

Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
22	(20,4,6)	(20,8,6)	4	2.05	2.05
21	(20,0,6)	(20,4,6)	4	2.05	2.05
2	(0,4,6)	(0,8,6)	4	2.05	2.05
1	(0,0,6)	(0,4,6)	4	2.05	2.05

Design Limit state:

Combo: 1.2D+1.4L

Md: 2.05 t.m

Vd: 2.05 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.5 t/m'

Design Checks

1-Check Local Buckling

$d_w/t_w = 29.65 < 81.98 \Rightarrow$ Compact Web

$c/t_f = 4.56 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$L_{uact} = 0 \text{ m} < L_{umax} = 129.1 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE270

$f_{act} = 1.06 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.18 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.41 \text{ cm} < d_{all} = 1.33 \text{ cm}$

Group Connection Design (Simple Shear Plate Connection)

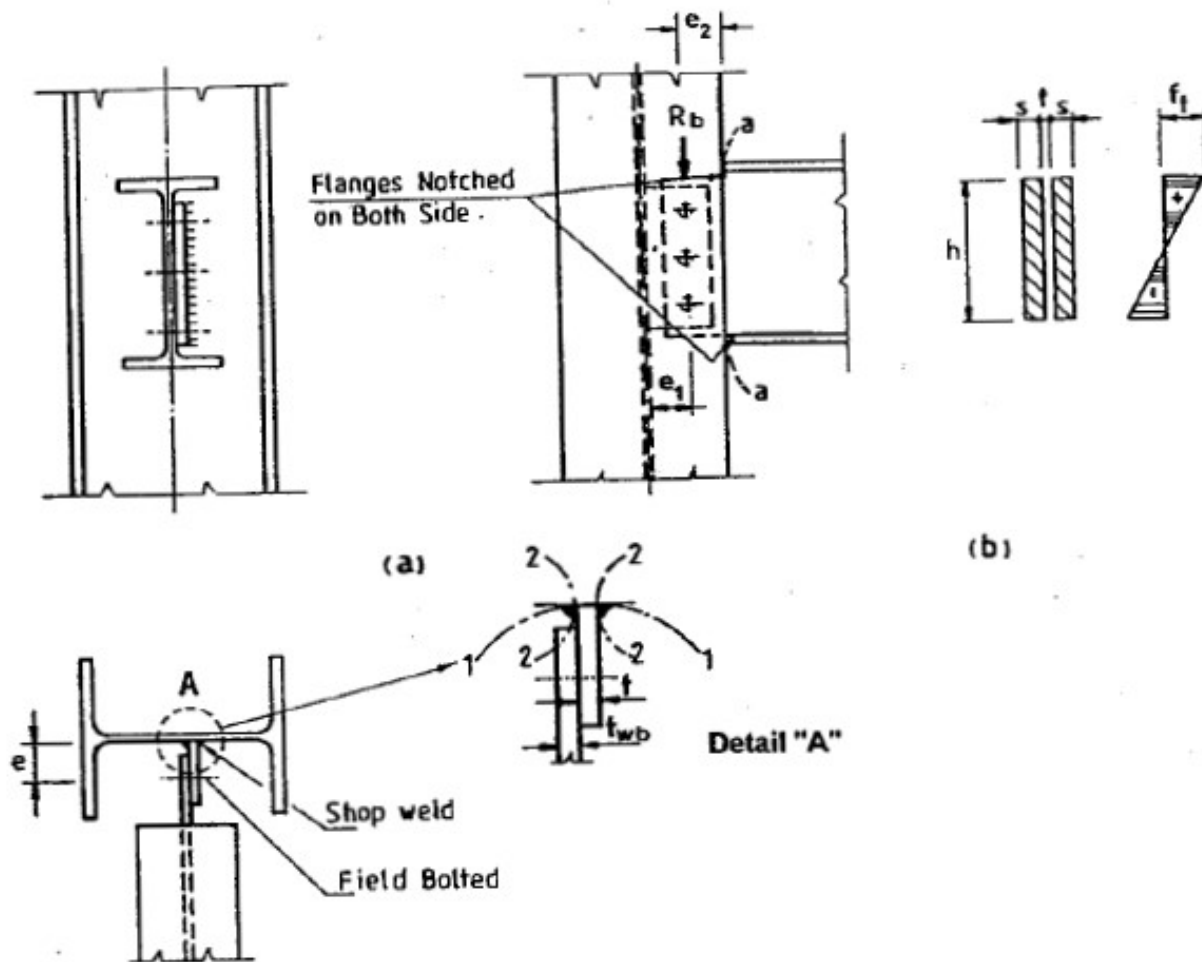


Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.05 ton

Rleast= 2.85 ton

N= 3 with Pitch= 63 mm & Full Layout: (31;63 63 31.5)

2-Stresses Induced in Fillet Weld Lines at Plane(1-1)

$f = 0.14 \text{ t/cm}^2$ & $q = 0.09 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.22 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

3-Stresses Induced in Fillet Weld Lines at Plane(2-2)

$q = 0.09 \text{ t/cm}^2$ & $q_{mt} = 0.14 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.17 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.17 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK IPE270}$

