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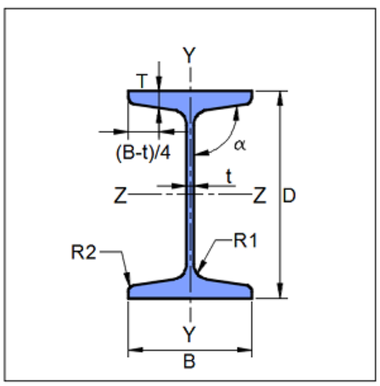
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Column-Column Cover Plate Bolted
Designer	Engineer #1	Job Number	1.2.3.1.1
Date	18 /12 /2020	Client	S R Satish Kumar, Professor, IIT Madras

1 Input Parameters

Module	Column Cover Plate - Bolted
Main Module	Moment Connection
Bending Moment (kNm)	127.0
Shear Force (kN)	0.0
Axial Force (kN)	320.0
Column Section - Mechanical Properties	



Beam Section *		HB 300	
Material		E 300 (Fe 440)	
Ultimate Strength, Fu (MPa)		440	
Yield Strength, Fy (MPa)		300	
Mass, m (kg/m)	58.74	I_z (cm^4)	12500.0
Area, A (cm^2)	74.8	I_y(cm^4)	2190.0
D (mm)	300.0	r_z (cm)	12.9
B (mm)	250.0	r_y (cm)	5.41
t (mm)	7.6	Z_z (cm^3)	836.0
T (mm)	10.6	Z_y (cm^3)	175.0
Flange Slope	94	Z_{pz} (cm^3)	921.0
R_1 (mm)	11.0	Z_{py} (cm^3)	291.0
R_2 (mm)	5.5		

Bolt Details - Input and Design Preference	
Diameter (mm)	[20, 24, 30]
Property Class	[10.9, 12.9]
Type	Bearing Bolt
Bolt Tension	Non pre-tensioned
Hole Type	Over-sized
Slip Factor, (mu_f)	0.3
Detailing - Design Preference	
Edge Preparation Method	Rolled, machine-flame cut, sawn and planed
Gap Between Columns (mm)	0.0
Are the Members Exposed to Corrosive Influences?	False
Plate Details - Input and Design Preference	
Preference	Outside + Inside

Material	E 300 (Fe 440)
Ultimate Strength, Fu (MPa)	440
Yield Strength, Fy (MPa)	300
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		$Semi-Compact$ $[Ref: Table\ 2, Cl.3.7.2\ and\ 3.7.4\ IS\ 800:2007]$	
Axial Capacity Member (kN)	$P_x = 320.0$	$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $= \frac{7480.0 \times 300}{1.1 \times 10^3}$ $= 2040.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Shear Capacity Member (kN)		$V_{dy} = \frac{A_v\ f_y}{\sqrt{3}\ \gamma_{mo}}$ $= \frac{278.8 \times 7.6 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 333.64$ $[Ref.IS\ 800:2007, Cl.10.4.3]$	
Allowable Shear Capacity (kN)	$V_y = 0.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 333.64$ $= 200.18$ $[Limited\ to\ low\ shear]$	
Plastic Moment Capacity (kNm)		$M_{dzz} = \frac{\beta_b \times Z_p \times fy}{\gamma_{mo} \times 10^6}$ $= \frac{0.91 \times 921000.0 \times 300}{1.1 \times 10^6}$ $= 228.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	

Check	Required	Provided	Remarks
Moment Deformation Criteria (kNm)		$Mdc = \frac{1.5 \times Z_e \times fy}{1.1 \times 10^6}$ $= \frac{1.5 \times 836000.0 \times 300}{1.1 \times 10^6}$ $= 342.0$ [$Ref.\ IS$ 800 : 2007, $Cl.$ 8.2.1.2]	
Moment Capacity Member (kNm)	$M_z = 127.0$	$M_{dzz} = min(M_{dzz}, Mdc)$ $= min(228.0, 342.0)$ $= 228.0$ [$Ref.\ IS$ 800 : 2007, $Cl.$ 8.2]	

