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Company Name	**IIT Bombay**	**Project Title**	**Moment Connection Design Example**
Group/Team Name	**Osdag**	**Subtitle**	**Extended both way end plate moment connection**
Designer	**Engineer #1**	**Job Number**	**1.2.1.2.1.1**
Date	**13 /06 /2019**	**Client**	**Somnath Mukherjee**

Design Conclusion	
Beam to Beam Extended End Plate Splice Connection	**Pass**
Connection Properties	
Connection	
Connection Title	Beam to Beam Extended End Plate Splice
Connection Type	Moment Connection
Connection Category	
Connectivity	Beam - Beam
Beam to End Plate Connection	Welded
End Plate to End Plate Connection	Bolted
End plate type	Extended both way
Loading (Factored Loads)	
Bending Moment (kNm)	200.0
Shear Force (kN)	150.0
Axial Force (kN)	0.0
Components	
Beam Section	NPB 350x170x50.2
Grade of Steel	Fe 450.0
Plate Section	527.6 X 195.0 X 20.0
Thickness (mm)	20.0
Width (mm)	195.0
Height (mm)	527.6
Clearance Holes for Fasteners	Standard
Grade of Steel	Fe 450.0
Weld	
Type	Groove Weld (CJP)
Size of Weld (mm)	20.0
Bolts	
Type	Bearing Bolt

Property Class	9.8
Diameter (d) (mm)	20
Hole Diameter (d_o) (mm)	22
Number of Bolts (n)	8
End Distance (e) (mm)	33
Edge Distance (e') (mm)	52
Gauge Distance (g) (mm)	50
Cross-centre gauge (g') (mm)	90.0
Pitch Distance (p) (mm)	
Pitch	234.6

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Design Preferences	
Bolt	
Hole Type	Standard
Hole Clearance (mm)	2.0
Ultimate Strength (f_u) (MPa)	900.0
Slip factor	N/A
Beta (β)(non pre-tensioned)	2
Weld	
Type of Weld	Shop weld
Detailing	
Type of Edges	Rolled, machine-flame cut, sawn and planed
Minimum Edge and End Distance	1.5 times the hole diameter
Are members exposed to corrosive influences?	No
Design	
Design Method	Limit State Design

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Design Check			
Check	**Required**	**Provided**	**Remark**
Bolt Checks			
Tension capacity of critical bolt (kN)	Tension in bolt due to external factored moment & external factored axial load + Prying force = 49.331+25.025 = 74.356 [cl. 10.4.7]	Tension capacity = (0.9*900*245) / (1.25*1000) = 158.76 [cl. 10.4.5]	**Pass**
Bolt shear capacity (kN)	Factored shear force / Number of bolts = 150.0 / 8 = 18.75	V_{dsb} = (900*1*0.6126*20*20)/(√3*1.25*1000) = 101.8 [cl. 10.3.3]	**Pass**
Bolt bearing capacity (kN)		V_{dpb} = (2.5*0.508*20*40.0*450.0) / (1.25*1000) = 365.5 [cl. 10.3.4]	
Bolt capacity (kN)	min (101.8, 365.5)	101.8	
Combined shear and tension capacity of bolt	≤ 1.0	(V_{sb}/V_{db})^2 + (T_b/T_{db})^2 = (18.75/101.8)^2 + (74.356/158.76)^2 = 0.253 [cl. 10.3.6]	**Pass**
No. of bolts		8.0	
No. of column(s)		2	
No. of row(s)		4	
Bolt gauge (mm)	≥ 2.5 * d = 50.0, ≤ min(32 * t, 300) = 300.0 [cl. 10.2.2 & cl. 10.2.3]	50	**Pass**
Bolt pitch (mm)	≥ 2.5 * d = 50.0, ≤ min(32 * t, 300) = 300.0 [cl. 10.2.2 & cl. 10.2.3]	50	**Pass**
End distance (mm)	≥ 1.7 d_o = 33.0,≤ 12*t*ε = 255.0 [cl. 10.2.4]	33	**Pass**
Edge distance	≥ 1.7 d_o = 33.0,≤ 12*t*ε = 255.0	33	**Pass**

