	Created with
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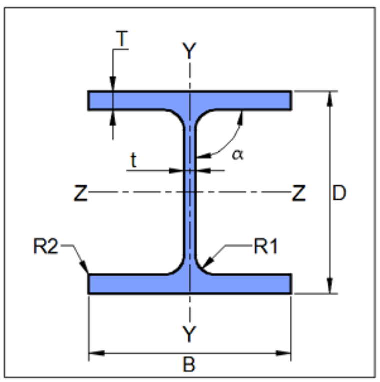
Date	17 /12 /2020

Project Title	Sample Connection Design
Subtitle	Cover Plate Bolted
Job Number	1.2.1.1.2
Client	Pratip Bhattacharya, TCE, Kolkata

1 Input Parameters

Module	Beam Cover Plate - Bolted
Main Module	Moment Connection
Bending Moment (kNm)	395.0
Shear Force (kN)	110.0
Axial Force (kN)	0.0

Beam Section - Mechanical Properties



Beam Section		WPB 900 X 300 X 198.01	
Material		E 350 (Fe 490)	
Ultimate Strength, f_u (MPa)		490	
Yield Strength, f_y (MPa)		330	
Mass, m (kg/m)	198.01	I_z (cm^4)	301000.0
Area, A (cm^2)	25200.0	I_y(cm^4)	9040.0
D (mm)	870.0	r_z (cm)	34.5
B (mm)	300.0	r_y (cm)	5.98
t (mm)	15.0	Z_z (cm^3)	6920.0
T (mm)	20.0	Z_y (cm^3)	602.0
Flange Slope	90	Z_{pz} (cm^3)	7990.0
R_1 (mm)	30.0	Z_{py} (cm^3)	957.0
R_2 (mm)	0.0		

Bolt Details - Input and Design Preference

Diameter (mm)	[24]
Property Class	[8.8]
Type	Bearing Bolt
Hole Type	Over-sized
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 + Inside
Ultimate Strength, Fu (MPa)	440
Yield Strength, Fy (MPa)	300

Material	E 300 (Fe 440)
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)	$P_x = 0.0$	$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $= \frac{25200.0 \times 330}{1.1 \times 10^3}$ $= 7560.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Shear Capacity Member (kN)		$V_{dy} = \frac{A_v\ f_y}{\sqrt{3}\ \gamma_{mo}}$ $= \frac{830.0 \times 15.0 \times 330}{\sqrt{3} \times 1.1 \times 1000}$ $= 2156.4$ $[Ref. IS\ 800:2007, Cl.10.4.3]$	
Allowable Shear Capacity (kN)	$V_y = 110.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 2156.4$ $= 1293.84$ $[Limited\ to\ low\ shear]$	Pass
Plastic Moment Capacity (kNm)		$M_{dzz} = \frac{\beta_b \times Z_p \times fy}{\gamma_{mo} \times 10^6}$ $= \frac{1 \times 7990000.0 \times 330}{1.1 \times 10^6}$ $= 2397.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	

Check	Required	Provided	Remarks
Moment Deformation Criteria (kNm)		$Mdc = \frac{1.5 \times Z_e \times fy}{1.1 \times 10^6}$ $= \frac{1.5 \times 6920000.0 \times 330}{1.1 \times 10^6}$ $= 3114.0$ [$Ref.\ IS$ 800 : 2007, $Cl.$ 8.2.1.2]	
Moment Capacity Member (kNm)	$M_z = 395.0$	$M_{dzz} = min(M_{dzz}, Mdc)$ $= min(2397.0, 3114.0)$ $= 2397.0$ [$Ref.\ IS$ 800 : 2007, $Cl.$ 8.2]	

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		$IR\ axial = P_x/T_{dg}$ $= 0.0/7560.0$ $= 0.0$ $IR\ moment = M_z/M_{dzz}$ $= 395.0/2397.0$ $= 0.1648$ $IR\ sum = IR\ axial + IR\ moment$ $= 0.0 + 0.1648$ $= 0.1648$	