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		$IR\ axial = P_x/T_{dg}$ $= 320.0/2040.0$ $= 0.1569$ $IR\ moment = M_z/M_{dzz}$ $= 127.0/228.0$ $= 0.557$ $IR\ sum = IR\ axial + IR\ moment$ $= 0.1569 + 0.557$ $= 0.7139$	

Check	Required	Provided	Remarks
Minimum Required Load	$if\ \ IR\ axial < 0.3\ and\ IR\ moment < 0.5$ $P_{x\,min} = 0.3 \times T_{dg}$ $M_{z\,min} = 0.5 \times M_{dzz}$ $elif\ \ sum\ IR <= 1.0\ and\ IR\ moment < 0.5$ $if\ \ (0.5 - IR\ moment) < (1 - sum\ IR)$ $M_{z\,min} = 0.5 \times M_{dzz}$ $else$ $M_{z\,min} = M_z + ((1 - sum\ IR) \times M_{dzz})$ $P_{x\,min} = P_x$ $elif\ \ sum\ IR <= 1.0\ and\ IR\ axial < 0.3$ $if\ \ (0.3 - IR\ axial) < (1 - sum\ IR)$ $P_{x\,min} = 0.3 \times T_{dg}$ $else$ $P_{x\,min} = P_x + ((1 - sum\ IR) \times T_{dg})$ $M_{z\,min} = M_z$ $else$ $P_{x\,min} = P_x$ $M_{z\,min} = M_z$ $Note:\ AL =\ User\ Applied\ Load$	$M_{z\,min} = 127.0$ $P_{x\,min} = 612.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.7]$	
Applied Axial Force (kN)	$P_x = 320.0$	$P_u = max(P_x,\ P_{x\,min})$ $= max(320.0, 612.0)$ $= 612.0$	

Check	Required	Provided	Remarks
Applied Shear Force (kN)	$V_y = 0.0$	$V_{y_{min}} = min(0.15 \times V_{dy}, 40.0)$ $= min(0.15 \times 333.64, 40.0)$ $= 40.0$ $V_u = max(V_y,\ V_{y_{min}})$ $= max(0.0, 40.0)$ $= 40.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.7]$	
Applied Moment (kNm)	$M_z = 127.0$	$M_u = max(M_z,\ M_{z_{min}})$ $= max(127.0,\ 127.0)$ $= 127.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	
Force Carried by Web		$A_w = Axial\ force\ in\ web$ $= \frac{(D-2T)\ t\ Au}{A}$ $= \frac{(300.0 - 2 \times 10.6) \times 7.6 \times 612.0}{7480.0}$ $= 173.36\ kN$ $M_w = Moment\ in\ web$ $= \frac{Z_w \times Mu}{Z}$ $= \frac{98457.29 \times 127.0}{921000.0}$ $= 13.58\ kNm$	

Check	Required	Provided	Remarks
Force Carried by Flange		$A_f = Axial\ force\ in\ flange$ $= \frac{Au\ B\ T}{A}$ $= \frac{612.0 \times 250.0 \times 10.6}{7480.0}$ $= 216.82\ kN$ $M_f = Moment\ in\ flange$ $= Mu - M_w$ $= 127.0 - 13.58$ $= 113.42\ kNm$ $F_f = flange\ force$ $= \frac{M_f \times 10^3}{D - T} + A_f$ $= \frac{113.42 \times 10^3}{300.0 - 10.6} + 216.82$ $= 608.74\ kN$	

