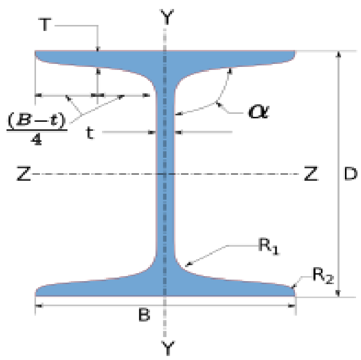
Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

1 Input Parameters

<table>
<tr><td colspan="2">Module</td><td colspan="2">Beam Coverplate Connection</td></tr>
<tr><td colspan="2">MainModule</td><td colspan="2">Moment Connection</td></tr>
<tr><td colspan="2">Moment(kNm)*</td><td colspan="2">0.0</td></tr>
<tr><td colspan="2">Shear(kN)*</td><td colspan="2">0.0</td></tr>
<tr><td colspan="2">Axial (kN) *</td><td colspan="2">0.0</td></tr>
<tr><td colspan="5">Section</td></tr>
<tr><td rowspan="14">
</td><td colspan="2">Beam Section *</td><td colspan="2">MB 500</td></tr>
<tr><td colspan="2">Preferences</td><td colspan="2">Outside</td></tr>
<tr><td colspan="2">Material *</td><td colspan="2">E 250 (Fe 410 W)A</td></tr>
<tr><td colspan="2">Ultimate strength, fu (MPa)</td><td colspan="2">410</td></tr>
<tr><td>Yield Strength , fy (MPa)</td><td>230</td><td>R2(mm)</td><td>8.5</td></tr>
<tr><td>Mass</td><td>86.9</td><td>Iz(mm4)</td><td>452280000.0</td></tr>
<tr><td>Area(mm2) - A</td><td>11100.0</td><td>Iy(mm4)</td><td>13200000.0</td></tr>
<tr><td>D(mm)</td><td>500.0</td><td>rz(mm)</td><td>202.0</td></tr>
<tr><td>B(mm)</td><td>180.0</td><td>ry(mm)</td><td>35.0</td></tr>
<tr><td>t(mm)</td><td>10.2</td><td>Zz(mm3)</td><td>1809100.0</td></tr>
<tr><td>T(mm)</td><td>17.2</td><td>Zy(mm3)</td><td>147000.0</td></tr>
<tr><td>FlangeSlope</td><td>98</td><td>Zpz(mm3)</td><td>2074800.0000000002</td></tr>
<tr><td>R1(mm)</td><td>17.0</td><td>Zpy(mm3)</td><td>147000.0</td></tr>
<tr><td colspan="5">Bolt Details</td></tr>
<tr><td colspan="2">Diameter (mm)*</td><td colspan="3">[12.0, 16.0, 20.0, 24.0, 30.0, 36.0]</td></tr>
<tr><td colspan="2">Grade *</td><td colspan="3">[3.6, 4.6, 4.8, 5.6, 5.8, 6.8, 8.8, 9.8, 10.9, 12.9]</td></tr>
<tr><td colspan="2">Type *</td><td colspan="3">Bearing Bolt</td></tr>
<tr><td colspan="2">Bolt.fu</td><td colspan="3">800.0</td></tr>
<tr><td colspan="2">Bolt.fy</td><td colspan="3">640.0</td></tr>
<tr><td colspan="2">Bolt hole type</td><td colspan="3">Standard</td></tr>
<tr><td colspan="2">Slip factor (µ_f)</td><td colspan="3">0.3</td></tr>
<tr><td colspan="2">Type of edges</td><td colspan="3">a - Sheared or hand flame cut</td></tr>
<tr><td colspan="2">Gap between beam and
support (mm)</td><td colspan="3">10.0</td></tr>
<tr><td colspan="2">Are the members exposed to
corrosive influences</td><td colspan="3">False</td></tr>
</table>

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

2 Design Checks

2.1 Member Capacity

Check	Required	Provided	Remarks
Axial Capacity (kN)		$Ac = \frac{A * f_y}{\gamma_{m0} * 1000}$ $= \frac{11100.0 * 230}{1.1 * 1000}$ $= 2320.91$	
Shear Capacity (kN)		$S_c = \frac{A_v * f_y}{\sqrt{3} * \gamma_{mo} * 1000}$ $= \frac{465.6 * 10.2 * 230}{\sqrt{3} * 1.1 * 1000}$ $= 573.3075600000001$	
Plastic Moment Capacity (kNm)		$Pmc = \frac{\beta_b * Z_p * fy}{\gamma_{mo} * 1000000}$ $= \frac{1 * 552798 * 230}{1.1 * 1000000}$ $= 115.59$	
Moment Deformation Criteria (kNm)		$Mdc = \frac{1.5 * Z_e * fy}{1.1 * 1000000}$ $= \frac{1.5 * 1809100.0 * 230}{1.1 * 1000000}$ $= 567.4$	
Moment Capacity (kNm)		$M_c = min(Pmc, Mdc)$ $= min(115.59, 567.4)$ $= 115.59$	

