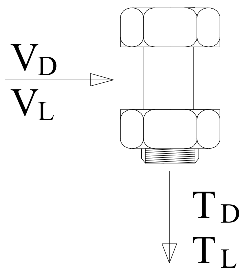
Design of Bolts in Bearing Type Connection Subjected to Combined Tension and Shear Forces



Details of Bolt

Grade:	SEL("AISC/ASTM_bolts"; Name;)	=	A325
F_u=	TAB("AISC/ASTM_bolts";F_u;Name=Grade)	=	120 ksi
Bolt:	SEL("AISC/bolt"; Size;)	=	d3/4
Bolt diameter, d_b=	TAB("AISC/bolt";dia;Size=Bolt)	=	0.7500 in
Area of bolt, A_b=	TAB("AISC/bolt";Area;Size=Bolt)	=	0.4418 in^4

Loads

Dead:

Tension force, T_D=	3.50 kips
Shear force, V_D=	1.3 kips

Live:

Tension force, T_L=	12.0 kips
Shear force, V_L=	4.0 kips

From Chapter 2 of ASCE/SEI 7, the required strength is:

T_u=	$1.2*T_D+1.6*T_L$	=	23.4 kips
V_u=	$1.2*V_D+1.6*V_L$	=	8.0 kips

Check for Shear

Φ= 0.75

From AISC Specification Table J3.2,

The available shear strength (F_{nv}):

F_{nv}=	$0.40*F_u$	=	48.0 ksi

The available shear stress (f_{rv}):

f_{rv}=	V_u / A_b	=	18.1 ksi
Check_Shear=	IF($\Phi*F_{nv} \geq f_{rv}$;"Safe";"Increase d_b")	=	Safe

Check for Tension Accompanied by Shear

From AISC Specification Table J3.2,

The available tensile strength (F_{nt}):

F_{nt}=	$0.75*F_u$	=	90.0 ksi

The available tensile strength of a bolt subject to combined tension and shear is as follows, from AISC Spec. Eqn. J3.3a,

F_{nt}' =	$1.30 * F_{nt} - \frac{F_{nt}}{\Phi * F_{nv}} * f_{rv}$	=	71.8 ksi

The available tension force (R_n):

R_n=	A_b * MIN(F_{nt}' ; F_{nt})	=	31.7 kips
Check_Tension=	IF(Φ*R_n≥T_u;"Safe";"Increase d_b")	=	Safe

Design Summary

Size=	d_b	=	0.7500 in
F_u=	TAB("AISC/ASTM_bolts";F_u;Name=Grade)	=	120 ksi
f_{rv}=	V_u / A_b	=	18.1 ksi
F_{nv}=	0.40*F_u	=	48.0 ksi
Check_Shear=	IF(Φ*F_{nv}≥f_{rv};"Safe";"Increase d_b")	=	Safe
T_u=	1.2*T_D+1.6*T_L	=	23.4 kips
R_n=	A_b * MIN(F_{nt}' ; F_{nt})	=	31.7 kips
Check_Tension=	IF(Φ*R_n≥T_u;"Safe";"Increase d_b")	=	Safe