(mm)	[cl. 10.2.4]		
Plate Checks			
Plate thickness (mm)	((4*1.10*1478.748*1000)/(230.0*85.0)) ^ 0.5 = 17.034 [Design of Steel Structures - N. Subramanian, 2014]	20.0	**Pass**
Plate height (mm)	Based on detailing requirements	527.6	
Plate width (mm)		195.0	
Plate moment capacity (kNm)	Moment demand (M_d) = ((17.034^2*230.0*85.0)/(4.4)) * 10^ -3 = 1478.748 [Design of Steel Structures - N. Subramanian, 2014]	Moment capacity (M_c) = ((20.0^2*230.0*85.0)/(4.4)) * 10^ -3 = 1651.295 [Design of Steel Structures - N. Subramanian, 2014]	**Pass**
Weld Checks			
Size of Butt Weld (mm)		20.0	
Stiffener Checks			
Height (mm)		85.0	
Thickness (mm)		8.0	
WeldSize (mm)		8.0	
MomentCapacity (KN-m)	≥ 5.13	6.959	**Pass**

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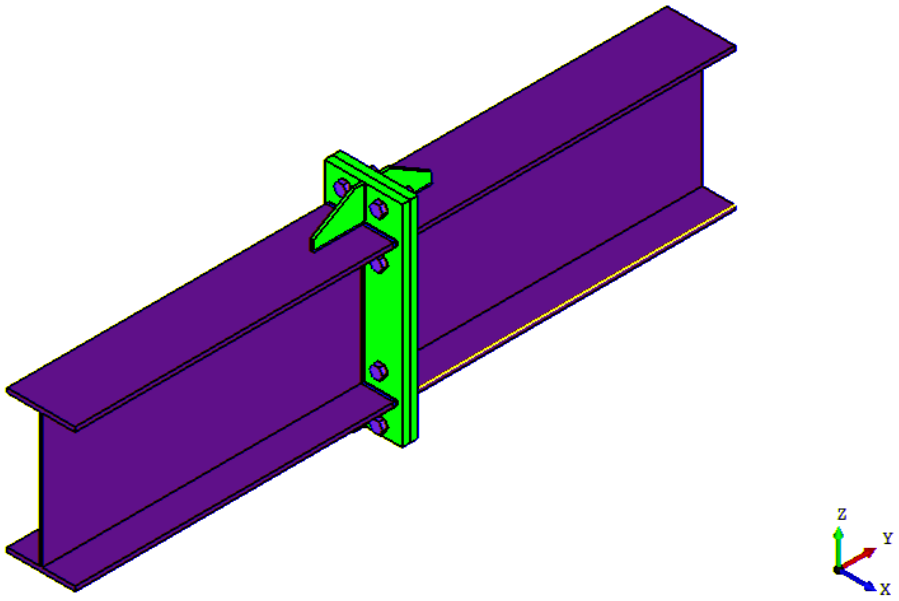
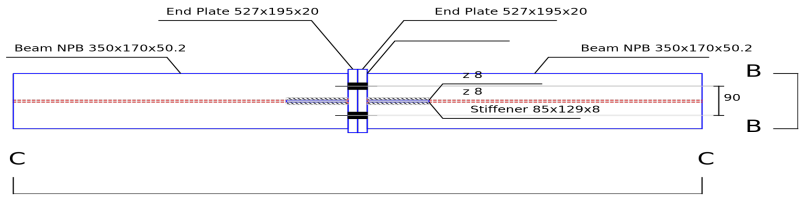
Fabrication Drawings