Plate Layout => L = 189 mm & tp = 10 mm & Sw = 6 mm

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
18	(16,4,6)	(16,8,6)	4	4.05	4.05
17	(16,0,6)	(16,4,6)	4	4.05	4.05
20	(18,4,6)	(18,8,6)	4	4.05	4.05
3	(2,0,6)	(2,4,6)	4	4.05	4.05
4	(2,4,6)	(2,8,6)	4	4.05	4.05
5	(4,0,6)	(4,4,6)	4	4.05	4.05
6	(4,4,6)	(4,8,6)	4	4.05	4.05
7	(6,0,6)	(6,4,6)	4	4.05	4.05
8	(6,4,6)	(6,8,6)	4	4.05	4.05
9	(8,0,6)	(8,4,6)	4	4.05	4.05
10	(8,4,6)	(8,8,6)	4	4.05	4.05
19	(18,0,6)	(18,4,6)	4	4.05	4.05
12	(10,4,6)	(10,8,6)	4	4.05	4.05
13	(12,0,6)	(12,4,6)	4	4.05	4.05
14	(12,4,6)	(12,8,6)	4	4.05	4.05
15	(14,0,6)	(14,4,6)	4	4.05	4.05
16	(14,4,6)	(14,8,6)	4	4.05	4.05
11	(10,0,6)	(10,4,6)	4	4.05	4.05

Design Limit state:

Combo: 1.2D+1.4L

Md: 4.05 t.m

Vd: 4.05 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -1 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 32.39 < 81.98 \Rightarrow$ Compact Web

$c/tf = 4.81 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 154.92 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE270

$f_{act} = 1.25 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.27 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.41 \text{ cm} < d_{all} = 1.33 \text{ cm}$

Group Connection Design (Simple Shear Plate Connection)