Check	Required	Provided	Remarks
Minimum Required Load	$if\ \ IR\ axial < 0.3\ and\ IR\ moment < 0.5$ $P_{x\,min} = 0.3 \times T_{dg}$ $M_{z\,min} = 0.5 \times M_{dzz}$ $elif\ \ sum\ IR <= 1.0\ and\ IR\ moment < 0.5$ $if\ \ (0.5 - IR\ moment) < (1 - sum\ IR)$ $M_{z\,min} = 0.5 \times M_{dzz}$ $else$ $M_{z\,min} = M_z + ((1 - sum\ IR) \times M_{dzz})$ $P_{x\,min} = P_x$ $elif\ \ sum\ IR <= 1.0\ and\ IR\ axial < 0.3$ $if\ \ (0.3 - IR\ axial) < (1 - sum\ IR)$ $P_{x\,min} = 0.3 \times T_{dg}$ $else$ $P_{x\,min} = P_x + ((1 - sum\ IR) \times T_{dg})$ $M_{z\,min} = M_z$ $else$ $P_{x\,min} = P_x$ $M_{z\,min} = M_z$ $Note:\ AL = \ User\ Applied\ Load$	$M_{z\,min} = 1198.5$ $P_{x\,min} = 2268.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.7]$	
Applied Axial Force (kN)	$P_x = 0.0$	$P_u = max(P_x,\ P_{x\,min})$ $= max(0.0, 2268.0)$ $= 2268.0$	

Check	Required	Provided	Remarks
Applied Shear Force (kN)	$V_y = 110.0$	$V_{y_{min}} = min(0.15 \times V_{dy}, 40.0)$ $= min(0.15 \times 2156.4, 40.0)$ $= 40.0$ $V_u = max(V_y,\ V_{y_{min}})$ $= max(110.0, 40.0)$ $= 110.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.7]$	
Applied Moment (kNm)	$M_z = 395.0$	$M_u = max(M_z,\ M_{z_{min}})$ $= max(395.0,\ 1198.5)$ $= 1198.5$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	
Force Carried by Web		$A_w = Axial\ force\ in\ web$ $= \frac{(D-2T)\ t\ Au}{A}$ $= \frac{(870.0 - 2 \times 20.0) \times 15.0 \times 2268.0}{25200.0}$ $= 1120.5\ kN$ $M_w = Moment\ in\ web$ $= \frac{Z_w \times Mu}{Z}$ $= \frac{2583375.0 \times 1198.5}{7990000.0}$ $= 387.51\ kNm$	

Check	Required	Provided	Remarks
Force Carried by Flange		$A_f = Axial\ force\ in\ flange$ $= \frac{Au\ B\ T}{A}$ $= \frac{2268.0 \times 300.0 \times 20.0}{25200.0}$ $= 540.0\ kN$ $M_f = Moment\ in\ flange$ $= Mu - M_w$ $= 1198.5 - 387.51$ $= 810.99\ kNm$ $F_f = flange\ force$ $= \frac{M_f \times 10^3}{D - T} + A_f$ $= \frac{810.99 \times 10^3}{870.0 - 20.0} + 540.0$ $= 1494.11\ kN$	

2.3 Flange Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 24.0$	
Property Class	Bolt Grade Optimization	8.8	
Bolt Ultimate Strength (N/mm2)		$f_{ub} = 830.0$	
Bolt Yield Strength (N/mm2)		$f_{yb} = 660.0$	
Nominal Stress Area (mm2)		$A_{nb} = 353\ (Ref\ IS\ 1367 - 3\ (2002))$	
Hole Diameter (mm)		$d_0 = 30.0$	
Min. Flange Plate Thickness (mm)	$T/2 = 10.0$	$t_{ifp} = 12.0$	Pass
No. of Bolt Columns		$n_c = 12$	
No. of Bolt Rows		$n_r = 2$	