3D Cad Model

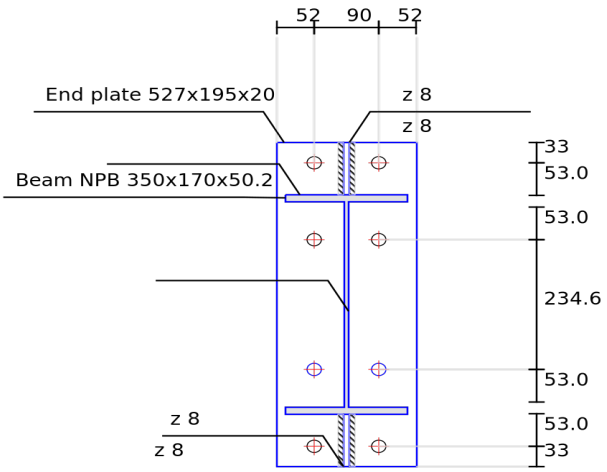


Top View



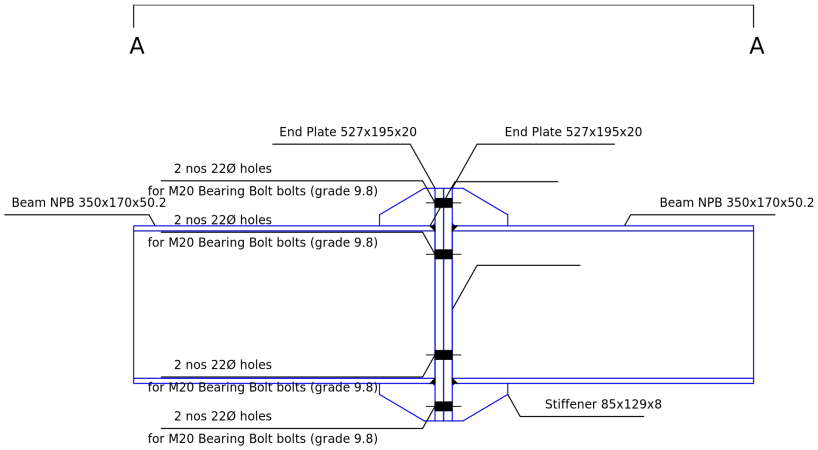
Top view (Sec A-A)
(All dimensions are in "mm")

Side View

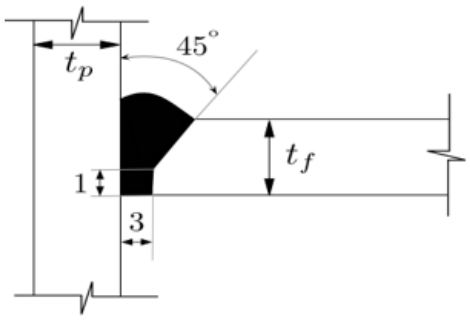
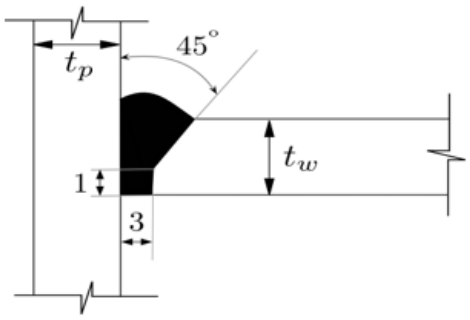


Side view (Sec B-B)
(All dimensions are in "mm")

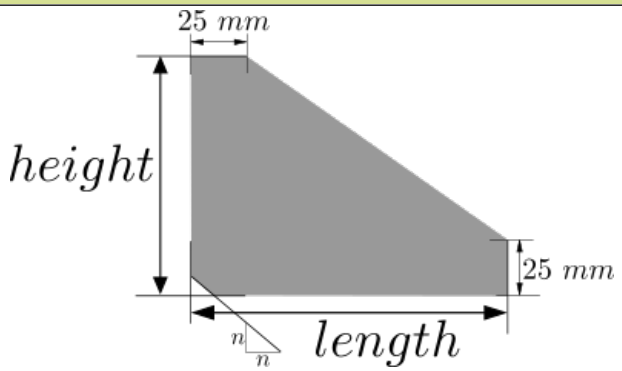
Front View



Front view (Sec C-C)
(All dimensions are in "mm")

Weld Detailing

Note :- As flange thickness, t_f (11.5mm) <= 12mm, single bevel butt welding is provided [Reference: IS 9595: 1996] (All dimensions are in mm)

Note :- As web thickness, t_w (6.6mm) <= 12mm, single bevel butt welding is provided [Reference: IS 9595: 1996] (All dimensions are in mm)

Stiffener Details



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Additional Comments	The stiffener is fillet welded, however, groove weld can also be provided.