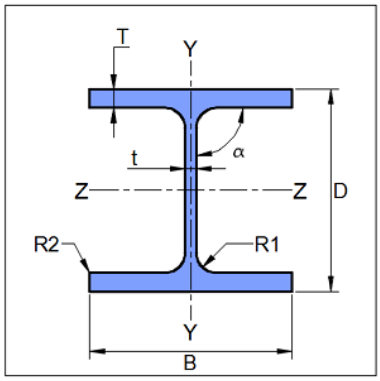
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Cover Plate Bolted
Designer	Engineer #1	Job Number	1.2.1.1.1
Date	17 /12 /2020	Client	Somnath Mukherjee, MN Dastur, Kolkata

1 Input Parameters

Module		Beam Cover Plate - Bolted	
Main Module		Moment Connection	
Bending Moment (kNm)		300.0	
Shear Force (kN)		160.0	
Axial Force (kN)		40.0	
Beam Section - Mechanical Properties			
			
Beam Section		UB 610 x 305 x 179	
Material		E 300 (Fe 440)	
Ultimate Strength, f_u (MPa)		440	
Yield Strength, f_y (MPa)		290	
Mass, m (kg/m)	179.0	I_z (cm^4)	153024.0
Area, A (cm^2)	22810.0	I_y(cm^4)	11407.0
D (mm)	620.0	r_z (cm)	25.9
B (mm)	307.1	r_y (cm)	7.1
t (mm)	14.1	Z_z (cm^3)	4935.0
T (mm)	23.6	Z_y (cm^3)	743.0
Flange Slope	90	Z_{pz} (cm^3)	5547.0
R_1 (mm)	16.5	Z_{py} (cm^3)	1144.0
R_2 (mm)	0.0		
Bolt Details - Input and Design Preference			
Diameter (mm)		[20, 24, 30, 36]	
Property Class		[6.8, 8.8, 9.8]	
Type		Bearing Bolt	
Hole Type		Standard	
Slip Factor, (mu_f)		0.3	
Edge Preparation Method		Rolled, machine-flame cut, sawn and planed	
Gap Between Beams (mm)		0.0	
Are the Members Exposed to Corrosive Influences?		False	
Plate Details - Input and Design Preference			
Preference		Outside	
Ultimate Strength, Fu (MPa)		410	
Yield Strength, Fy (MPa)		240	

Material	E 250 (Fe 410 W)A
Thickness (mm)	[8, 10, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 75, 80, 90, 100, 110, 120]

2 Design Checks

Design Status	Pass

2.1 Member Capacity

Check	Required	Provided	Remarks
Section Classification		*Plastic* [*Ref* : *Table* 2, *Cl*.3.7.2 *and* 3.7.4 *IS* 800 : 2007]	
Axial Capacity Member (kN)	$P_x = 40.0$	$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $= \frac{22810.0 \times 290}{1.1 \times 10^3}$ $= 6013.55$ [*Ref*. *IS* 800 : 2007, *Cl*. 6.2]	
Shear Capacity Member (kN)		$V_{dy} = \frac{A_v \ f_y}{\sqrt{3} \ \gamma_{mo}}$ $= \frac{572.8 \times 14.1 \times 290}{\sqrt{3} \times 1.1 \times 1000}$ $= 1229.33$ [*Ref*.*IS* 800 : 2007, *Cl*.10.4.3]	
Allowable Shear Capacity (kN)	$V_y = 160.0$	$V_d = 0.6 \ V_{dy}$ $= 0.6 \times 1229.33$ $= 737.6$ [*Limited to low shear*]	Pass
Plastic Moment Capacity (kNm)		$M_{dzz} = \frac{\beta_b \times Z_p \times fy}{\gamma_{mo} \times 10^6}$ $= \frac{1 \times 5547000.0 \times 290}{1.1 \times 10^6}$ $= 1462.39$ [*Ref*. *IS* 800 : 2007, *Cl*. 8.2.1.2]	

Check	Required	Provided	Remarks
Moment Deformation Criteria (kNm)		$Mdc = \frac{1.5 \times Z_e \times fy}{1.1 \times 10^6}$ $= \frac{1.5 \times 4935000.0 \times 290}{1.1 \times 10^6}$ $= 1951.57$ [$Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2$]	
Moment Capacity Member (kNm)	$M_z = 300.0$	$M_{dzz} = min(M_{dzz}, Mdc)$ $= min(1462.39, 1951.57)$ $= 1462.39$ [$Ref.\ IS\ 800:2007,\ Cl.\ 8.2$]	

