19.8	16.9	14.5	12.7	11.3	10.2	9.4	8.5
			SC Class A	0.51	STD	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	10.6	9.1	7.8	6.8	6.1	5.5	5.0	4.6
				0.50	OVS	t = limit	18.3	15.6	13.4	11.7	10.4	9.5	8.6	7.8
						t > limit	9.1	7.8	6.6	5.8	5.2	4.7	4.3	3.9
				0.43	SSLT	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	9.1	7.8	6.6	5.8	5.2	4.7	4.3	3.9
			SC Class B	0.77*	STD	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	16.2	13.9	11.8	10.4	9.2	8.4	7.7	6.9
				0.76*	OVS	t = limit	18.3	15.6	13.4	11.7	10.4	9.5	8.6	7.8
						t > limit	13.8	11.8	10.1	8.9	7.9	7.1	6.5	5.9
				0.66*	SSLT	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	13.8	11.8	10.1	8.9	7.9	7.1	6.5	5.9
		A490	N	0.94*		t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	19.8	16.9	14.5	12.7	11.3	10.2	9.4	8.5
			X	1.18*		t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	24.8	21.2	18.1	15.9	14.1	12.8	11.7	10.6
			SC Class A	0.64*	STD	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	13.4	11.5	9.8	8.6	7.6	6.9	6.3	5.7
				0.62*	OVS	t = limit	18.3	15.6	13.4	11.7	10.4	9.5	8.6	7.8
						t > limit	11.4	9.7	8.3	7.3	6.5	5.9	5.4	4.9
				0.54	SSLT	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	11.4	9.7	8.3	7.3	6.5	5.9	5.4	4.9
			SC Class B	0.97*	STD	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	20.3	17.4	14.9	13.1	11.6	10.5	9.6	8.7
				0.95*	OVS	t = limit	18.3	15.6	13.4	11.7	10.4	9.5	8.6	7.8
						t > limit	17.3	14.8	12.7	11.1	9.9	8.9	8.2	7.4
				0.82*	SSLT	t = limit	21.0	18.0	15.4	13.5	12.0	10.9	9.9	9.0
						t > limit	17.3	14.8	12.7	11.1	9.9	8.9	8.2	7.4

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
3	1	A325/ F1852	N	0.75*		t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	32.5	27.5	23.5	20.7	18.4	16.7	15.3	13.9
			X	0.94*		t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	40.6	34.2	29.3	25.8	22.9	20.8	19.1	17.3
			SC Class A	0.51	STD	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	21.9	18.4	15.8	13.9	12.4	11.2	10.3	9.3
				0.50	OVS	t = limit	37.5	31.6	27.1	23.8	21.2	19.2	17.6	16.0
						t > limit	18.6	15.7	13.4	11.8	10.5	9.6	8.7	7.9
				0.43	SSLT	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	18.6	15.7	13.4	11.8	10.5	9.6	8.7	7.9
			SC Class B	0.77*	STD	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	33.2	28.0	24.0	21.1	18.8	17.0	15.6	14.2
				0.76*	OVS	t = limit	37.5	31.6	27.1	23.8	21.2	19.2	17.6	16.0
						t > limit	28.3	23.9	20.4	18.0	16.0	14.5	13.3	12.1
				0.66*	SSLT	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	28.3	23.9	20.4	18.0	16.0	14.5	13.3	12.1
		A490	N	0.94*		t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	40.6	34.2	29.3	25.8	22.9	20.8	19.1	17.3
			X	1.18*		t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	50.8	42.9	36.7	32.3	28.7	26.1	23.9	21.7
			SC Class A	0.64*	STD	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	27.5	23.2	19.8	17.4	15.5	14.1	12.9	11.7
				0.62*	OVS	t = limit	37.5	31.6	27.1	23.8	21.2	19.2	17.6	16.0
						t > limit	23.3	19.7	16.8	14.8	13.2	12.0	11.0	9.9
				0.54	SSLT	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	23.3	19.7	16.8	14.8	13.2	12.0	11.0	9.9
			SC Class B	0.97*	STD	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	41.8	35.2	30.2	26.5	23.6	21.4	19.6	17.8
				0.95*	OVS	t = limit	37.5	31.6	27.1	23.8	21.2	19.2	17.6	16.0
						t > limit	35.5	29.9	25.6	22.5	20.1	18.2	16.7	15.1
				0.82*	SSLT	t = limit	43.1	36.4	31.1	27.4	24.4	22.1	20.3	18.4
						t > limit	35.5	29.9	25.6	22.5	20.1	18.2	16.7	15.1

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
4	1	A325/ F1852	N	0.75*		t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	56.9	49.0	42.7	37.9	34.2	30.8	28.4	26.0
