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# 1 Input Parameters

Modu	ıle		Bea	m Coverplate Connection
MainMo	odule		Moment Connection	
Moment(kNm)*				10.0
Shear(l	(N)*			10.0
Axial (k	(N) *			10.0
	·	Section		
	Beam S	ection *		NPB 330x160x49.1
	Prefe	rences		Outside
т Ү	Mate	erial *		E 250 (Fe 410 W)A
	Ultimate stren	ngth, fu (MPa)		410
<u>(B-t)</u> t	Yield Strength , fy (MPa)	230	R2(mm)	0.0
	Mass	49.15	Iz(mm4)	117669000.0
R <sub>1</sub>	Area(mm2) -	6260.0	Iy(mm4)	7869000.0
В	D(mm)	330.0	rz(mm)	137.10000000000000
Y	B(mm)	160.0	ry(mm)	35.5
	t(mm)	7.5	Zz(mm3)	713150.0
	T(mm)	11.5	Zy(mm3)	98360.0
	FlangeSlope	90	Zpz(mm3)	804330.0
	R1(mm)	1.8	Zpy(mm3)	98360.0
		Bolt Details		
Diameter	` '		[12.0,	16.0, 20.0, 24.0, 30.0, 36.0
Grade	e *		[3.6, 4.6, 4.8	8, 5.6, 5.8, 6.8, 8.8, 9.8, 10.9, 12.9]
Туре	*			Bearing Bolt
Bolt.	fu			500.0
Bolt.	fy			300.0
Bolt hole	e type			Standard
Slip factor	r (µ_f)			0.3
Type of	edges		a - S	Sheared or hand flame cut
Gap between beam and	. support (	mm)		10.0
Are the members exposed to	 corrosive	influences		False

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## 2 Design Checks

## 2.1 Member Capacity

Check	Required	Provided	Remarks
Axial Capacity (kN)		$Ac = \frac{A * f_y}{\gamma_{m0} * 1000}$ $= \frac{6260.0 * 230}{1.1 * 1000}$ $= 1308.91$	
Shear Capacity (kN)		$S_c = \frac{A_v * f_y}{\sqrt{3} * \gamma_{mo} * 1000}$ $= \frac{307.0 * 7.5 * 230}{\sqrt{3} * 1.1 * 1000}$ $= 277.95479$	
Plastic Moment Capacity (kNm)		$Pmc = \frac{\beta_b * Z_p * fy}{\gamma_{mo} * 1000000}$ $= \frac{1 * 176717 * 230}{1.1 * 1000000}$ $= 36.95$	
Moment Deformation Criteria (kNm)		$Mdc = \frac{1.5 * Z_e * fy}{1.1 * 1000000}$ $= \frac{1.5 * 713150.0 * 230}{1.1 * 1000000}$ $= 223.67$	
Moment Capacity (kNm)		$M_c = min(Pmc, Mdc)$ = $min(36.95, 223.67)$ = $36.95$	