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		$IR\ axial = P_x/T_{dg}$ $= 40.0/6013.55$ $= 0.0067$ $IR\ moment = M_z/M_{dzz}$ $= 300.0/1462.39$ $= 0.2051$ $IR\ sum = IR\ axial + IR\ moment$ $= 0.0067 + 0.2051$ $= 0.2118$	

Check	Required	Provided	Remarks
Minimum Required Load	*if IR axial* < 0.3 *and IR moment* < 0.5 $P_{x\,min} = 0.3 \times T_{dg}$ $M_{z\,min} = 0.5 \times M_{dzz}$ *elif sum IR* $<= 1.0$ *and IR moment* < 0.5 *if* $(0.5 - IR\ moment) < (1 - sum\ IR)$ $M_{z\,min} = 0.5 \times M_{dzz}$ *else* $M_{z\,min} = M_z + ((1 - sum\ IR) \times M_{dzz})$ $P_{x\,min} = P_x$ *elif sum IR* $<= 1.0$ *and IR axial* < 0.3 *if* $(0.3 - IR\ axial) < (1 - sum\ IR)$ $P_{x\,min} = 0.3 \times T_{dg}$ *else* $P_{x\,min} = P_x + ((1 - sum\ IR) \times T_{dg})$ $M_{z\,min} = M_z$ *else* $P_{x\,min} = P_x$ $M_{z\,min} = M_z$ *Note : AL = User Applied Load*	$M_{z\,min} = 731.2$ $P_{x\,min} = 1804.06$ [*Ref. IS* 800 : 2007, *Cl.* 10.7]	
Applied Axial Force (kN)	$P_x = 40.0$	$P_u = max(P_x,\ P_{x\,min})$ $= max(40.0, 1804.06)$ $= 1804.06$	

Check	Required	Provided	Remarks
Applied Shear Force (kN)	$V_y = 160.0$	$V_{y_{min}} = min(0.15 \times V_{dy}, 40.0)$ $= min(0.15 \times 1229.33, 40.0)$ $= 40.0$ $V_u = max(V_y,\ V_{y_{min}})$ $= max(160.0, 40.0)$ $= 160.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.7]$	
Applied Moment (kNm)	$M_z = 300.0$	$M_u = max(M_z,\ M_{z\,min})$ $= max(300.0,\ 731.2)$ $= 731.2$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	
Force Carried by Web		$A_w = Axial\ force\ in\ web$ $= \frac{(D - 2T)\ t\ Au}{A}$ $= \frac{(620.0 - 2 \times 23.6) \times 14.1 \times 1804.06}{22810.0}$ $= 638.78\ kN$ $M_w = Moment\ in\ web$ $= \frac{Z_w \times Mu}{Z}$ $= \frac{1156551.94 \times 731.2}{5547000.0}$ $= 152.45\ kNm$	

Check	Required	Provided	Remarks
Force Carried by Flange		$A_f = Axial\ force\ in\ flange$ $= \frac{Au\ B\ T}{A}$ $= \frac{1804.06 \times 307.1 \times 23.6}{22810.0}$ $= 573.22\ kN$ $M_f = Moment\ in\ flange$ $= Mu - M_w$ $= 731.2 - 152.45$ $= 578.74\ kNm$ $F_f = flange\ force$ $= \frac{M_f \times 10^3}{D - T} + A_f$ $= \frac{578.74 \times 10^3}{620.0 - 23.6} + 573.22$ $= 1543.61\ kN$	

2.3 Flange Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 36.0$	
Property Class	Bolt Grade Optimization	6.8	
Bolt Ultimate Strength (N/mm2)		$f_{ub} = 600.0$	
Bolt Yield Strength (N/mm2)		$f_{yb} = 480.0$	
Nominal Stress Area (mm2)		$A_{nb} = 817\ (Ref\ IS\ 1367 - 3\ (2002))$	
Hole Diameter (mm)		$d_0 = 39.0$	
Min. Flange Plate Thickness (mm)	$T = 23.6$	$t_{fp} = 25.0$	**Pass**
No. of Bolt Columns		$n_c = 8$	
No. of Bolt Rows		$n_r = 2$	