			X	0.94*		t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	71.0	61.1	53.3	47.3	42.7	38.5	35.5	32.5
			SC Class A	0.51	STD	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	38.2	32.9	28.7	25.5	23.0	20.7	19.1	17.5
				0.50	OVS	t = limit	65.5	56.4	49.2	43.7	39.4	35.5	32.8	30.0
						t > limit	32.6	28.0	24.5	21.7	19.6	17.7	16.3	14.9
				0.43	SSLT	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	32.6	28.0	24.5	21.7	19.6	17.7	16.3	14.9
			SC Class B	0.77*	STD	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	58.0	50.0	43.6	38.7	34.9	31.5	29.0	26.6
				0.76*	OVS	t = limit	65.5	56.4	49.2	43.7	39.4	35.5	32.8	30.0
						t > limit	49.5	42.6	37.2	33.0	29.8	26.8	24.7	22.7
				0.66*	SSLT	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	49.5	42.6	37.2	33.0	29.8	26.8	24.7	22.7
		A490	N	0.94*		t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	71.0	61.1	53.3	47.3	42.7	38.5	35.5	32.5
			X	1.18*		t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	88.8	76.5	66.7	59.2	53.5	48.2	44.4	40.7
			SC Class A	0.64*	STD	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	48.0	41.3	36.1	32.0	28.9	26.1	24.0	22.0
				0.62*	OVS	t = limit	65.5	56.4	49.2	43.7	39.4	35.5	32.8	30.0
						t > limit	40.8	35.1	30.7	27.2	24.6	22.1	20.4	18.7
				0.54	SSLT	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	40.8	35.1	30.7	27.2	24.6	22.1	20.4	18.7
			SC Class B	0.97*	STD	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	73.0	62.8	54.9	48.7	44.0	39.6	36.5	33.4
				0.95*	OVS	t = limit	65.5	56.4	49.2	43.7	39.4	35.5	32.8	30.0
						t > limit	62.0	53.4	46.6	41.3	37.3	33.6	31.0	28.4
				0.82*	SSLT	t = limit	75.4	64.9	56.6	50.3	45.4	40.9	37.7	34.5
						t > limit	62.0	53.4	46.6	41.3	37.3	33.6	31.0	28.4

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
5	1	A325/ F1852	N	0.75*		t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	83.8	73.3	64.5	57.7	51.8	47.0	43.3	39.6
			X	0.94*		t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	104.5	91.4	80.5	72.0	64.6	58.6	54.0	49.4
			SC Class A	0.51	STD	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	56.2	49.2	43.3	38.8	34.8	31.5	29.1	26.6
				0.50	OVS	t = limit	96.5	84.4	74.3	66.5	59.7	54.1	49.9	45.6
						t > limit	48.0	42.0	36.9	33.0	29.6	26.9	24.8	22.7
				0.43	SSLT	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	48.0	42.0	36.9	33.0	29.6	26.9	24.8	22.7
			SC Class B	0.77*	STD	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	85.5	74.8	65.8	58.9	52.9	47.9	44.2	40.4
				0.76*	OVS	t = limit	96.5	84.4	74.3	66.5	59.7	54.1	49.9	45.6
						t > limit	72.9	63.8	56.1	50.2	45.1	40.9	37.7	34.5
				0.66*	SSLT	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	72.9	63.8	56.1	50.2	45.1	40.9	37.7	34.5
		A490	N	0.94*		t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	104.5	91.4	80.5	72.0	64.6	58.6	54.0	49.4
			X	1.18*		t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	130.8	114.5	100.8	90.2	80.9	73.4	67.6	61.9
			SC Class A	0.64*	STD	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	70.7	61.9	54.5	48.8	43.7	39.7	36.6	33.5
				0.62*	OVS	t = limit	96.5	84.4	74.3	66.5	59.7	54.1	49.9	45.6
						t > limit	60.1	52.6	46.3	41.4	37.1	33.7	31.1	28.4
				0.54	SSLT	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	60.1	52.6	46.3	41.4	37.1	33.7	31.1	28.4
			SC Class B	0.97*	STD	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	107.5	94.1	82.8	74.1	66.5	60.3	55.6	50.9
				0.95*	OVS	t = limit	96.5	84.4	74.3	66.5	59.7	54.1	49.9	45.6
						t > limit	91.3	79.9	70.4	62.9	56.5	51.2	47.2	43.2
				0.82*	SSLT	t = limit	111.0	97.1	85.5	76.5	68.6	62.3	57.4	52.5