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#### 2.2 Load Considered

$ \begin{array}{c} {\rm Axial\ Load\ (kN)} & = 0.3*1308.91 & = max(A,Ac_{min}) \\ & = 0.3*1308.91 & = max(10.0,392.67) & {\rm Pass} \\ & = 392.67 & = 392.67 & \\ \hline & Vc_{min} = 0.6*S_c & Vu = max(V,Vc_{min}) \\ & = 0.6*277.95 & = max(10.0,166.77) & {\rm Pass} \\ & = 166.77 & = 166.77 & {\rm mu} = max(M,Mc_{min}) \\ & = 0.5*M_c & Mu = max(M,Mc_{min}) & = max(10.0,18.47) & {\rm Pass} \\ & = 18.47 & Mu = max(M,Mc_{min}) & = max(10.0,18.47) & {\rm Pass} \\ & = 18.47 & A_w = Axial\ force\ in\ web \\ & = \frac{(330.0-2*11.5)*7.5*392.67}{6260.0} & = 144.43 & {\rm M}_w = Moment\ in\ web \\ & = \frac{Z_w*Mu}{Z} & = \frac{16717*18.47}{804330.0} & = 4.06 & {\rm M}_w = \frac{2}{300.0} & = 115.42 & {\rm M}_w = 115.42 & {\rm M}_w = \frac{2}{300.0} & = 115.42 & {\rm M}_w = \frac{2}{300.0$	Check	Required	Provided	Remarks
$\begin{array}{c} = 392.67 \\ Vc_{min} = 0.6*S_{S} \\ = 0.6*27.95 \\ = 166.77 \\ = 166.77 \\ = 166.77 \\ = 166.77 \\ = 166.77 \\ = 18.47 \\ \\ \end{array} \begin{array}{c} Mu = max(V,Vc_{min}) \\ = max(10.0,18.47) \\ = max(10.0,18.47) \\ = 18.47 \\ \\ = \frac{(330.0-2*11.5)*7.5*392.67}{6260.0} \\ = 144.43 \\ M_{w} = Moment in web \\ = \frac{Z_{w}*Mu}{Z} \\ = \frac{176717*18.47}{804330.0} \\ = 4.06 \\ A_{f} = Axial force in flange \\ = \frac{Au*B*T}{6260.0} \\ = 115.42 \\ \\ M_{f} = Moment in flange \\ = Mu - M_{w} \\ = 18.47 + 0.66 \\ = 14.42 \\ \\ M_{f} = 1000 \\ = 115.42 \\ \\ M_{f} = 115.42 \\ \\ M_{$		$Ac_{min} = 0.3 * A_c$	$Au = max(A, Ac_{min})$	
$\begin{array}{c} Vc_{min} = 0.6*S_c \\ = 0.6*277.95 \\ = 166.77 \\ = 166.77 \\ \\ Moment Load (kNm) \\ = 0.5*M_c \\ = 0.5*36.95 \\ = 18.47 \\ \\ M_w = Axial force in web \\ = \frac{(D-2*T)*t*Au}{A} \\ = \frac{(330.0-2*11.5)*7.5*392.67}{6260.0} \\ = 144.43 \\ M_w = Moment in web \\ = \frac{Z_w*Mu}{Z} \\ = \frac{176717*18.47}{804330.0} \\ = 4.06 \\ \\ A_f = Axial force in flange \\ = \frac{Au*B*T}{A} \\ = \frac{392.67*160.0*11.5}{6260.0} \\ = 115.42 \\ M_f = Moment in flange \\ = Mu - Mw \\ = 18.47 \\ = \frac{115.42}{4} \\ M_f = Moment in flange \\ = Mu - Mw \\ = 14.42 \\ F_f = flange force \\ = \frac{M_f*1000}{D-T} + A_f \\ = \frac{14.42}{330.0-11.5} + 115.42 \\ \end{array}$	Axial Load (kN)	= 0.3 * 1308.91	= max(10.0, 392.67)	Pass
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$Vc_{min} = 0.6 * S_c$	$Vu = max(V, Vc_{min})$	
$ \text{Moment Load (kNm)} \begin{tabular}{ll} $Mc_{min} = 0.5 * M_c$ & $Mu = max(M, Mc_{min})$ & $= max(10.0, 18.47)$ & $= 18.47$ & $= 18.47$ & $= 18.47$ & $A_w = Axial force in web & $= \frac{(D-2*T)*t*Au}{6260.0}$ & $= 144.43$ & $M_w = Moment in web & $= \frac{Z_w * Mu}{Z}$ & $= \frac{176717*18.47}{804330.0}$ & $= 4.06$ & $A_f = Axial force in flange & $= \frac{Au*B*T}{A}$ & $= \frac{392.67*160.0*11.5}{6260.0}$ & $= 115.42$ & $M_f = Moment in flange & $= Mu - M_w$ & $= Mu - M_w$ & $= 18.47 - 4.06$ & $= 14.42$ & $F_f = flange force & $= \frac{M_f*1000}{D-T} + A_f$ & $= \frac{14.42}{330.0-11.5} + 115.42$ & $= \frac{114.42}{330.0-11.5} + 115.42$ & $= \frac{114.42}{330.0-11.5}$ & $= 115.42$ & $= 115$	Shear Load (kN)	= 0.6 * 277.95	= max(10.0, 166.77)	Pass