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

2.2 Load Considered

Check	Required	Provided	Remarks
Axial Load (kN)	$Ac_{min} = 0.3 * A_c$ $= 0.3 * 2320.91$ $= 696.27$	$Au = max(A, Ac_{min})$ $= max(0.0, 696.27)$ $= 696.27$	Pass
Shear Load (kN)	$Sc_{min} = 0.6 * A_c$ $= 0.6 * 573.31$ $= 343.98$	$Vu = max(V, Vc_{min})$ $= max(0.0, 343.98)$ $= 343.98$	Pass
Moment Load (kNm)	$Mc_{min} = 0.5 * M_c$ $= 0.5 * 115.59$ $= 57.79$	$Mu = max(M, Mc_{min})$ $= max(0.0, 57.79)$ $= 57.79$	Pass
Forces Carried by Web		$A_w = Axial\ force\ in\ web$ $= \frac{(D - 2 * T) * t * Au}{A}$ $= \frac{(500.0 - 2 * 17.2) * 10.2 * 696.27}{11100.0}$ $= 297.9$ $M_w = Moment\ in\ web$ $= \frac{Z_w * Mu}{Z}$ $= \frac{552798 * 57.79}{2074800.0000000002}$ $= 15.4$	
Forces Carried by Flange		$A_f = Axial\ force\ in\ flange$ $= \frac{Au * B * T}{A}$ $= \frac{696.27 * 180.0 * 17.2}{11100.0}$ $= 194.2$ $M_f = Moment\ in\ flange$ $= Mu - M_w$ $= 57.79 - 15.4$ $= 42.39$ $F_f = flange\ force$ $= \frac{M_f * 1000}{D - T} + A_f$ $= \frac{42.39}{500.0 - 17.2} + 194.2$ $= 282.01$	

2.3 Flange Bolt Checks

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	$d = 12.0$	
Grade	Bolt Grade Optimisation	8.8	
Hole Diameter (mm)		$d_0 = 13.0$	
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{800.0 * 1 * 84.3}{\sqrt{3}\ *\ 1.25}$ $= 31.15$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5\ * 0.52 * 12.0 * 17.2 * 410}{1.25}$ $= 88.01$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (31.15, 88.01)$ $= 31.15$	
No of Bolts	$R_u = \sqrt{V_u^2 + A_u^2}$ $n_{trial} = R_u/V_{bolt}$ $R_u = \frac{\sqrt{0.0^2 + 282.01^2}}{31.15}$ $= 20$	20	
No of Columns		$n_c = 10$	
No of Rows		$n_r = 2$	
Min. Pitch (mm)	$p/g_{min} = 2.5\ d$ $= 2.5 * 12.0 \quad = 30.0$	30	Pass
Max. Pitch (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 *\ 17.2,\ 300\ mm)$ $= 550.4$	30	Pass
Min. Gauge (mm)	$p/g_{min} = 2.5\ d$ $= 2.5 * 12.0 \quad = 30.0$	0.0	N/A
Max. Gauge (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 *\ 17.2,\ 300\ mm)$ $= 550.4$	0.0	N/A
Min. End Distance (mm)	$e/e`_{min} = [1.5\ or\ 1.7] * d_0$ $= 1.7 * 13.0 = 22.1$	25	Pass
Max. End Distance (mm)	$e/e`_{max} = 12\ t\ \varepsilon$ $\varepsilon = \sqrt{\frac{250}{f_y}}$ $e/e`_{max} = 12\ * 20.0 * \sqrt{\frac{250}{230}}$ $= 249.6$	25	Pass