Check	Required	Provided	Remarks
Min. Pitch Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 24.0$ $= 60.0$ $[Ref\ IS\ 800:2007,\ Cl.\ 10.2.2]$	60	**Pass**
Max. Pitch Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 12.0,\ 300\ mm)$ $= \min(384.0,\ 300\ mm)$ $= 300$ $Where,\ t = min(12.0, 20.0)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	60	**Pass**
Min. Gauge Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 24.0$ $= 60.0$ $[Ref\ IS\ 800:2007,\ Cl.\ 10.2.2]$	0	
Max. Gauge Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 12.0,\ 300\ mm)$ $= \min(384.0,\ 300\ mm)$ $= 300$ $Where,\ t = min(12.0, 20.0)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	0	
Min. End Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 30.0$ $= 45.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.2]$	45	**Pass**

Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 24.0 \times \sqrt{\frac{250}{300}} = 262.91$ $e_2 = 12 \times 20.0 \times \sqrt{\frac{250}{330}} = 208.89$ $e_{max} = min(e_1, e_2) = 208.89$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	45	**Pass**
Min. Edge Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 30.0$ $= 45.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.2]$	56.25	**Pass**
Max. Edge Distance (mm)	$e'_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 24.0 \times \sqrt{\frac{250}{300}} = 262.91$ $e_2 = 12 \times 20.0 \times \sqrt{\frac{250}{330}} = 208.89$ $e'_{max} = min(e_1, e_2) = 208.89$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	56.25	**Pass**
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{830.0 \times 2 \times 353}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 270.65$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3]$	

Check	Required	Provided	Remarks
Kb		$k_b = min\left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right)$ $= min\left(\frac{45}{3 \times 30.0}, \frac{60}{3 \times 30.0} - 0.25, \frac{830.0}{490}, 1.0\right)$ $= min(0.5, 0.42, 1.69, 1.0)$ $= 0.42$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 20.0 \times 490}{1000 \times 1.25}$ $= 138.3$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (270.65, 138.3)$ $= 138.3$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.2]$	

Check	Required	Provided	Remarks
Long Joint Reduction Factor	$if\ l_j \geq 15d\ then\ V_{rd} = \beta_{lj} V_{db}$ $if\ l_j < 15d\ then\ V_{rd} = V_{db}$ $where,$ $l_j = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $\beta_{lj} = 1.075 - l/(200d)$ $but\ 0.75 \leq \beta_{lj} \leq 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	$l = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $lr = 2 \times ((\frac{12}{2} - 1) \times 60 + 45) + 0.0$ $= 690.0$ $lc = 2 \times ((\frac{2}{2} - 1) \times 0 + 56.25$ $+ 30.0) + 15.0 = 187.5$ $l = 690.0$ $15d = 15 \times 24.0 = 360.0$ $since,\ l \geq 15d$ $then\ V_{rd} = \beta_{lj} \times V_{db}$ $\beta_{lj} = 1.075 - 690.0/(200 \times 24.0)$ $= 0.93$ $V_{rd} = 0.93 \times 138.3 = 128.62$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	
Large Grip Length Reduction Factor	$if\ l_g \geq 5\ d\ then\ V_{rd} = \beta_{lg}\ V_{db}$ $if\ l_g < 5d\ then\ V_{rd} = V_{db}$ $l_g \leq 8d$ $where,$ $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ $but\ \beta_{lg} \leq \beta_{lj}$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	$l_g = \Sigma\ (t_p + t_{member})$ $= 44.0$ $5d = 120.0$ $8d = 192.0$ $since,\ l_g < 5d\ ;\ \beta_{lg} = 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	

Check	Required	Provided	Remarks
Capacity (kN)	$V_{res} = \frac{2\sqrt{V_u^2 + A_u^2}}{bolt_{req}}$ $= \frac{2 \times \sqrt{0.0^2 + 1494.11^2}}{24}$ $= 124.51$	$V_{rd} = \beta_{lj}\beta_{lg}V_{db}$ $= 0.93 \times 1.0 \times 138.3$ $= 128.62$	Pass