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				
= 18.47		$Mc_{min} = 0.5 * M_c$	$Mu = max(M, Mc_{min})$	
$A_{w} = Axial\ force\ in\ web \\ = \frac{(D-2*T)*t*Au}{A} \\ = \frac{(330.0-2*11.5)*7.5*392.67}{6260.0}$ Forces Carried by Web $= \frac{I44.43}{M_{w} = Moment\ in\ web} \\ = \frac{Z_{w}*Mu}{Z} \\ = \frac{176717*18.47}{804330.0} \\ = 4.06$ $A_{f} = Axial\ force\ in\ flange \\ = \frac{Au*B*T}{A} \\ = \frac{392.67*160.0*11.5}{6260.0} \\ = 115.42$ $M_{f} = Moment\ in\ flange \\ = Mu - M_{w} \\ = 18.47 - 4.06 \\ = 14.42$ $F_{f} = flange\ force \\ = \frac{M_{f}*1000}{D-T} + A_{f} \\ = \frac{14.42}{330.0 - 11.5} + 115.42$	Moment Load (kNm)	= 0.5 * 36.95	= max(10.0, 18.47)	Pass
Forces Carried by Web $ = \frac{(D-2*T)*t*Au}{A} $ $= \frac{(330.0-2*11.5)*7.5*392.67}{6260.0} $ $= 144.43$ $M_w = Moment in web$ $= \frac{Z_w*Mu}{Z} $ $= \frac{176717*18.47}{804330.0} $ $= 4.06$ $A_f = Axial force in flange$ $= \frac{Au*B*T}{A} $ $= \frac{392.67*160.0*11.5}{6260.0} $ $= 115.42$ $M_f = Moment in flange$ $= Mu - M_w $ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange force$ $= \frac{M_f*1000}{D-T} + A_f $ $= \frac{14.42}{330.0 - 11.5} + 115.42$		= 18.47		
Forces Carried by Web $ = \frac{(330.0 - 2*11.5)*7.5*392.67}{6260.0} $ $= 144.43$ $M_w = Moment in web$ $= \frac{Z_w * Mu}{Z}$ $= \frac{176717*18.47}{804330.0}$ $= 4.06$ $A_f = Axial force in flange$ $= \frac{Au*8*T}{A}$ $= \frac{392.67*160.0*11.5}{6260.0}$ $= 115.42$ $M_f = Moment in flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange force$ $= \frac{M_f*1000}{D-T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$			$A_w = Axial \ force \ in \ web$	
Forces Carried by Web $ = \frac{(330.0 - 2*11.5)*7.5*392.67}{6260.0} $ $= 144.43$ $M_w = Moment in web$ $= \frac{Z_w * Mu}{Z}$ $= \frac{176717*18.47}{804330.0}$ $= 4.06$ $A_f = Axial force in flange$ $= \frac{Au*8*T}{A}$ $= \frac{392.67*160.0*11.5}{6260.0}$ $= 115.42$ $M_f = Moment in flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange force$ $= \frac{M_f*1000}{D-T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$			$-\frac{(D-2*T)*t*Au}{}$	
Forces Carried by Web $ = \begin{array}{c} 6260.0 \\ = 144.43 \\ M_w = Moment \ in \ web \\ = \frac{Z_w * Mu}{Z} \\ = \frac{176717 * 18.47}{804330.0} \\ = 4.06 \\ A_f = Axial \ force \ in \ flange \\ = \frac{Au * B * T}{A} \\ = \frac{392.67 * 160.0 * 11.5}{6260.0} \\ = 115.42 \\ M_f = Moment \ in \ flange \\ = Mu - M_w \\ = 18.47 - 4.06 \\ = 14.42 \\ F_f = flange \ force \\ = \frac{M_f * 1000}{D - T} + A_f \\ = \frac{14.42}{330.0 - 11.5} + 115.42 \\ \end{array} $				
Forces Carried by Web $ = \frac{144.43}{M_w = Moment \ in \ web} $ $ = \frac{Z_w * Mu}{Z} $ $ = \frac{176717 * 18.47}{804330.0} $ $ = 4.06 $ $ A_f = Axial \ force \ in \ flange $ $ = \frac{Au * B * T}{A} $ $ = \frac{392.67 * 160.0 * 11.5}{6260.0} $ $ = 115.42 $ $ M_f = Moment \ in \ flange $ $ = Mu - M_w $ $ = 18.47 - 4.06 $ $ = 14.42 $ $ F_f = flange \ force $ $ = \frac{M_f * 1000}{D - T} + A_f $ $ = \frac{14.42}{330.0 - 11.5} + 115.42 $			$= \frac{(330.0 - 2 * 11.5) * 7.5 * 392.6}{3200.0}$	7