2.3 Flange Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	$d = 24.0$	
Property Class	Bolt Grade Optimisation	10.9	
Bolt Ultimate Strength (N/mm2)		$f_{ub} = 1040.0$	
Bolt Yield Strength (N/mm2)		$f_{yb} = 940.0$	
Nominal Stress Area (mm2)		$A_{nb} = 353\ (Ref\ IS\ 1367 - 3\ (2002))$	
Hole Diameter (mm)		$d_0 = 30.0$	
Min. Plate Thickness (mm)	$T/2 = 5.3$	$t_{ifp} = 8.0$	**Pass**
No. of Bolt Columns		$n_c = 2$	
No. of Bolt Rows		$n_r = 10$	

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)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 8.0,\ 300\ mm)$ $= \min(256.0,\ 300\ mm)$ $= 256.0$ $Where,\ t = min(8.0, 10.6)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	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)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 8.0,\ 300\ mm)$ $= \min(256.0,\ 300\ mm)$ $= 256.0$ $Where,\ t = min(8.0, 10.6)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	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)	$e_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 10.6 \times \sqrt{\frac{250}{300}} = 116.12$ $e_{max} = min(e_1, e_2) = 116.12$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	45	**Pass**
Min. Edge Distance (mm)	$e_{min} = 1.5\ d_0$ $= 1.5 \times 30.0$ $= 45.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.2]$	55.1	**Pass**
Max. Edge Distance (mm)	$e'_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 10.6 \times \sqrt{\frac{250}{300}} = 116.12$ $e'_{max} = min(e_1, e_2) = 116.12$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	55.1	**Pass**
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{1040.0 \times 2 \times 353}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 339.13$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3]$	

Check	Required	Provided	Remarks
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 10.6 \times 440}{1000 \times 1.25}$ $= 65.82$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.4]$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (339.13, 65.82)$ $= 65.82$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.2]$	
Long Joint Reduction Factor	$if\ l_j \geq 15d\ then\ V_{rd} = \beta_{lj} V_{db}$ $if\ l_j < 15d\ then\ V_{rd} = V_{db}$ $where,$ $l_j = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $\beta_{lj} = 1.075 - l/(200d)$ $but\ 0.75 \leq \beta_{lj} \leq 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	$l\ = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $lc = 2 \times ((\frac{10}{2} - 1) \times 60 + 45) + 0.0$ $= 570.0$ $lr = 2 \times ((\frac{2}{2} - 1) \times 0 + 55.1$ $+ 11.0) + 7.6 = 139.8$ $l\ = 570.0$ $15d = 15 \times 24.0 = 360.0$ $since,\ l \geq 15d$ $then\ V_{rd} = \beta_{lj} \times V_{db}$ $\beta_{lj} = 1.075 - 570.0/(200 \times 24.0)$ $= 0.96$ $V_{rd} = 0.96 \times 65.82 = 63.19$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	

Check	Required	Provided	Remarks
Large Grip Length Reduction Factor	$if\ l_g \geq 5\ d\ then\ V_{rd} = \beta_{lg}\ V_{db}$ $if\ l_g < 5d\ then\ V_{rd} = V_{db}$ $l_g \leq 8d$ $where,$ $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ $but\ \beta_{lg} \leq \beta_{lj}$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	$l_g = \Sigma\ (t_p + t_{member})$ $= 26.6$ $5d = 120.0$ $8d = 192.0$ $since,\ l_g < 5d\ ;\ \beta_{lg} = 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	
Capacity (kN)	$V_{res} = \dfrac{2\ \sqrt{V_u^2 + A_u^2}}{bolt_{req}}$ $= \dfrac{2 \times \sqrt{0.0^2 + 608.74^2}}{20}$ $= 60.87$	$V_{rd} = \beta_{lj}\beta_{lg}V_{db}$ $= 0.96 \times 1.0 \times 65.82$ $= 63.19$	**Pass**

2.4 Web Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	$d = 24.0$	
Property Class	Bolt Grade Optimisation	10.9	
Min. Plate Thickness (mm)	$t/2 = 3.8$	$t_{wp} = 8.0$	**Pass**
No. of Bolt Rows		$n_r = 8$	
No. of Bolt Columns		$n_c = 3$	
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**