Check	Required	Provided	Remarks
Min. Pitch Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 36.0$ $= 90.0$ [$Ref\ IS\ 800:2007,\ Cl.\ 10.2.2$]	90	**Pass**
Max. Pitch Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 23.6,\ 300\ mm)$ $= \min(755.2,\ 300\ mm)$ $= 300$ $Where,\ t = min(25.0, 23.6)$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3$]	90	**Pass**
Min. Gauge Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 36.0$ $= 90.0$ [$Ref\ IS\ 800:2007,\ Cl.\ 10.2.2$]	0	
Max. Gauge Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 23.6,\ 300\ mm)$ $= \min(755.2,\ 300\ mm)$ $= 300$ $Where,\ t = min(25.0, 23.6)$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3$]	0	
Min. End Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 39.0$ $= 58.5$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.2$]	60	**Pass**

Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 25.0 \times \sqrt{\frac{250}{240}} = 306.19$ $e_2 = 12 \times 23.6 \times \sqrt{\frac{250}{290}} = 262.94$ $e_{max} = min(e_1, e_2) = 262.94$ [*Ref. IS* 800 : 2007, *Cl.* 10.2.4.3]	60	**Pass**
Min. Edge Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 39.0$ $= 58.5$ [*Ref. IS* 800 : 2007, *Cl.* 10.2.4.2]	65.0	**Pass**
Max. Edge Distance (mm)	$e'_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 25.0 \times \sqrt{\frac{250}{240}} = 306.19$ $e_2 = 12 \times 23.6 \times \sqrt{\frac{250}{290}} = 262.94$ $e'_{max} = min(e_1, e_2) = 262.94$ [*Ref. IS* 800 : 2007, *Cl.* 10.2.4.3]	65.0	**Pass**
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{600.0 \times 1 \times 817}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 226.41$ [*Ref. IS* 800 : 2007, *Cl.* 10.3.3]	

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Designer	Engineer #1	Job Number	1.2.1.1.1
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Check	Required	Provided	Remarks
Kb		$k_b = min\left(\frac{e}{3d_0},\ \frac{p}{3d_0} - 0.25,\ \frac{f_{ub}}{f_u},1.0\right)$ $= min\left(\frac{60}{3 \times 39.0},\ \frac{90}{3 \times 39.0} - 0.25,\ \frac{600.0}{410},\ 1.0\right)$ $= min(0.51, 0.52, 1.46, 1.0)$ $= 0.51$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.51 \times 36.0 \times 25.0 \times 410}{1000 \times 1.25}$ $= 376.38$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (226.41, 376.38)$ $= 226.41$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.2]$	

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Check	Required	Provided	Remarks
Long Joint Reduction Factor	$if\ l_j \geq 15d\ then\ V_{rd} = \beta_{lj} V_{db}$ $if\ l_j < 15d\ then\ V_{rd} = V_{db}$ $where,$ $l_j = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $\beta_{lj} = 1.075 - l/(200d)$ $but\ 0.75 \leq \beta_{lj} \leq 1.0$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.1]$	$l = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $lr = 2 \times ((\frac{8}{2} - 1) \times 90 + 60) + 0.0$ $= 660.0$ $lc = 2 \times ((\frac{2}{2} - 1) \times 0 + 65.0$ $+ 16.5) + 14.1 = 177.1$ $l = 660.0$ $15d = 15 \times 36.0 = 540.0$ $since,\ l \geq 15d$ $then\ V_{rd} = \beta_{lj} \times V_{db}$ $\beta_{lj} = 1.075 - 660.0/(200 \times 36.0)$ $= 0.98$ $V_{rd} = 0.98 \times 226.41 = 221.89$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.1]$	
Large Grip Length Reduction Factor	$if\ l_g \geq 5\ d\ then\ V_{rd} = \beta_{lg}\ V_{db}$ $if\ l_g < 5d\ then\ V_{rd} = V_{db}$ $l_g \leq 8d$ $where,$ $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ $but\ \beta_{lg} \leq \beta_{lj}$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.2]$	$l_g = \Sigma\ (t_p + t_{member})$ $= 48.6$ $5d = 180.0$ $8d = 288.0$ $since,\ l_g < 5d\ ;\ \beta_{lg} = 1.0$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.2]$	