Forces Carried by Web				
$= \frac{Z_w * Mu}{Z}$ $= \frac{176717 * 18.47}{804330.0}$ $= 4.06$ $A_f = Axial \ force \ in \ flange$ $= \frac{Au * B * T}{A}$ $= \frac{392.67 * 160.0 * 11.5}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$	Forces Carried by Web			
$= \frac{176717 * 18.47}{804330.0}$ $= 4.06$ $A_f = Axial \ force \ in \ flange$ $= \frac{Au * B * T}{A}$ $= \frac{392.67 * 160.0 * 11.5}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$				
$= \frac{176717 * 18.47}{804330.0}$ $= 4.06$ $A_f = Axial \ force \ in \ flange$ $= \frac{Au * B * T}{A}$ $= \frac{392.67 * 160.0 * 11.5}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$			$=\frac{Z_w*Mu}{Z}$	
$ = 4.06 $ $A_f = Axial \ force \ in \ flange $ $ = \frac{Au*B*T}{A} $ $ = \frac{392.67*160.0*11.5}{6260.0} $ $ = 115.42 $ $M_f = Moment \ in \ flange $ $ = Mu - M_w $ $ = 18.47 - 4.06 $ $ = 14.42 $ $F_f = flange \ force $ $ = \frac{M_f*1000}{D-T} + A_f $ $ = \frac{14.42}{330.0 - 11.5} + 115.42 $			2	
$ = 4.06 $ $A_f = Axial \ force \ in \ flange $ $ = \frac{Au*B*T}{A} $ $ = \frac{392.67*160.0*11.5}{6260.0} $ $ = 115.42 $ $M_f = Moment \ in \ flange $ $ = Mu - M_w $ $ = 18.47 - 4.06 $ $ = 14.42 $ $F_f = flange \ force $ $ = \frac{M_f*1000}{D-T} + A_f $ $ = \frac{14.42}{330.0 - 11.5} + 115.42 $			$=\frac{804330.0}{804330.0}$	
$= \frac{Au * B * T}{A}$ $= \frac{392.67 * 160.0 * 11.5}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$				
Forces Carried by Flange $= \frac{392.67*160.0*11.5}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f*1000}{D-T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$				
Forces Carried by Flange $= \frac{392.67*160.0*11.5}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f*1000}{D-T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$			$\underline{  }Au*B*T$	
Forces Carried by Flange $= \frac{6260.0}{6260.0}$ $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$				
Forces Carried by Flange $= 115.42$ $M_f = Moment \ in \ flange$ $= Mu - M_w$ $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$			=	
Forces Carried by Flange $ = Mu - M_w $ $= 18.47 - 4.06 $ $= 14.42 $ $F_f = flange\ force $ $= \frac{M_f*1000}{D-T} + A_f $ $= \frac{14.42}{330.0 - 11.5} + 115.42 $				
Forces Carried by Flange $ = Mu - M_w $ $= 18.47 - 4.06 $ $= 14.42 $ $F_f = flange \ force $ $= \frac{M_f * 1000}{D - T} + A_f $ $= \frac{14.42}{330.0 - 11.5} + 115.42 $				
Forces Carried by Flange $= 18.47 - 4.06$ $= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$			•	
$= 14.42$ $F_f = flange \ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$	Forces Carried by Flange			
$F_f = flange\ force$ $= rac{M_f * 1000}{D - T} + A_f$ $= rac{14.42}{330.0 - 11.5} + 115.42$				
$= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{14.42}{330.0 - 11.5} + 115.42$				
$= \frac{14.42}{330.0 - 11.5} + 115.42$				
$= \frac{14.42}{330.0 - 11.5} + 115.42$			$=\frac{M_f*1000}{D_fT}+A_f$	
			$=\frac{14.42}{330.0-11.5}+115.42$	
			= 160.68	