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

Check	Required	Provided	Remarks
Min. Edge Distance (mm)	$e/e`_{min} = [1.5\ or\ 1.7] * d_0$ $= 1.7 * 13.0 = 22.1$	33.95	Pass
Max. Edge Distance (mm)	$e/e`_{max} = 12\ t\ \varepsilon$ $\varepsilon = \sqrt{\frac{250}{f_y}}$ $e/e`_{max} = 12\ * 20.0 * \sqrt{\frac{250}{230}}$ $= 249.6$	33.95	Pass
Long Joint Reduction	$if\ l \geq 15 * d\ then\ V_{rd} = \beta_{ij} * V_{db}$ $if\ l < 15 * d\ then\ V_{rd} = V_{db}$ $where,$ $l = ((nc\ or\ nr) - 1) * (p\ or\ g)$ $\beta_{ij} = 1.075 - l/(200 * d)$ $but\ 0.75 \leq \beta_{ij} \leq 1.0$	$l = ((nc\ or\ nr) - 1) * (p\ or\ g)$ $= (10 - 1) * 30 = 270$ $= (2 - 1) * 0.0 = 0.0$ $l = 270$ $15 * d = 15 * 12.0 = 180.0$ $since,\ l \geq 15 * d\ then\ V_{rd} = \beta_{ij} * V_{db}$ $\beta_{ij} = 1.075 - 270/(200 * 12.0) = 0.96$ $V_{rd} = 0.96 * 31.15 = 31149.2$	

2.4 Web Bolt Checks

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}\ n_n\ A_{nb}}{\sqrt{3}\ \gamma_{mb}}$ $= \frac{800.0 * 2 * 84.3}{\sqrt{3}\ *\ 1.25}$ $= 62.3$	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5\ k_b\ d\ t\ f_u}{\gamma_{mb}}$ $= \frac{2.5\ * 0.52 * 12.0 * 10.2 * 410}{1.25}$ $= 52.19$	
Bolt Capacity (kN)		$V_{db} = min\ (V_{dsb}, V_{dpb})$ $= min\ (62.3, 52.19)$ $= 52.19$	
No of Bolts	$R_u = \sqrt{V_u^2 + A_u^2}$ $n_{trial} = R_u/V_{bolt}$ $R_u = \frac{\sqrt{343.98^2 + 297.9^2}}{52.19}$ $= 18$	36	
No of Columns		$n_c = 4$	
No of Rows		$n_r = 9$	
Min. Pitch (mm)	$p/g_{min} = 2.5\ d$ $=2.5 * 12.0 \quad = 30.0$	30	Pass
Max. Pitch (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 *\ 6.0,\ 300\ mm)$ $= 300$	30	Pass
Min. Gauge (mm)	$p/g_{min} = 2.5\ d$ $=2.5 * 12.0 \quad = 30.0$	40	Pass
Max. Gauge (mm)	$p/g_{max} = \min(32\ t,\ 300\ mm)$ $= \min(32 *\ 6.0,\ 300\ mm)$ $= 300$	40	Pass
Min. End Distance (mm)	$e/e`_{min} = [1.5\ or\ 1.7] * d_0$ $= 1.7 * 13.0 = 22.1$	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)	$e/e`_{min} = [1.5\ or\ 1.7] * d_0$ $= 1.7 * 13.0 = 22.1$	25	Pass

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

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		$l_n = length\ available$ $l_n = (n_r - 1) * g$ $= (9 - 1) * 40$ $= 320$ $y_{max} = l_n/2$ $= 320/2$ $= 160.0$ $x_{max} = p * (n_c - 1)/2$ $= 30 * (4 - 1)/2$ $= 15.0$	
Moment Demand		$M_d = (V_u * ecc + M_w)$ $= (343.98 * 45.0 + 15.4)$ $= 30.88$	
Bolt.Force		$vbv = V_u/(n_r * n_c)$ $= \frac{343.98}{(9 * 4)}$ $= 19.11$ $tmh = \frac{M_d * y_{max}}{\Sigma r_i^2}$ $= \frac{30.88 * 160.0}{196.05}$ $= 25.2$ $tmv = \frac{M_d * x_{max}}{\Sigma r_i^2}$ $= \frac{30.88 * 15.0}{196.05}$ $= 2.36$ $abh = \frac{A_u}{(n_r * n_c)}$ $= \frac{297.9}{(9 * 4)}$ $= 16.55$ $vres = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2}$ $= \sqrt{(19.11 + 2.36)^2 + (25.2 + 16.55)^2}$ $= 46.95$	