						t > limit	91.3	79.9	70.4	62.9	56.5	51.2	47.2	43.2

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
6	1	A325/ F1852	N	0.75*		t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	112.6	100.5	89.7	80.7	73.3	66.8	61.7	56.6
			X	0.94*		t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	140.5	125.3	111.9	100.6	91.4	83.3	77.0	70.6
			SC Class A	0.51	STD	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	75.6	67.5	60.2	54.2	49.2	44.8	41.4	38.0
				0.50	OVS	t = limit	129.7	115.7	103.3	92.9	84.4	76.9	71.1	65.2
						t > limit	64.5	57.5	51.4	46.2	42.0	38.2	35.3	32.4
				0.43	SSLT	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	64.5	57.5	51.4	46.2	42.0	38.2	35.3	32.4
			SC Class B	0.77*	STD	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	114.9	102.5	91.5	82.3	74.8	68.2	63.0	57.8
				0.76*	OVS	t = limit	129.7	115.7	103.3	92.9	84.4	76.9	71.1	65.2
						t > limit	98.0	87.4	78.1	70.2	63.8	58.1	53.7	49.2
				0.66*	SSLT	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	98.0	87.4	78.1	70.2	63.8	58.1	53.7	49.2
		A490	N	0.94*		t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	140.5	125.3	111.9	100.6	91.4	83.3	77.0	70.6
			X	1.18*		t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	175.9	156.9	140.1	126.0	114.5	104.3	96.4	88.4
			SC Class A	0.64*	STD	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	95.1	84.8	75.8	68.1	61.9	56.4	52.1	47.8
				0.62*	OVS	t = limit	129.7	115.7	103.3	92.9	84.4	76.9	71.1	65.2
						t > limit	80.8	72.1	64.4	57.9	52.6	47.9	44.3	40.6
				0.54	SSLT	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	80.8	72.1	64.4	57.9	52.6	47.9	44.3	40.6
			SC Class B	0.97*	STD	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	144.6	129.0	115.2	103.5	94.1	85.7	79.2	72.7
				0.95*	OVS	t = limit	129.7	115.7	103.3	92.9	84.4	76.9	71.1	65.2
						t > limit	122.8	109.5	97.8	87.9	79.9	72.8	67.3	61.7
				0.82*	SSLT	t = limit	149.3	133.1	118.9	106.9	97.1	88.5	81.8	75.0
						t > limit	122.8	109.5	97.8	87.9	79.9	72.8	67.3	61.7

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
7	1	A325/ F1852	N	0.75*		t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	142.9	129.3	116.9	106.1	96.8	88.9	82.4	75.8
			X	0.94*		t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	178.3	161.3	145.8	132.4	120.7	110.8	102.7	94.6
			SC Class A	0.51	STD	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	96.0	86.8	78.5	71.3	65.0	59.7	55.3	50.9
				0.50	OVS	t = limit	164.6	149.0	134.6	122.3	111.5	102.4	94.9	87.4
						t > limit	81.8	74.0	66.9	60.8	55.4	50.9	47.1	43.4
				0.43	SSLT	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	81.8	74.0	66.9	60.8	55.4	50.9	47.1	43.4
			SC Class B	0.77*	STD	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	145.8	132.0	119.3	108.3	98.8	90.7	84.0	77.4
				0.76*	OVS	t = limit	164.6	149.0	134.6	122.3	111.5	102.4	94.9	87.4
						t > limit	124.4	112.5	101.7	92.3	84.2	77.3	71.7	66.0
				0.66*	SSLT	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	124.4	112.5	101.7	92.3	84.2	77.3	71.7	66.0
		A490	N	0.94*		t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	178.3	161.3	145.8	132.4	120.7	110.8	102.7	94.6
			X	1.18*		t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	223.2	202.0	182.5	165.8	151.2	138.8	128.6	118.5
			SC Class A	0.64*	STD	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	120.7	109.2	98.7	89.6	81.7	75.0	69.5	64.1
				0.62*	OVS	t = limit	164.6	149.0	134.6	122.3	111.5	102.4	94.9	87.4
						t > limit	102.5	92.8	83.8	76.1	69.4	63.7	59.1	54.4
				0.54	SSLT	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	102.5	92.8	83.8	76.1	69.4	63.7	59.1	54.4