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### 2.3 Flange Bolt Checks

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	d = 12.0	
Grade	Bolt Grade Optimisation	5.6	
Hole Diameter (mm)		$d_0 = 13.0$	
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub} \ n_n \ A_{nb}}{1000 * \sqrt{3} \ \gamma_{mb}}$ $= \frac{500.0 * 1 * 84.3}{1000 * \sqrt{3} \ * 1.25}$ $= 19.47$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5 \ k_b \ d \ t \ f_u}{1000 * \gamma_{mb}}$ $= \frac{2.5 * 0.52 * 12.0 * 11.5 * 410}{1000 * 1.25}$ $= 58.84$	
Bolt Capacity (kN)		$V_{db} = min (V_{dsb}, V_{dpb})$ = $min (19.47, 58.84)$ = 19.47	
No of Bolts	$R_{u} = \sqrt{V_{u}^{2} + A_{u}^{2}}$ $n_{trial} = R_{u}/V_{bolt}$ $R_{u} = \frac{\sqrt{0.0^{2} + 160.68^{2}}}{19.47}$ $= 18$	20	
No of Columns		$n_c = 10$	
No of Rows		$n_r = 2$	
Min. Pitch (mm)	$p/g_{min} = 2.5 d$ = $2.5 * 12.0 = 30.0$	30	Pass
Max. Pitch (mm)	$p/g_{max} = \min(32 \ t, \ 300 \ mm)$ = $\min(32 * 11.5, \ 300 \ mm)$ = 300	) 30	Pass
Min. Gauge (mm)	$p/g_{min} = 2.5 d$ $= 2.5 * 12.0 = 30.0$	0.0	N/A
Max. Gauge (mm)	$p/g_{max} = \min(32 \ t, \ 300 \ mm)$ = $\min(32 * 11.5, \ 300 \ mm)$ = 300	0.0	N/A
Min. End Distance (mm)	$e/e'_{min} = [1.5 \text{ or } 1.7] * d_0$ = 1.7 * 13.0 = 22.1	25	Pass
Max. End Distance (mm)	$e/e'_{max} = 12 \ t \ \varepsilon$ $\varepsilon = \sqrt{\frac{250}{f_y}}$ $e/e'_{max} = 12 \ *14.0 * \sqrt{\frac{250}{230}}$ $= 174.72$	25	Pass

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Check	Required	Provided	Remarks
Min. Edge Distance (mm)	$e/e^{\circ}_{min} = [1.5 \text{ or } 1.7] * d_0$ = 1.7 * 13.0 = 22.1	37.225	Pass
Max. Edge Distance (mm)	$e/e'_{max} = 12 \ t \ \varepsilon$ $\varepsilon = \sqrt{\frac{250}{f_y}}$ $e/e'_{max} = 12 \ *14.0 * \sqrt{\frac{250}{230}}$ $= 174.72$	37.225	Pass
Long Joint Reduction	$if \ l \ge 15 * d \ then \ V_{rd} = \beta_{ij} * V_{db}$ $if \ l < 15 * d \ then \ V_{rd} = V_{db}$ $where,$ $l = ((nc \ or \ nr) - 1) * (p \ or \ g)$ $\beta_{ij} = 1.075 - l/(200 * d)$ $but \ 0.75 \le \beta_{ij} \le 1.0$	$l = ((nc \ or \ nr) - 1) * (p \ or \ g)$ $= (10 - 1) * 30 = 270$ $= (2 - 1) * 0.0 = 0.0$ $l = 270$ $15 * d = 15 * 12.0 = 180.0$ $since, \ l \ge 15 * d \ then \ V_{rd} = \beta_{ij} * V_{d}$ $\beta_{ij} = 1.075 - 270/(200 * 12.0) = 0.90$ $V_{rd} = 0.96 * 19.47 = 19468.25$	