Check	Required	Provided	Remarks
Capacity (kN)	$V_{res} = \frac{2\sqrt{V_u^2 + A_u^2}}{bolt_{req}}$ $= \frac{2 \times \sqrt{0.0^2 + 1543.61^2}}{16}$ $= 192.95$	$V_{rd} = \beta_{lj}\beta_{lg}V_{db}$ $= 0.98 \times 1.0 \times 226.41$ $= 221.89$	**Pass**

2.4 Web Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 36.0$	
Property Class	Bolt Grade Optimization	6.8	
Min. Web Plate Thickness (mm)	$t/2 = 7.05$	$t_{wp} = 14.0$	**Pass**
No. of Bolt Columns		$n_c = 4$	
No. of Bolt Rows		$n_r = 5$	
Min. Pitch Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 36.0$ $= 90.0$ $[Ref\ IS\ 800:2007,\ Cl.\ 10.2.2]$	90	**Pass**
Max. Pitch Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 14.0,\ 300\ mm)$ $= \min(448.0,\ 300\ mm)$ $= 300$ $Where,\ t = min(14.0, 14.1)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	90	**Pass**
Min. Gauge Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 36.0$ $= 90.0$ $[Ref\ IS\ 800:2007,\ Cl.\ 10.2.2]$	100	**Pass**

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Check	Required	Provided	Remarks
Max. Gauge Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 14.0,\ 300\ mm)$ $= \min(448.0,\ 300\ mm)$ $= 300$ $Where,\ t = min(14.0, 14.1)$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.2.3]$	100	**Pass**
Min. End Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 39.0$ $= 58.5$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.2.4.2]$	60	**Pass**
Max. End Distance (mm)	$e_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 28.0 \times \sqrt{\frac{250}{250}} = 336.0$ $e_2 = 12 \times 14.1 \times \sqrt{\frac{250}{290}} = 157.1$ $e_{max} = min(e_1, e_2) = 157.1$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.2.4.3]$	60	**Pass**
Min. Edge Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 39.0$ $= 58.5$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.2.4.2]$	60	**Pass**

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Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 28.0 \times \sqrt{\frac{250}{250}} = 336.0$ $e_2 = 12 \times 14.1 \times \sqrt{\frac{250}{290}} = 157.1$ $e'_{max} = min(e_1, e_2) = 157.1$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3$]	60	**Pass**
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{600.0 \times 2 \times 817}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 452.83$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3$]	
Kb		$k_b = min\left(\frac{e}{3d_0},\ \frac{p}{3d_0} - 0.25,\ \frac{f_{ub}}{f_u},\ 1.0\right)$ $= min\left(\frac{60}{3 \times 39.0},\ \frac{90}{3 \times 39.0} - 0.25,\ \frac{600.0}{440},\ 1.0\right)$ $= min(0.51, 0.52, 1.36, 1.0)$ $= 0.51$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4$]	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.51 \times 36.0 \times 14.1 \times 440}{1000 \times 1.25}$ $= 227.81$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4$]	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (452.83, 227.81)$ $= 227.81$ [$Ref.\ IS\ 800:2007,\ Cl.\ 10.3.2$]	

Check	Required	Provided	Remarks
Bolt Force Parameter(s) (mm)	$l_n = \textit{length available}$ $l_n = g\ (n_r - 1)$ $= 100 \times (5 - 1)$ $= 400$ $y_{max} = l_n/2$ $= 400/2$ $= 200.0$ $x_{max} = p(\frac{n_c}{2} - 1)/2$ $= 90 \times (\frac{4}{2} - 1)/2$ $= 45.0$		
Moment Demand (kNm)	$M_d = (V_u \times ecc + M_w)$ $ecc = \textit{eccentricity}$ $M_w = \textit{external moment acting on web}$ $= \frac{(160.0 \times 10^3 \times 105.0 + 152.45 \times 10^6)}{10^6}$ $= 169.25$		

Check	Required	Provided	Remarks
Bolt Force (kN)	$vbv = V_u/(n_r \times (n_c/2))$ $= \frac{160.0}{(5 \times (4/2))}$ $= 16.0$ $tmh = \frac{M_d \times y_{max}}{\Sigma r_i^2}$ $= \frac{169.25 \times 200.0}{220.25}$ $= 153.69$ $tmv = \frac{M_d \times x_{max}}{\Sigma r_i^2}$ $= \frac{169.25 \times 45.0}{220.25}$ $= 34.58$ $abh = \frac{A_u}{(n_r \times n_c/2)}$ $= \frac{638.78}{(5 \times (4/2))}$ $= 63.88$ $vres = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2}$ $= \sqrt{(16.0 + 34.58)^2 + (153.69 + 63.88)^2}$ $= 223.37$		