2.4 Web Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 24.0$	
Property Class	Bolt Grade Optimization	8.8	
Min. Web Plate Thickness (mm)	$t/2 = 7.5$	$t_{wp} = 16.0$	Pass
No. of Bolt Columns		$n_c = 8$	
No. of Bolt Rows		$n_r = 11$	
Min. Pitch Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 24.0$ $= 60.0$ $[Ref\ IS\ 800:2007,\ Cl.\ 10.2.2]$	60	Pass
Max. Pitch Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 15.0,\ 300\ mm)$ $= \min(480.0,\ 300\ mm)$ $= 300$ $Where,\ t = min(16.0, 15.0)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	60	Pass
Min. Gauge Distance (mm)	$p_{min} = 2.5\ d$ $= 2.5 \times 24.0$ $= 60.0$ $[Ref\ IS\ 800:2007,\ Cl.\ 10.2.2]$	60	Pass

Check	Required	Provided	Remarks
Max. Gauge Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 15.0,\ 300\ mm)$ $= \min(480.0,\ 300\ mm)$ $= 300$ $Where,\ t = min(16.0, 15.0)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	60	**Pass**
Min. End Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 30.0$ $= 45.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.2]$	45	**Pass**
Max. End Distance (mm)	$e_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 32.0 \times \sqrt{\frac{250}{300}} = 350.54$ $e_2 = 12 \times 15.0 \times \sqrt{\frac{250}{330}} = 156.67$ $e_{max} = min(e_1, e_2) = 156.67$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	45	**Pass**
Min. Edge Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 30.0$ $= 45.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.2]$	45	**Pass**

Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 32.0 \times \sqrt{\frac{250}{300}} = 350.54$ $e_2 = 12 \times 15.0 \times \sqrt{\frac{250}{330}} = 156.67$ $e'_{max} = min(e_1, e_2) = 156.67$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	45	Pass
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{830.0 \times 2 \times 353}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 270.65$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3]$	
Kb		$k_b = min\left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right)$ $= min\left(\frac{45}{3 \times 30.0}, \frac{60}{3 \times 30.0} - 0.25, \frac{830.0}{490}, 1.0\right)$ $= min(0.5, 0.42, 1.69, 1.0)$ $= 0.42$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 15.0 \times 490}{1000 \times 1.25}$ $= 103.72$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (270.65, 103.72)$ $= 103.72$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.2]$	

Check	Required	Provided	Remarks
Bolt Force Parameter(s) (mm)	$l_n = length\ available$ $l_n = g\ (n_r - 1)$ $= 60 \times (11 - 1)$ $= 600$ $y_{max} = l_n/2$ $= 600/2$ $= 300.0$ $x_{max} = p(\frac{n_c}{2} - 1)/2$ $= 60 \times (\frac{8}{2} - 1)/2$ $= 90.0$		
Moment Demand (kNm)	$M_d = (V_u \times ecc + M_w)$ $ecc = eccentricity$ $M_w = external\ moment\ acting\ on\ web$ $= \frac{(110.0 \times 10^3 \times 135.0 + 387.51 \times 10^6)}{10^6}$ $= 402.36$		

Check	Required	Provided	Remarks
Bolt Force (kN)	$vbv = V_u/(n_r \times (n_c/2)) = \frac{110.0}{(11 \times (8/2))} = 2.5$ $tmh = \frac{M_d \times y_{max}}{\Sigma r_i^2} = \frac{402.36 \times 300.0}{1782.0} = 67.74$ $tmv = \frac{M_d \times x_{max}}{\Sigma r_i^2} = \frac{402.36 \times 90.0}{1782.0} = 20.32$ $abh = \frac{A_u}{(n_r \times n_c/2)} = \frac{1120.5}{(11 \times (8/2))} = 25.47$ $vres = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2} = \sqrt{(2.5 + 20.32)^2 + (67.74 + 25.47)^2} = 95.96$		