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#### 2.4 Web Bolt Checks

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub} \ n_n \ A_{nb}}{1000 * \sqrt{3} \ \gamma_{mb}}$ $= \frac{500.0 * 2 * 84.3}{1000 * \sqrt{3} \ * 1.25}$ $= 38.94$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5 \ k_b \ d \ t \ f_u}{1000 * \gamma_{mb}}$ $= \frac{2.5 \ * 0.52 * 12.0 * 7.5 * 410}{1000 * 1.25}$ $= 38.38$	
Bolt Capacity (kN)		$V_{db} = min (V_{dsb}, V_{dpb})$ = $min (38.94, 38.38)$ = $38.38$	
No of Bolts	$R_{u} = \sqrt{V_{u}^{2} + A_{u}^{2}}$ $n_{trial} = R_{u}/V_{bolt}$ $R_{u} = \frac{\sqrt{166.77^{2} + 144.43^{2}}}{38.38}$ $= 12$	20	
No of Columns		$n_c = 4$	
No of Rows		$n_r = 5$	
Min. Pitch (mm)	$p/g_{min} = 2.5 d$ = $2.5 * 12.0 = 30.0$	30	Pass
Max. Pitch (mm)	$p/g_{max} = \min(32 \ t, \ 300 \ mm)$ $= \min(32 * 6.0, \ 300 \ mm)$ $= 192.0$	30	Pass
Min. Gauge (mm)	$p/g_{min} = 2.5 d$ = $2.5 * 12.0 = 30.0$	65	Pass
Max. Gauge (mm)	$p/g_{max} = \min(32 \ t, \ 300 \ mm)$ = $\min(32 * 6.0, \ 300 \ mm)$ = 192.0	65	Pass
Min. End Distance (mm)	$e/e^{\circ}_{min} = [1.5 \text{ or } 1.7] * d_0$ = 1.7 * 13.0 = 22.1	25	Pass
Max. End Distance (mm)	$e/e'_{max} = 12 \ t \ \varepsilon$ $\varepsilon = \sqrt{\frac{250}{f_y}}$ $e/e'_{max} = 12 \ *6.0 * \sqrt{\frac{250}{230}}$ $= 74.88$	25	Pass
Min. Edge Distance (mm)	$e/e^{\circ}_{min} = [1.5 \text{ or } 1.7] * d_0$ = 1.7 * 13.0 = 22.1	25	Pass

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Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e/e'_{max} = 12 \ t \ \varepsilon$ $\varepsilon = \sqrt{\frac{250}{f_y}}$ $e/e'_{max} = 12 \ *6.0 * \sqrt{\frac{250}{230}}$ $= 74.88$	25	Pass
Parameters required for bolt force		$\begin{array}{ll} l_n &= length \ available \\ l_n &= (n_r - 1) * g \\ &= (5 - 1) * 65 \\ &= 260 \\ y_{max} &= l_n/2 \\ &= 260/2 \\ &= 130.0 \\ x_{max} &= p * (n_c - 1)/2 \\ &= 30 * (4 - 1)/2 \\ &= 15.0 \\ M_d &= (V_u * ecc + M_w) \end{array}$	
Moment Demand		= (166.77 * 45.0 + 4.06) $= 11.56$	
Bolt.Force		$vbv = V_u/(n_r * n_c)$ $= \frac{166.77}{(5 * 4)}$ $= 16.68$ $tmh = \frac{M_d * y_{max}}{\Sigma r_i^2}$ $= \frac{11.56 * 130.0}{86.75}$ $= 17.33$ $tmv = \frac{M_d * x_{max}}{\Sigma r_i^2}$ $= \frac{11.56 * 15.0}{86.75}$ $= 2.0$ $abh = \frac{A_u}{(n_r * n_c)}$ $= \frac{144.43}{(5 * 4)}$ $= 14.44$ $vres = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2}$ $= \sqrt{(16.68 + 2.0)^2 + (17.33 + 14.44)^2}$ $= 36.85$	

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Check	Required	Provided	Remarks
		$l = ((nc \ or \ nr) - 1) * (p \ or \ g)$	
	$if l \ge 15 * d then V_{rd} = \beta_{ij} * V_{db}$	= (4-1) * 30 = 90	
	if $l < 15 * d$ then $V_{rd} = V_{db}$	= (5-1) * 65 = 260	
I I-: D - l +:	where,	l = 260	
Long Joint Reduction	$l = ((nc \ or \ nr) - 1) * (p \ or \ g)$	15 * d = 15 * 12.0 = 180.0	
	$\beta_{ij} = 1.075 - l/(200 * d)$	since, $l \ge 15 * d then V_{rd} = \beta_{ij} * V_{db}$	
	$but \ 0.75 \le \beta_{ij} \le 1.0$	$\beta_{ij} = 1.075 - 260/(200 * 12.0) = 0.97$	
		$V_{rd} = 0.97 * 38.38 = 37.1$	
Capacity (kN)	36.85	37.1	Pass