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Check	Required	Provided	Remarks
Long Joint Reduction Factor	$if\ l_j \geq 15d\ then\ V_{rd} = \beta_{lj} V_{db}$ $if\ l_j < 15d\ then\ V_{rd} = V_{db}$ $where,$ $l_j = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $\beta_{lj} = 1.075 - l/(200d)$ $but\ 0.75 \leq \beta_{lj} \leq 1.0$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.1]$	$l = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $lr = 2 \times ((\frac{4}{2} - 1) \times 90 + 60) + 0.0$ $= 300.0$ $lc = (5 - 1) \times 100 = 400$ $l = 400$ $15d = 15 \times 36.0 = 540.0$ $since,\ l < 15d$ $then\ V_{rd} = V_{db}$ $V_{rd} = 227.81$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.1]$	
Large Grip Length Reduction Factor	$if\ l_g \geq 5\ d\ then\ V_{rd} = \beta_{lg}\ V_{db}$ $if\ l_g < 5d\ then\ V_{rd} = V_{db}$ $l_g \leq 8d$ $where,$ $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ $but\ \beta_{lg} \leq \beta_{lj}$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.2]$	$l_g = \Sigma\ (t_p + t_{member})$ $= 42.1$ $5d = 180.0$ $8d = 288.0$ $since,\ l_g < 5d\ ;\ \beta_{lg} = 1.0$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.3.2]$	
Capacity (kN)	223.37	$V_{rd} = \beta_{lj}\beta_{lg}V_{db}$ $= 1.0 \times 1.0 \times 227.81$ $= 227.81$	**Pass**

2.5 Flange Plate Dimension Check - Outside

Check	Required	Provided	Remarks
Min. Flange Plate Width (mm)	$min\ flange\ plate\ ht = beam\ width$ $= 307.1$	307.1	**Pass**
Min. Flange Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})] + \frac{gap}{2}]$ $= 2 \times [(2 \times 58.5 + (\frac{8}{2} - 1) \times 90.0 = + \frac{0.0}{2}]$ $= 774.0$	780.0	**Pass**
Min. Flange Plate Thickness (mm)	$T = 23.6$	$t_{fp} = 25.0$	**Pass**
Plate Area Check (mm2)	$pt.area >=$ $connected\ member\ area \times 1.05$ $= 7609.94$ $[Ref : Cl.8.6.3.2\ IS\ 800 : 2007]$	$pt.area = B_{fp} \times t_{ifp}$ $= 307.1 \times 25.0$ $= 7677.500000000001$	**Pass**

2.6 Web Plate Dimension Check

Check	Required	Provided	Remarks
Min. Web Plate Height (mm)	$= 0.6 \times D$ $= 0.6 \times 620.0$ $= 323.88$ $[Ref : INSDAG - Chp\ 5, Sect.5.2.3]$	520	**Pass**

Check	Required	Provided	Remarks
Min. Web Plate Width (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})] + \frac{gap}{2}]$ $= 2 \times [(2 \times 58.5 + (\frac{4}{2} - 1) \times 90.0 = + \frac{0.0}{2}]$ $= 414.0$	420.0	**Pass**
Min. Web Plate Thickness (mm)	$t/2 = 7.05$	$t_{wp} = 14.0$	**Pass**
Plate Area Check (mm2)	$pt.area >=$ *connected member area* $\times 1.05$ $= 8480.3$ $[Ref : Cl.8.6.3.2\ IS\ 800 : 2007]$	$pt.area = 2 \times W_{wp} \times t_{wp}$ $= 2 \times 520 \times 14.0$ $= 14560.0$	**Pass**

2.7 Member Check

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 307.1 \times 23.6$ $= \frac{7247.56 \times 290}{1.1 \times 10^3}$ $= 1910.72$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 6.2]$	
Flange Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (307.1 - 2 \times 39.0) \times 23.6 \times 440}{1.25}$ $= 1712.86$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 6.3.1]$	

Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Cover Plate Bolted
Designer	Engineer #1	Job Number	1.2.1.1.1
Date	17 /12 /2020	Client	Somnath Mukherjee, MN Dastur, Kolkata