Check	Required	Provided	Remarks
Max. Pitch Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 7.6,\ 300\ mm)$ $= \min(243.2,\ 300\ mm)$ $= 243.2$ $Where,\ t = min(8.0, 7.6)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	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**
Max. Gauge Distance (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 \times 7.6,\ 300\ mm)$ $= \min(243.2,\ 300\ mm)$ $= 243.2$ $Where,\ t = min(8.0, 7.6)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.3]$	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**

Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 7.6 \times \sqrt{\frac{250}{300}} = 83.25$ $e_{max} = min(e_1, e_2) = 83.25$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	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**
Max. Edge Distance (mm)	$e'_{max} = 12\ t\ \varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 7.6 \times \sqrt{\frac{250}{300}} = 83.25$ $e'_{max} = min(e_1, e_2) = 83.25$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.2.4.3]$	45	**Pass**
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{1040.0 \times 2 \times 353}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 339.13$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3]$	

Check	Required	Provided	Remarks
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 7.6 \times 440}{1000 \times 1.25}$ $= 47.19$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.4]$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (339.13, 47.19)$ $= 47.19$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 10.3.2]$	
Bolt Force Parameter(s) (mm)	$l_n = length\ available$ $l_n = g\ (n_c - 1)$ $= 60 \times (3 - 1)$ $= 450.0$ $y_{max} = l_n/2$ $= 450.0/2$ $= 60.0$ $x_{max} = p(\frac{n_r}{2} - 1)/2$ $= 60 \times (\frac{8}{2} - 1)/2$ $= 90.0$		
Moment Demand (kNm)	$M_d = (V_u \times ecc + M_w)$ $ecc = eccentricity$ $M_w = external\ moment\ acting\ on\ web$ $= \frac{(40.0 \times 10^3 \times 135.0 + 13.58 \times 10^6)}{10^6}$ $= 18.98$		

Check	Required	Provided	Remarks
Bolt Force (kN)	$vbv = V_u/((n_r/2) \times n_c) = \frac{40.0}{(3 \times (8/2))} = 3.33$ $tmh = \frac{M_d \times y_{max}}{\Sigma r_i^2} = \frac{18.98 \times 60.0}{82.8} = 13.75$ $tmv = \frac{M_d \times x_{max}}{\Sigma r_i^2} = \frac{18.98 \times 90.0}{82.8} = 20.63$ $abh = \frac{A_u}{((n_r/2) \times n_c)} = \frac{173.36}{(3 \times (8/2))} = 14.45$ $vres = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2} = \sqrt{(3.33 + 20.63)^2 + (13.75 + 14.45)^2} = 37.0$		

Check	Required	Provided	Remarks
Long Joint Reduction Factor	$if\ l_j \geq 15d\ then\ V_{rd} = \beta_{lj} V_{db}$ $if\ l_j < 15d\ then\ V_{rd} = V_{db}$ $where,$ $l_j = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $\beta_{lj} = 1.075 - l/(200d)$ $but\ 0.75 \leq \beta_{lj} \leq 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	$l = ((nc\ or\ nr) - 1) \times (p\ or\ g)$ $lc = 2 \times ((\frac{8}{2} - 1) \times 60 + 45) + 0.0$ $= 450.0$ $lr = (3 - 1) \times 60 = 120$ $l = 450.0$ $15d = 15 \times 24.0 = 360.0$ $since,\ l \geq 15d$ $then\ V_{rd} = \beta_{lj} \times V_{db}$ $\beta_{lj} = 1.075 - 450.0/(200 \times 24.0)$ $= 0.98$ $V_{rd} = 0.98 \times 47.19 = 46.25$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.1]$	
Large Grip Length Reduction Factor	$if\ l_g \geq 5\ d\ then\ V_{rd} = \beta_{lg}\ V_{db}$ $if\ l_g < 5d\ then\ V_{rd} = V_{db}$ $l_g \leq 8d$ $where,$ $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ $but\ \beta_{lg} \leq \beta_{lj}$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	$l_g = \Sigma\ (t_p + t_{member})$ $= 23.6$ $5d = 120.0$ $8d = 192.0$ $since,\ l_g < 5d\ ;\ \beta_{lg} = 1.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.3.3.2]$	
Capacity (kN)	37.0	$V_{rd} = \beta_{lj}\beta_{lg}V_{db}$ $= 0.98 \times 1.0 \times 47.19$ $= 46.25$	**Pass**