			SC Class B	0.97*	STD	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	183.5	166.0	150.0	136.2	124.2	114.1	105.7	97.4
				0.95*	OVS	t = limit	164.6	149.0	134.6	122.3	111.5	102.4	94.9	87.4
						t > limit	155.8	141.0	127.4	115.7	105.5	96.9	89.8	82.7
				0.82*	SSLT	t = limit	189.4	171.4	154.9	140.6	128.3	117.8	109.1	100.5
						t > limit	155.8	141.0	127.4	115.7	105.5	96.9	89.8	82.7

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
8	1	A325/ F1852	N	0.75*		t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	173.5	159.3	145.7	133.6	122.8	113.2	105.3	97.4
			X	0.94*		t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	216.4	198.7	181.8	166.6	153.2	141.2	131.3	121.4
			SC Class A	0.51	STD	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	116.5	107.0	97.9	89.7	82.5	76.0	70.7	65.4
				0.50	OVS	t = limit	199.8	183.5	167.9	153.9	141.5	130.4	121.3	112.1
						t > limit	99.3	91.2	83.4	76.5	70.3	64.8	60.3	55.7
				0.43	SSLT	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	99.3	91.2	83.4	76.5	70.3	64.8	60.3	55.7
			SC Class B	0.77*	STD	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	177.0	162.6	148.7	136.3	125.3	115.5	107.4	99.3
				0.76*	OVS	t = limit	199.8	183.5	167.9	153.9	141.5	130.4	121.3	112.1
						t > limit	150.9	138.6	126.8	116.2	106.9	98.5	91.6	84.7
				0.66*	SSLT	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	150.9	138.6	126.8	116.2	106.9	98.5	91.6	84.7
		A490	N	0.94*		t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	216.4	198.7	181.8	166.6	153.2	141.2	131.3	121.4
			X	1.18*		t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	270.9	248.8	227.6	208.6	191.8	176.8	164.4	152.0
			SC Class A	0.64*	STD	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	146.5	134.6	123.1	112.8	103.7	95.6	88.9	82.2
				0.62*	OVS	t = limit	199.8	183.5	167.9	153.9	141.5	130.4	121.3	112.1
						t > limit	124.4	114.3	104.5	95.8	88.1	81.2	75.5	69.8
				0.54	SSLT	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	124.4	114.3	104.5	95.8	88.1	81.2	75.5	69.8
			SC Class B	0.97*	STD	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	222.7	204.5	187.1	171.5	157.7	145.3	135.1	125.0
				0.95*	OVS	t = limit	199.8	183.5	167.9	153.9	141.5	130.4	121.3	112.1
						t > limit	189.1	173.7	158.9	145.6	133.9	123.4	114.8	106.1
				0.82*	SSLT	t = limit	229.9	211.1	193.1	177.0	162.8	150.0	139.5	129.0
						t > limit	189.1	173.7	158.9	145.6	133.9	123.4	114.8	106.1

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
9	1	A325/ F1852	N	0.75*		t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	204.3	189.6	175.5	162.2	150.3	139.2	130.0	120.8
			X	0.94*		t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	254.9	236.5	218.9	202.3	187.4	173.7	162.2	150.7
			SC Class A	0.51	STD	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	137.2	127.3	117.8	108.9	100.9	93.5	87.3	81.1
				0.50	OVS	t = limit	235.4	218.4	202.1	186.8	173.1	160.4	149.8	139.2
						t > limit	117.0	108.5	100.4	92.8	86.0	79.7	74.4	69.2
				0.43	SSLT	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	117.0	108.5	100.4	92.8	86.0	79.7	74.4	69.2
			SC Class B	0.77*	STD	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	208.5	193.5	179.1	165.5	153.4	142.1	132.7	123.3
				0.76*	OVS	t = limit	235.4	218.4	202.1	186.8	173.1	160.4	149.8	139.2
						t > limit	177.8	165.0	152.7	141.1	130.8	121.2	113.1	105.1
				0.66*	SSLT	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	177.8	165.0	152.7	141.1	130.8	121.2	113.1	105.1
		A490	N	0.94*		t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	254.9	236.5	218.9	202.3	187.4	173.7	162.2	150.7