Check	Required	Provided	Remarks
Long Joint Reduction Factor	$if\ l_j \geq 15d\ then\ V_{rd} = \beta_{lj} V_{db}$ $if\ l_j < 15d\ then\ V_{rd} = V_{db}$ $where,$ $l_j = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $\beta_{lj} = 1.075 - l/(200d)$ $but\ 0.75 \leq \beta_{lj} \leq 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	$l = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $lr = 2 \times ((\frac{8}{2} - 1) \times 60 + 45) + 0.0$ $= 450.0$ $lc = (11 - 1) \times 60 = 600$ $l = 600$ $15d = 15 \times 24.0 = 360.0$ $since,\ l \geq 15d$ $then\ V_{rd} = \beta_{lj} \times V_{db}$ $\beta_{lj} = 1.075 - 600/(200 \times 24.0)$ $= 0.95$ $V_{rd} = 0.95 \times 103.72 = 98.54$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	
Large Grip Length Reduction Factor	$if\ l_g \geq 5\ d\ then\ V_{rd} = \beta_{lg}\ V_{db}$ $if\ l_g < 5d\ then\ V_{rd} = V_{db}$ $l_g \leq 8d$ $where,$ $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ $but\ \beta_{lg} \leq \beta_{lj}$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	$l_g = \Sigma\ (t_p + t_{member})$ $= 47.0$ $5d = 120.0$ $8d = 192.0$ $since,\ l_g < 5d\ ;\ \beta_{lg} = 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	
Capacity (kN)	95.96	$V_{rd} = \beta_{lj} \beta_{lg} V_{db}$ $= 0.95 \times 1.0 \times 103.72$ $= 98.54$	**Pass**

2.5 Flange Plate Dimension Check - Outside/Inside

Check	Required	Provided	Remarks
Min. Flange Plate Width (mm)	$min\ flange\ plate\ ht = beam\ width$ $= 300.0$	300.0	Pass
Min. Flange Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 45.0 + (\frac{12}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 780.0$	780.0	Pass
Min. Inner Plate Width (mm)	>=50	110	Pass
Max. Inner Plate Width (mm)	$= \frac{B - t - (2R1)}{2}$ $= \frac{300.0 - 15.0 - 2 \times 30.0}{2}$ $= 112$	110	Pass
Min. Inner Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 45.0 + (\frac{12}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 780.0$	780.0	Fail
Min. Flange Plate Thickness (mm)	$T/2 = 10.0$	$t_{ifp} = 12.0$	Pass
Plate Area Check (mm2)	$pt.area >=$ $connected\ member\ area \times 1.05$ $= 6300.0$ $[Ref: Cl.8.6.3.2\ IS\ 800:2007]$	$pt.area = (B_{fp} + (2 \times B_{ifp})) \times t_{ifp}$ $= (300.0 + (2 \times 110)) \times 12.0$ $= 6240.0$	Fail

2.6 Web Plate Dimension Check

Check	Required	Provided	Remarks
Min. Web Plate Height (mm)	$= 0.6 \times D$ $= 0.6 \times 870.0$ $= 462.0$ $[Ref: INSDAG - Chp\ 5,$ $Sect.5.2.3]$	690	**Pass**
Min. Web Plate Width (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 45.0 + (\frac{8}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 540.0$	540.0	**Pass**
Min. Web Plate Thickness (mm)	$t/2 = 7.5$	$t_{wp} = 16.0$	**Pass**
Plate Area Check (mm2)	$pt.area >=$ $connected\ member\ area \times 1.05$ $= 13072.5$ $[Ref: Cl.8.6.3.2\ IS\ 800:2007]$	$pt.area = 2 \times W_{wp} \times t_{wp}$ $= 2 \times 690 \times 16.0$ $= 22080.0$	**Pass**

2.7 Member Check

Check	Required	Provided	Remarks

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 300.0 \times 20.0$ $= \frac{6000.0 \times 330}{1.1 \times 10^3}$ $= 1800.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Flange Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (300.0 - 2 \times 30.0) \times 20.0 \times 490}{1.25}$ $= 1693.44$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	
Flange Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 2141.56$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Flange Tension Capacity (kN)	$F_f = 1494.11$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(1800.0, 1693.44, 2141.56)$ $= 1693.44$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