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

Check	Required	Provided	Remarks
Long Joint Reduction	$if\ l \geq 15 * d\ then\ V_{rd} = \beta_{ij} * V_{db}$ $if\ l < 15 * d\ then\ V_{rd} = V_{db}$ $where,$ $l = ((nc\ or\ nr) - 1) * (p\ or\ g)$ $\beta_{ij} = 1.075 - l/(200 * d)$ $but\ 0.75 \leq \beta_{ij} \leq 1.0$	$l = ((nc\ or\ nr) - 1) * (p\ or\ g)$ $= (4 - 1) * 30 = 90$ $= (9 - 1) * 40 = 320$ $l = 320$ $15 * d = 15 * 12.0 = 180.0$ $since,\ l \geq 15 * d\ then\ V_{rd} = \beta_{ij} * V_{db}$ $\beta_{ij} = 1.075 - 320/(200 * 12.0) = 0.94$ $V_{rd} = 0.94 * 52.19 = 49.15$	
Capacity (kN)	46.95	49.15	Pass

2.5 Outer flange plate Checks

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$min\ flange\ plate\ ht = beam\ width$ $= 180.0$	180.0	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)	$t_w = 17.2$	20.0	Pass

2.6 Member Checks

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{dg} = \frac{l * t_p * f_y}{\gamma_{mo}}$ $= \frac{180.0 * 17.2 * 230}{1.1}$ $= 647.35$	
Flange Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 * A_n * f_u}{\gamma_{m1}}$ $= \frac{0.9 * (180.0 - 2 * 13.0) * 17.2 * 410}{1.25}$ $= 781.93$	
Flange Block Shear Capacity (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9 * A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 751335.905$	
Flange Tension Capacity (kN)	$f_f = 282.01$	$T_d = Min(T_{dg}, T_{dn}, T_{db})$ $= Min(647.35, 781.93, 751.34)$ $= 647.35$	Pass
Web Tension Yielding Capacity (kN)		$T_{dg} = \frac{l * t_p * f_y}{\gamma_{mo}}$ $= \frac{465.6 * 10.2 * 230}{1.1}$ $= 993.0$	
Web Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 * A_n * f_u}{\gamma_{m1}}$ $= \frac{0.9 * (465.6 - 9 * 13.0) * 10.2 * 410}{1.25}$ $= 1049.65$	
Web Block Shear Capacity (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9 * A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 861.11$	
Web Tension Capacity (kN)	$A_w = 297.9$	$T_d = Min(T_{dg}, T_{dn}, T_{db})$ $= Min(993.0, 1049.65, 861.11)$ $= 861.11$	Pass

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

2.7 Flange Plate Capacity Checks in Axial-Outside

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{l * t_p * f_y}{\gamma_{mo}}$ $= \frac{180.0 * 20.0 * 230}{1.1}$ $= 752.73$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 * A_n * f_u}{\gamma_{m1}}$ $= \frac{0.9 * (180.0 - 2 * 13.0) * 20.0 * 410}{1.25}$ $= 909.22$	
Block Shear Capacity (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9 * A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 1058.48$	
Plate Tension Capacity (kN)	$f_f = 282.01$	$T_d = Min(T_{dg}, T_{dn}, T_{db})$ $= Min(752.73, 909.22, 1058.48)$ $= 752.73$	Pass

2.8 Web Plate Capacity Checks in Axial

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{l * t_p * f_y}{\gamma_{mo}}$ $= \frac{370 * 6.0 * 230}{1.1}$ $= 928.36$	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 * A_n * f_u}{\gamma_{m1}}$ $= \frac{0.9 * (370 - 9 * 13.0) * 6.0 * 410}{1.25}$ $= 896.23$	
Block Shear Capacity (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9 * A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 1013.07$	
Plate Tension Capacity (kN)	$A_w = 297.9$	$T_d = Min(T_{dg}, T_{dn}, T_{db})$ $= Min(928.36, 896.23, 1013.07)$ $= 896.23$	Pass

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

2.9 Web Plate Capacity Checks in Shear

Check	Required	Provided	Remarks
Shear yielding Capacity (V_dy) (kN)		$V_{dg} = \frac{A_v * f_y}{\sqrt{3} * \gamma_{mo}}$ $= \frac{370 * 6.0 * 230}{\sqrt{3} * 1.1}$ $= 535.99$	
Shear Rupture Capacity (V_dn) (kN)		$V_{dn} = \frac{0.9 * A_{vn} * f_u}{\sqrt{3} * \gamma_{mo}}$ $= 0.9 * (370 - (2.0 * 13.0)) * 6.0 * 410$ $= 517.44$	
Block Shear Capacity in Shear (V_db) (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9 * A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = min(T_{db1}, T_{db2}) = 617.6$	
Plate Shear Capacity (kN)	$V_u = 343.98$	$V_d = Min(V_{dy}, V_{dn}, V_{db})$ $= Min(535.99, 517.44, 1013.07)$ $= 517.44$	Pass