			X	1.18*		t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	319.1	296.1	274.0	253.3	234.7	217.5	203.1	188.7
			SC Class A	0.64*	STD	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	172.6	160.1	148.2	136.9	126.9	117.6	109.8	102.1
				0.62*	OVS	t = limit	235.4	218.4	202.1	186.8	173.1	160.4	149.8	139.2
						t > limit	146.6	136.0	125.9	116.3	107.8	99.9	93.3	86.7
				0.54	SSLT	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	146.6	136.0	125.9	116.3	107.8	99.9	93.3	86.7
			SC Class B	0.97*	STD	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	262.3	243.4	225.2	208.2	192.9	178.7	166.9	155.1
				0.95*	OVS	t = limit	235.4	218.4	202.1	186.8	173.1	160.4	149.8	139.2
						t > limit	222.8	206.7	191.3	176.8	163.8	151.8	141.8	131.8
				0.82*	SSLT	t = limit	270.8	251.3	232.5	214.9	199.1	184.5	172.3	160.1
						t > limit	222.8	206.7	191.3	176.8	163.8	151.8	141.8	131.8

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
10	1	A325/ F1852	N	0.75*		t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	234.9	220.5	206.0	191.9	178.9	166.7	156.2	145.7
			X	0.94*		t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	293.0	275.0	257.0	239.3	223.1	207.9	194.9	181.8
			SC Class A	0.51	STD	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	157.7	148.0	138.3	128.8	120.1	111.9	104.9	97.9
				0.50	OVS	t = limit	270.6	254.0	237.3	221.0	206.0	192.0	180.0	167.9
						t > limit	134.5	126.2	117.9	109.8	102.4	95.4	89.4	83.4
				0.43	SSLT	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	134.5	126.2	117.9	109.8	102.4	95.4	89.4	83.4
			SC Class B	0.77*	STD	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	239.7	225.0	210.2	195.8	182.5	170.1	159.4	148.7
				0.76*	OVS	t = limit	270.6	254.0	237.3	221.0	206.0	192.0	180.0	167.9
						t > limit	204.4	191.8	179.3	167.0	155.6	145.0	135.9	126.8
				0.66*	SSLT	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	204.4	191.8	179.3	167.0	155.6	145.0	135.9	126.8
		A490	N	0.94*		t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	293.0	275.0	257.0	239.3	223.1	207.9	194.9	181.8
			X	1.18*		t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	366.9	344.3	321.8	299.7	279.3	260.3	244.0	227.6
			SC Class A	0.64*	STD	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	198.4	186.2	174.0	162.0	151.0	140.8	131.9	123.1
				0.62*	OVS	t = limit	270.6	254.0	237.3	221.0	206.0	192.0	180.0	167.9
						t > limit	168.5	158.1	147.8	137.6	128.3	119.6	112.1	104.5
				0.54	SSLT	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	168.5	158.1	147.8	137.6	128.3	119.6	112.1	104.5
			SC Class B	0.97*	STD	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	301.5	283.0	264.5	246.3	229.6	214.0	200.5	187.1
				0.95*	OVS	t = limit	270.6	254.0	237.3	221.0	206.0	192.0	180.0	167.9
						t > limit	256.1	240.4	224.6	209.2	195.0	181.7	170.3	158.9
				0.82*	SSLT	t = limit	311.3	292.1	273.0	254.3	237.0	220.9	207.0	193.1
						t > limit	256.1	240.4	224.6	209.2	195.0	181.7	170.3	158.9

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
11	1	A325/ F1852	N	0.75*		t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	265.5	251.0	236.6	222.2	208.3	195.3	183.8	172.3
			X	0.94*		t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	331.1	313.1	295.1	277.1	259.8	243.6	229.3	215.0
			SC Class A	0.51	STD	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	178.2	168.5	158.8	149.2	139.8	131.1	123.4	115.7
				0.50	OVS	t = limit	305.8	289.2	272.5	255.9	239.9	224.9	211.7	198.5
						t > limit	152.0	143.7	135.4	127.2	119.2	111.8	105.2	98.7
				0.43	SSLT	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	152.0	143.7	135.4	127.2	119.2	111.8	105.2	98.7