Check	Required	Provided	Remarks
Flange Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 2479.34$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Flange Tension Capacity (kN)	$F_f = 1543.61$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(1910.72, 1712.86, 2479.34)$ $= 1712.86$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**
Web Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 572.8 \times 14.1$ $= \frac{8076.48 \times 290}{1.1 \times 10^3}$ $= 2129.25$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Web Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (572.8 - 5 \times 39.0) \times 14.1 \times 440}{1.25}$ $= 1687.59$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	

Check	Required	Provided	Remarks
Web Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 2001.78$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Tension Capacity (kN)	$A_w = 638.78$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(2129.25, 1687.59, 2001.78)$ $= 1687.59$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

2.8 Flange Plate Capacity Check for Axial Load - Outside

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 307.1 \times 25.0$ $= \frac{7677.5 \times 240}{1.1 \times 10^3}$ $= 1675.09$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (307.1 - 2 \times 39.0) \times 25.0 \times 410}{1.25}$ $= 1690.76$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	

Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 2358.04$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Flange Plate Tension Capacity (kN)	$F_f = 1543.61$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(1675.09, 1690.76, 2358.04)$ $= 1675.09$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

2.9 Web Plate Capacity Check for Axial Load

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = 2l \times t = 2 \times 520 \times 14.0$ $= \frac{7280.0 \times 250}{1.1 \times 10^3}$ $= 3309.09$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{2 \times\ 0.9 \times (520 - 5 \times 39.0) \times 14.0 \times 410}{1.25}$ $= 2686.32$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	

Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 3614.96$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Plate Tension Capacity (kN)	$A_w = 638.78$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(3309.09, 2686.32, 3614.96)$ $= 2686.32$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

2.10 Web Plate Capacity Checks for Shear Load

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v\ f_y}{\sqrt{3}\ \gamma_{mo}}$ $= \frac{2 \times 520 \times 14.0 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 1910.5$ $[Ref. IS\ 800:2007, Cl. 10.4.3]$	
Allowable Shear Capacity (kN)	$V = 160.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 1910.5$ $= 1146.3$ $[Limited\ to\ low\ shear]$	**Pass**

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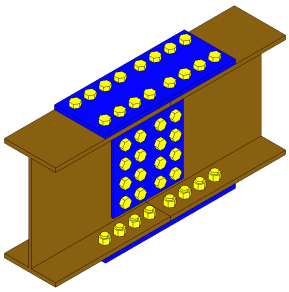
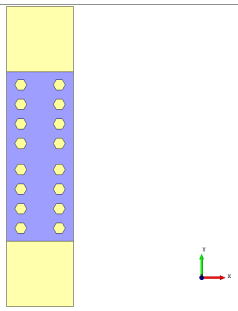
Designer	Engineer #1	Job Number	1.2.1.1.1
Date	17 /12 /2020	Client	Somnath Mukherjee, MN Dastur, Kolkata

Check	Required	Provided	Remarks
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75\ A_{vn}\ f_u}{\sqrt{3}\ \gamma_{m1}}$ $= 2 \times \frac{(520 - (5 \times 39.0)) \times 14.0 \times 410}{\sqrt{3} \times 1.25}$ $= 1292.46$ $[Ref. AISC\ \ Sect. J4]$	
Block Shear Capacity (kN)		$V_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{db} = min(V_{db1}, V_{db2}) = 2312.22$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Plate Shear Capacity (kN)		$V_d = min(S_c, V_{dn}, V_{db})$ $= min(1146.3, 1292.46, 2312.22)$ $= 1146.3$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

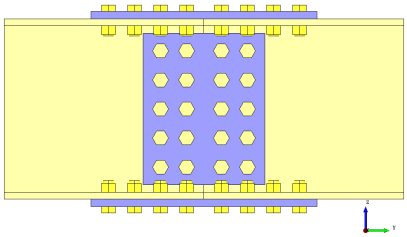
3 3D Views



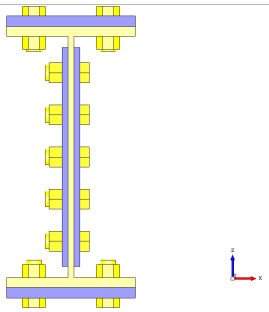
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2020-12-17 23:40:25 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2020-12-17 23:40:25 - Osdag - INFO - The value of load(s) is/are set at minimum recommended value as per IS 800:2007, Cl.10.7.
2020-12-17 23:40:25 - Osdag - INFO - : Overall bolted cover plate splice connection design is safe