Company Name		Project Title	
Group/Team Name		Subtitle	
Designer		Job Number	
Date	08 /05 /2020	Client	

3 3D View

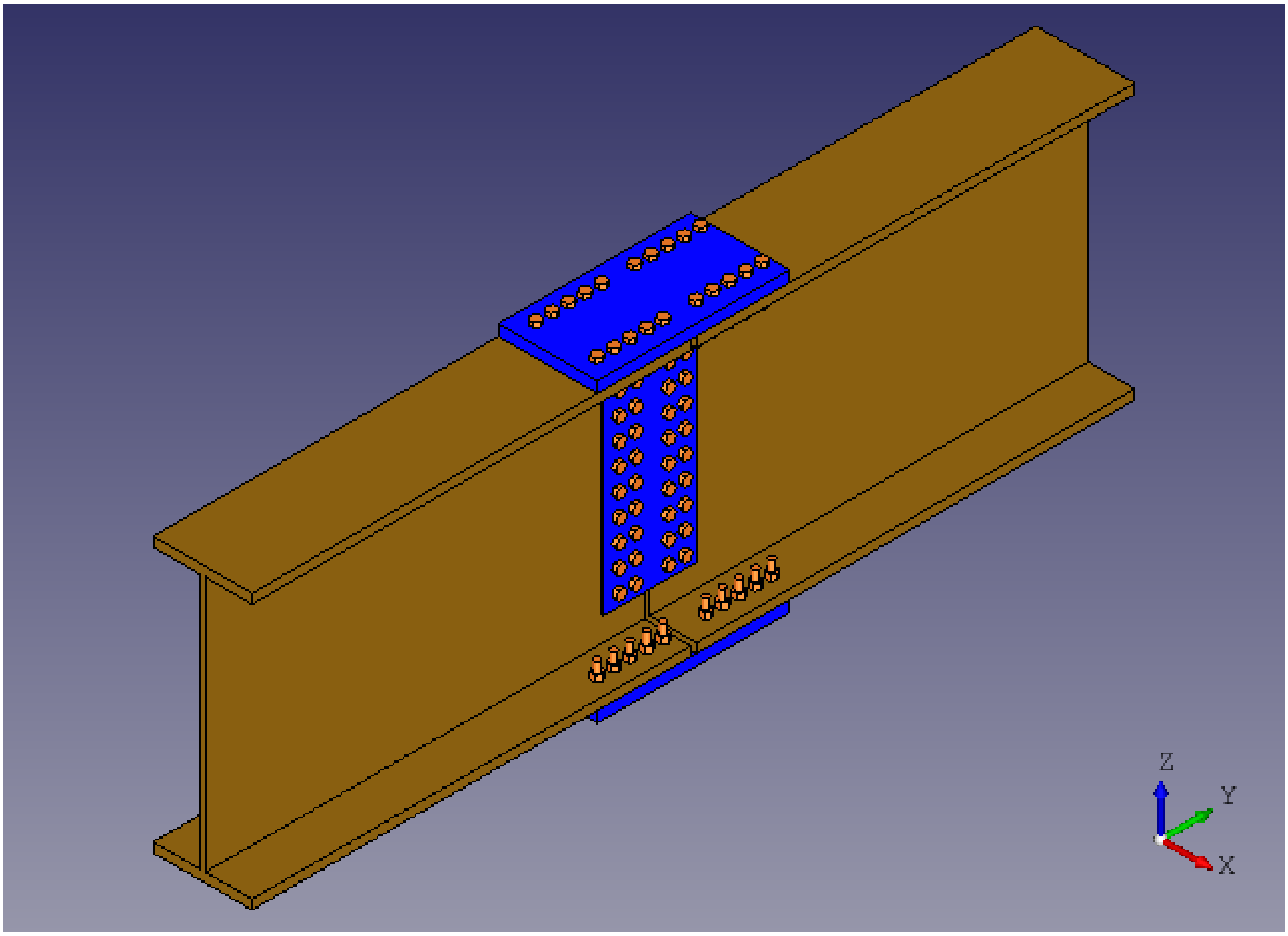


Figure 1: 3D View