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### 2.5 Outer flange plate Checks

Check	Required	Provided	Remarks
Min. Plate Height (mm)		160.0	Pass
Min. Plate Length (mm)	$2[2 * e_{min} + (\frac{bolt \ lines}{2} - 1) * p_{min})] + \frac{gap}{2}]$ $= 2 * [(2 * 22.1 + (\frac{10}{2} - 1) * 30.0]$ $= +\frac{10.0}{2}]$ $= 338.4$	350.0	Pass
Min.Plate Thickness (mm)	$t_w = 11.5$	14.0	Pass

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#### 2.6 Member Checks

Check	Required	Provided	Remarks
		$T_{dg} = \frac{l * t_p * f_y}{1000 * \gamma_{mo}}$	
Flange Tension Yielding			
Capacity (kN)		$=\frac{160.0*11.5*230}{1000*1.1}$	
		- 384 73	
		$T_{dn} = \frac{0.9 * A_n * f_u}{1000 * \gamma_{m1}}$	
Flange Tension Rupture		$= \frac{0.9 * (160.0 - 2 * 13.0) * 11.5 *}{1000 * 1.25}$	410
Capacity (kN)			
		=454.9	
		$T_{db1} = \frac{A_{vg}f_y}{1000 * \sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{1000 * \gamma_{m1}}$	
Flange Block Shear Capacity (kN)		$T_{db2} = \frac{0.9 * A_{vn} f_u}{1000 * \sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{1000 * \gamma_{m0}}$	
		$T_{db} = min(T_{db1}, T_{db2}) = 518.1$ $T_d = Min(T_{dg}, T_{dn}, T_{db})$	
Flange Tension Capacity	$f_f = 160.68$	= Min(384.73, 454.9, 518.1)	Pass
(kN)		= 384.73	
		$T_{dg} = \frac{l * t_p * f_y}{1000 * \gamma_{mo}}$	
		$^{Idg} = 1000 * \gamma_{mo}$	
Web Tension Yielding Ca-		$=\frac{307.0*7.5*230}{1000*1.1}$	
pacity (kN)		1000 * 1.1	
		=481.43	
		$= 481.43$ $T_{dn} = \frac{0.9 * A_n * f_u}{1000 * \gamma_{m1}}$	
Web Tension Rupture Ca-			10
pacity (kN)		$= \frac{0.9 * (307.0 - 5 * 13.0) * 7.5 * 4}{1000 * 1.25}$	
		= 535.79	
		$= 535.79$ $T_{db1} = \frac{A_{vg}f_y}{1000 * \sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{1000 * \gamma_{m1}}$	
Web Block Shear Capac-		$0.9 * A_{vn} f_u \qquad A_{ta} f_u$	
ity (kN)		$T_{db2} = \frac{0.9 * A_{vn} f_u}{1000 * \sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{1000 * \gamma_{m0}}$	
		$T_{db} = min(T_{db1}, T_{db2}) = 615.45$ $T_d = Min(T_{dq}, T_{dn}, T_{db})$	
		$T_d = \overline{Min(T_{dg}, T_{dn}, T_{db})}$	
Web Tension Capacity	$A_w = 144.43$	= Min(481.43, 535.79, 615.45)	Pass
(kN)		=481.43	

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### 2.7 Flange Plate Capacity Checks in Axial-Outside

Check	Required	Provided	Remarks
		$T_{dg} = \frac{l * t_p * f_y}{1000 * \gamma_{mo}}$	
Tension Yielding Capacity		$=\frac{160.0*14.0*230}{}$	
(kN)		1000 * 1.1 = 468.36	
		$T_{dn} = \frac{0.9 * A_n * f_u}{1000 * \gamma_{m1}}$	
Tension Rupture Capacity		$= \frac{0.9 * (160.0 - 2 * 13.0) * 14.0 *}{1000 * 1.25}$	410
(kN)		$=\frac{1000*1.25}{}$	
		=553.8	
		$T_{db1} = \frac{A_{vg}f_y}{1000 * \sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{1000 * \gamma_{m1}}$	
Block Shear Capacity (kN)		$T_{db2} = \frac{0.9 * A_{vn} f_u}{1000 * \sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{1000 * \gamma_{m0}}$	
		$T_{db} = min(T_{db1}, T_{db2}) = 663.22$	
		$T_d = Min(T_{dg}, T_{dn}, T_{db})$	
Plate Tension Capacity	$f_f = 160.68$	= Min(468.36, 553.8, 663.22)	Pass
(kN)		=468.36	