2.5 Flange Plate Dimensions Check - Outside/Inside

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$min\ flange\ plate\ ht = beam\ width$ $= 250.0$	250.0	**Pass**
Min. Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_r}{2} - 1)p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 45.0 + (\frac{10}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 660.0$	660.0	**Pass**
Min. Inner Plate Width (mm)	>=50	110	**Pass**
Max. Inner Plate Width (mm)	$= \frac{B - t - (2R1)}{2}$ $= \frac{250.0 - 7.6 - 2 \times 11.0}{2}$ $= 110$	110	**Pass**
Min. Inner Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_r}{2} - 1)p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 45.0 + (\frac{10}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 660.0$	660.0	**Fail**
Min. Plate Thickness (mm)	$T/2 = 5.3$	$t_{ifp} = 8.0$	**Pass**
Plate Area Check (mm2)	$pt.area >=$ $connected\ member\ area \times 1.05$ $= 2782.5$ $[Ref : Cl.8.6.3.2\ IS\ 800 : 2007]$	$pt.area = (B_{fp} + (2 \times B_{ifp})) \times t_{ifp}$ $= (250.0 + (2 \times 110)) \times 8.0$ $= 3760.0$	**Pass**

2.6 Web Plate Dimensions Check

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$= 0.6 \times D$ $= 0.6 \times 300.0$ $= 180.0$ $[Ref: INSDAG - Chp\ 5,$ $Sect.5.2.3]$	210	Pass
Min. Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_r}{2} - 1)p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 45.0 + (\frac{8}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 540.0$	540.0	Pass
Min. Plate Thickness (mm)	$t/2 = 3.8$	$t_{wp} = 8.0$	Pass
Plate Area Check (mm2)	$pt.area >=$ $connected\ member\ area \times 1.05$ $= 2224.82$ $[Ref: Cl.8.6.3.2\ IS\ 800: 2007]$	$pt.area = 2 \times W_{wp} \times t_{wp}$ $= 2 \times 210 \times 8.0$ $= 3360.0$	Pass

2.7 Member Check

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 250.0 \times 10.6$ $= \frac{2650.0 \times 300}{1.1 \times 10^3}$ $= 722.73$ $[Ref.\ IS\ 800: 2007,\ Cl.\ 6.2]$	

Check	Required	Provided	Remarks
Flange Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1\times\ 0.9 \times (250.0 - 2 \times 30.0) \times 10.6 \times 440}{1.25}$ $= 638.04$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	
Flange Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 900.21$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Flange Tension Capacity (kN)	$F_f = 608.74$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(722.73, 638.04, 900.21)$ $= 638.04$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**
Web Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 278.8 \times 7.6$ $= \frac{2118.88 \times 300}{1.1 \times 10^3}$ $= 577.88$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Web Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1\times\ 0.9 \times (278.8 - 3 \times 30.0) \times 7.6 \times 440}{1.25}$ $= 454.57$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	

Check	Required	Provided	Remarks
Web Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 675.62$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Tension Capacity (kN)	$A_w = 173.36$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(577.88, 454.57, 675.62)$ $= 454.57$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	Pass