Check	Required	Provided	Remarks
Web Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 830.0 \times 15.0$ $= \frac{12450.0 \times 330}{1.1 \times 10^3}$ $= 3735.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Web Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (830.0 - 11 \times 30.0) \times 15.0 \times 490}{1.25}$ $= 2646.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	
Web Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 2994.87$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Tension Capacity (kN)	$A_w = 1120.5$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(3735.0, 2646.0, 2994.87)$ $= 2646.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

2.8 Flange Plate Capacity Check for Axial Load - Outside/Inside

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 520.0 \times 12.0$ $= \frac{6240.0 \times 300}{1.1 \times 10^3}$ $= 1701.82$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (520.0 - 2 \times 30.0) \times 12.0 \times 440}{1.25}$ $= 1748.74$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 2316.66$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Flange Plate Tension Capacity (kN)	$F_f = 1494.11$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(1701.82, 1748.74, 2316.66)$ $= 1701.82$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

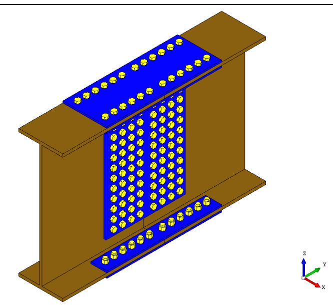
2.9 Web Plate Capacity Check for Axial Load

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = 2l \times t = 2 \times 690 \times 16.0$ $= \frac{11040.0 \times 300}{1.1 \times 10^3}$ $= 6021.82$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{2 \times\ 0.9 \times (690 - 11 \times 30.0) \times 16.0 \times 440}{1.25}$ $= 3649.54$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 5764.88$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Plate Tension Capacity (kN)	$A_w = 1120.5$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(6021.82, 3649.54, 5764.88)$ $= 3649.54$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	Pass

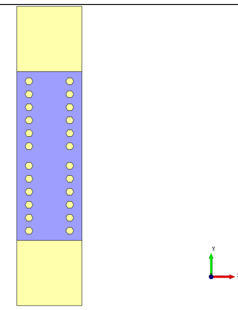
2.10 Web Plate Capacity Checks for Shear Load

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v\ f_y}{\sqrt{3}\ \gamma_{mo}}$ $= \frac{2 \times 690 \times 16.0 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 3476.7$ $[Ref. IS\ 800:2007, Cl. 10.4.3]$	
Allowable Shear Capacity (kN)	$V = 110.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 3476.7$ $= 2086.02$ $[Limited\ to\ low\ shear]$	Pass
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75\ A_{vn}\ f_u}{\sqrt{3}\ \gamma_{m1}}$ $= 2 \times \frac{(690 - (11 \times 30.0)) \times 16.0 \times 440}{\sqrt{3} \times 1.25}$ $= 1755.88$ $[Ref. AISC\ \ Sect. J4]$	
Block Shear Capacity (kN)		$V_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3} \gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{db} = min(V_{db1}, V_{db2}) = 3895.11$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Plate Shear Capacity (kN)		$V_d = min(S_c, V_{dn}, V_{db})$ $= min(2086.02, 1755.88, 3895.11)$ $= 1755.88$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	Pass

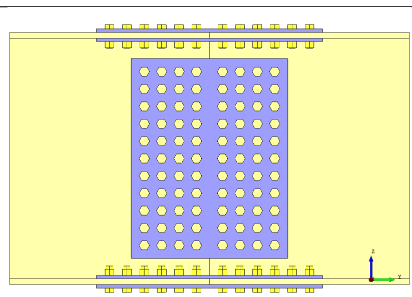
3 3D Views



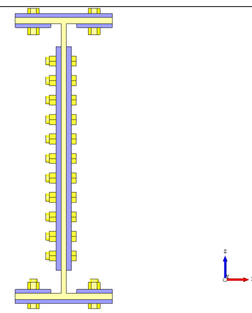
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2020-12-17 23:41:41 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2020-12-17 23:41:41 - 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 23:41:41 - Osdag - INFO - : Overall bolted cover plate splice connection design is safe