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### 2.8 Web Plate Capacity Checks in Axial

Check	Required	Provided	Remarks
		$T_{dg} = \frac{l * t_p * f_y}{1000 * \gamma_{mo}}$	
Tension Yielding Capacity		$=\frac{310*6.0*230}{}$	
(kN)		-1000 * 1.1	
		=449.07	
		$T_{dn} = \frac{0.9 * A_n * f_u}{1000 * \gamma_{m1}}$	
		$1000 * \gamma_{m1}$	
Tension Rupture Capacity		$= \frac{0.9 * (310 - 5 * 13.0) * 6.0 * 410}{1000 * 1.25}$	)
(kN)		$=\frac{1000*1.25}{}$	
		=867.89	
		$T_{db1} = \frac{A_{vg}f_y}{1000 * \sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{1000 * \gamma_{m1}}$	
Block Shear Capacity (kN)		$T_{db2} = \frac{0.9 * A_{vn} f_u}{1000 * \sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{1000 * \gamma_{m0}}$	
		$T_{db} = min(T_{db1}, T_{db2}) = 984.73$	
		$T_d = Min(T_{dg}, T_{dn}, T_{db})$	
Plate Tension Capacity	$A_w = 144.43$	= Min(777.82, 867.89, 984.73)	Pass
(kN)		=777.82	

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### 2.9 Web Plate Capacity Checks in Shear

Check	Required	Provided	Remarks
Shear yielding Capacity (V_dy) (kN)		$V_{dy} = \frac{A_v * f_y}{1000 * \sqrt{3} * \gamma_{mo}}$ $= \frac{310 * 6.0 * 230}{1000 * \sqrt{3} * 1.1}$ $= 449.07$	
Shear Rupture Capacity (V_dn) (kN)		$V_{dn} = \frac{0.9 * A_{vn} * f_u}{1000 * \sqrt{3} * \gamma_{mo}}$ $= \frac{0.9 * (310 - (2.0 * 13.0)) * 6.0 *}{1.1 * 1000 * \sqrt{3}}$ $= 501.08$	* 410
Block Shear Capacity in Shear (V_db) (kN)		$T_{db1} = \frac{A_{vg}f_y}{1000 * \sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{1000 * \gamma_{m1}}$ $T_{db2} = \frac{0.9 * A_{vn}f_u}{1000 * \sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{1000 * \gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 601.24$	
Plate Shear Capacity (kN)	$V_u = 166.77$	$V_d = min(V_{dy}, V_{dn}, V_{db})$ $= min(449.07, 501.08, 984.73)$ $= 449.07$	Pass

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## 3 3D View

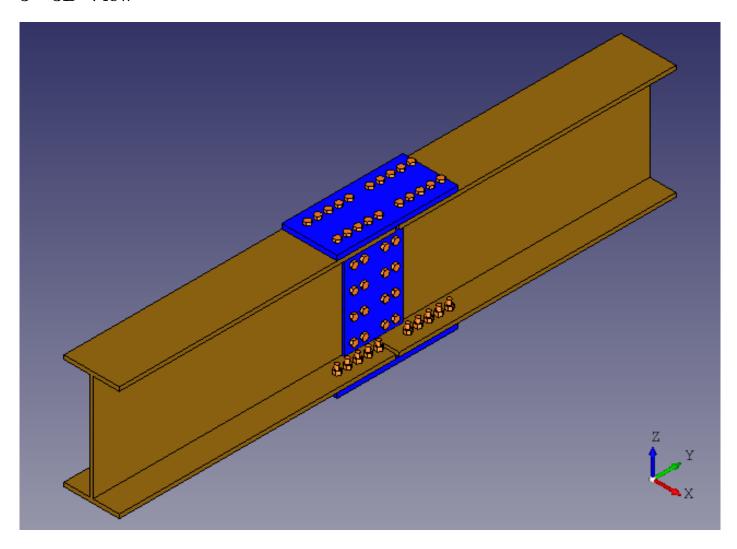


Figure 1: 3D View