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

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 470.0 \times 8.0$ $= \frac{3760.0 \times 300}{1.1 \times 10^3}$ $= 1025.45$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (470.0 - 2 \times 30.0) \times 8.0 \times 440}{1.25}$ $= 1039.1$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	

Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 1358.81$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Flange Plate Tension Capacity (kN)	$F_f = 608.74$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(1025.45, 1039.1, 1358.81)$ $= 1025.45$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	Pass

2.9 Web Plate Capacity Check for Axial Load

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = 2l \times t = 2 \times 210 \times 8.0$ $= \frac{1680.0 \times 300}{1.1 \times 10^3}$ $= 916.36$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.2]$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{2 \times\ 0.9 \times (210 - 3 \times 30.0) \times 8.0 \times 440}{1.25}$ $= 608.26$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.3.1]$	

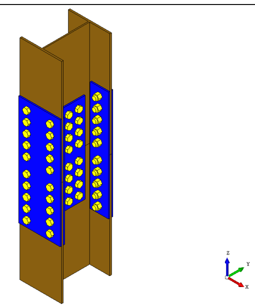
Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 1422.35$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Plate Tension Capacity (kN)	$A_w = 173.36$	$T_d = min(T_{dg}, T_{dn}, T_{db})$ $= min(916.36, 608.26, 1422.35)$ $= 608.26$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	Pass

2.10 Web Plate Capacity Check for Shear Load

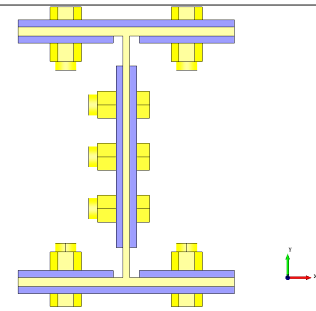
Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v\ f_y}{\sqrt{3}\ \gamma_{mo}}$ $= \frac{2 \times 210 \times 8.0 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 529.06$ $[Ref. IS\ 800:2007, Cl. 10.4.3]$	
Allowable Shear Capacity (kN)	$V = 0.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 529.06$ $= 317.44$ $[Limited\ to\ low\ shear]$	

Check	Required	Provided	Remarks
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75\ A_{vn}\ f_u}{\sqrt{3}\ \gamma_{m1}}$ $= 2 \times \frac{(210 - (3 \times 30.0)) \times 8.0 \times 440}{\sqrt{3} \times 1.25}$ $= 292.65$ $[Ref. AISC \ \ Sect. J4]$	
Block Shear Capacity (kN)		$V_{dbl1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{dbl2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{db} = min(V_{db1}, V_{db2}) = 1023.95$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.4]$	
Web Plate Shear Capacity (kN)	$V_u = 40.0$	$V_d = min(S_c, V_{dn}, V_{db})$ $= min(317.44, 292.65, 1023.95)$ $= 292.65$ $[Ref.\ IS\ 800:2007,\ Cl.\ 6.1]$	**Pass**

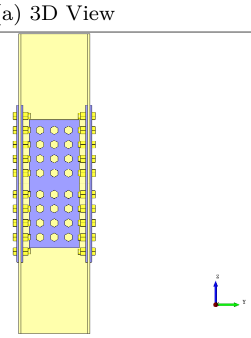
3 3D Views



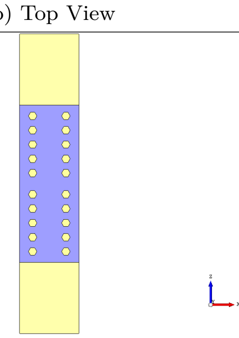
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2020-12-18 01:15:41 - Osdag - WARNING - The defined factored Axial Force is less than the minimum recommended value [Cl.10.7, IS 800:2007]

2020-12-18 01:15:41 - Osdag - INFO - The value of Axial Force is set at 612.0 kN

2020-12-18 01:15:41 - Osdag - INFO - : Overall Bolted Cover Plate Splice Connection design is SAFE