			SC Class B	0.77*	STD	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	270.9	256.2	241.4	226.7	212.6	199.3	187.6	175.9
				0.76*	OVS	t = limit	305.8	289.2	272.5	255.9	239.9	224.9	211.7	198.5
						t > limit	231.0	218.4	205.9	193.3	181.2	169.9	159.9	150.0
				0.66*	SSLT	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	231.0	218.4	205.9	193.3	181.2	169.9	159.9	150.0
		A490	N	0.94*		t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	331.1	313.1	295.1	277.1	259.8	243.6	229.3	215.0
			X	1.18*		t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	414.6	392.1	369.5	347.0	325.3	305.0	287.1	269.2
			SC Class A	0.64*	STD	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	224.2	212.0	199.8	187.6	175.9	164.9	155.2	145.6
				0.62*	OVS	t = limit	305.8	289.2	272.5	255.9	239.9	224.9	211.7	198.5
						t > limit	190.4	180.1	169.7	159.4	149.4	140.1	131.8	123.6
				0.54	SSLT	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	190.4	180.1	169.7	159.4	149.4	140.1	131.8	123.6
			SC Class B	0.97*	STD	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	340.8	322.2	303.7	285.2	267.4	250.7	236.0	221.2
				0.95*	OVS	t = limit	305.8	289.2	272.5	255.9	239.9	224.9	211.7	198.5
						t > limit	289.4	273.7	258.0	242.2	227.1	212.9	200.4	187.9
				0.82*	SSLT	t = limit	351.8	332.6	313.5	294.4	276.0	258.8	243.6	228.4
						t > limit	289.4	273.7	258.0	242.2	227.1	212.9	200.4	187.9

N (# of Bolts)	Bolt Dia.	ASTM Desig.	Thread Cond.	Limit Thickness (in)	Hole Type		Eccentricity (in)							
							5	6	7	8	9	10	11	12
12	1	A325/ F1852	N	0.75*		t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	294.3	281.9	267.2	252.7	238.3	224.7	212.3	199.8
			X	0.94*		t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	367.1	351.6	333.2	315.2	297.2	280.3	264.8	249.2
			SC Class A	0.51	STD	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	197.6	189.2	179.4	169.7	160.0	150.9	142.5	134.1
				0.50	OVS	t = limit	339.0	324.7	307.7	291.1	274.5	258.8	244.5	230.2
						t > limit	168.5	161.4	152.9	144.7	136.4	128.6	121.5	114.4
				0.43	SSLT	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	168.5	161.4	152.9	144.7	136.4	128.6	121.5	114.4
			SC Class B	0.77*	STD	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	300.4	287.6	272.6	257.9	243.2	229.3	216.6	203.9
				0.76*	OVS	t = limit	339.0	324.7	307.7	291.1	274.5	258.8	244.5	230.2
						t > limit	256.1	245.3	232.5	219.9	207.3	195.5	184.7	173.8
				0.66*	SSLT	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	256.1	245.3	232.5	219.9	207.3	195.5	184.7	173.8
		A490	N	0.94*		t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	367.1	351.6	333.2	315.2	297.2	280.3	264.8	249.2
			X	1.18*		t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	459.7	440.2	417.2	394.7	372.2	350.9	331.5	312.1
			SC Class A	0.64*	STD	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	248.6	238.0	225.6	213.4	201.2	189.8	179.3	168.7
				0.62*	OVS	t = limit	339.0	324.7	307.7	291.1	274.5	258.8	244.5	230.2
						t > limit	211.1	202.2	191.6	181.3	170.9	161.2	152.3	143.3
				0.54	SSLT	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	211.1	202.2	191.6	181.3	170.9	161.2	152.3	143.3
			SC Class B	0.97*	STD	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	377.8	361.8	342.9	324.4	305.9	288.4	272.5	256.5
				0.95*	OVS	t = limit	339.0	324.7	307.7	291.1	274.5	258.8	244.5	230.2
						t > limit	320.9	307.3	291.3	275.5	259.8	245.0	231.4	217.8
				0.82*	SSLT	t = limit	390.0	373.5	354.0	334.9	315.8	297.8	281.3	264.8
						t > limit	320.9	307.3	291.3	275.5	259.8	245.0	231.4	217.8