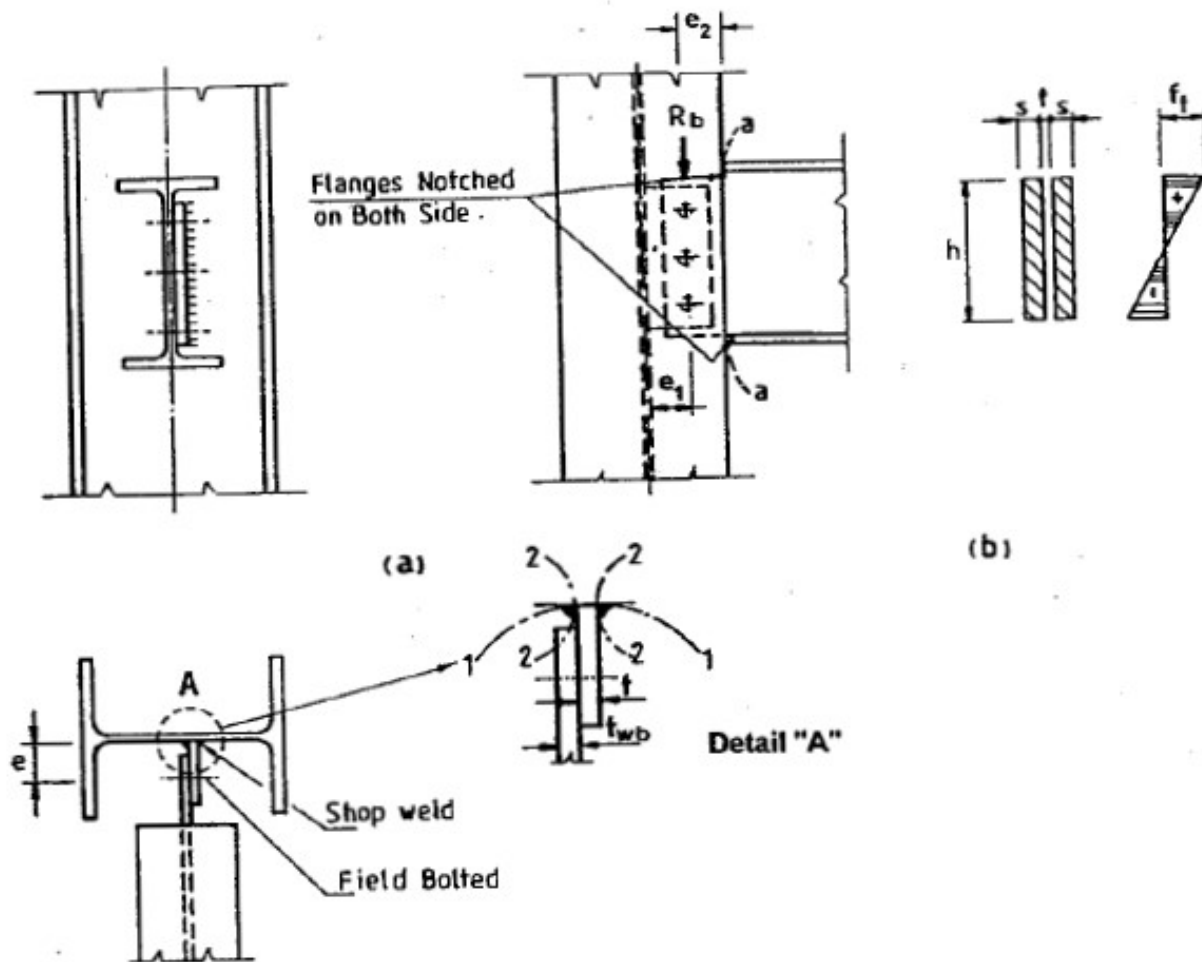


Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 4.05 ton

Rleast= 2.85 ton

N= 3 with Pitch= 63 mm & Full Layout: (31;63 63 31.5)

2-Stresses Induced in Fillet Weld Lines at Plane(1-1)

$f = 0.28 \text{ t/cm}^2$ & $q = 0.18 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.43 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

3-Stresses Induced in Fillet Weld Lines at Plane(2-2)

$q = 0.18 \text{ t/cm}^2$ & $q_{mt} = 0.28 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.34 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.34 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK IPE270}$

Plate Layout => L = 189 mm & tp = 10 mm & Sw = 6 mm

Main Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
9	(14,8,6)	(20,8,6)	6	8.3	4.18
7	(0,8,6)	(6,8,6)	6	8.3	4.18
3	(14,0,6)	(20,0,6)	6	8.3	4.18
1	(0,0,6)	(6,0,6)	6	8.3	4.18

Design Limit state:

Combo: 1.2D+1.4L

Md: 8.3 t.m

Vd: 4.18 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -0.67 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 36.23 < 81.98 \Rightarrow$ Compact Web

$c/tf = 5.68 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 193.65 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE300

$f_{act} = 1.49 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.2 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.64 \text{ cm} < d_{all} = 2 \text{ cm}$

Group Connection Design (Simple Shear Plate Connection)

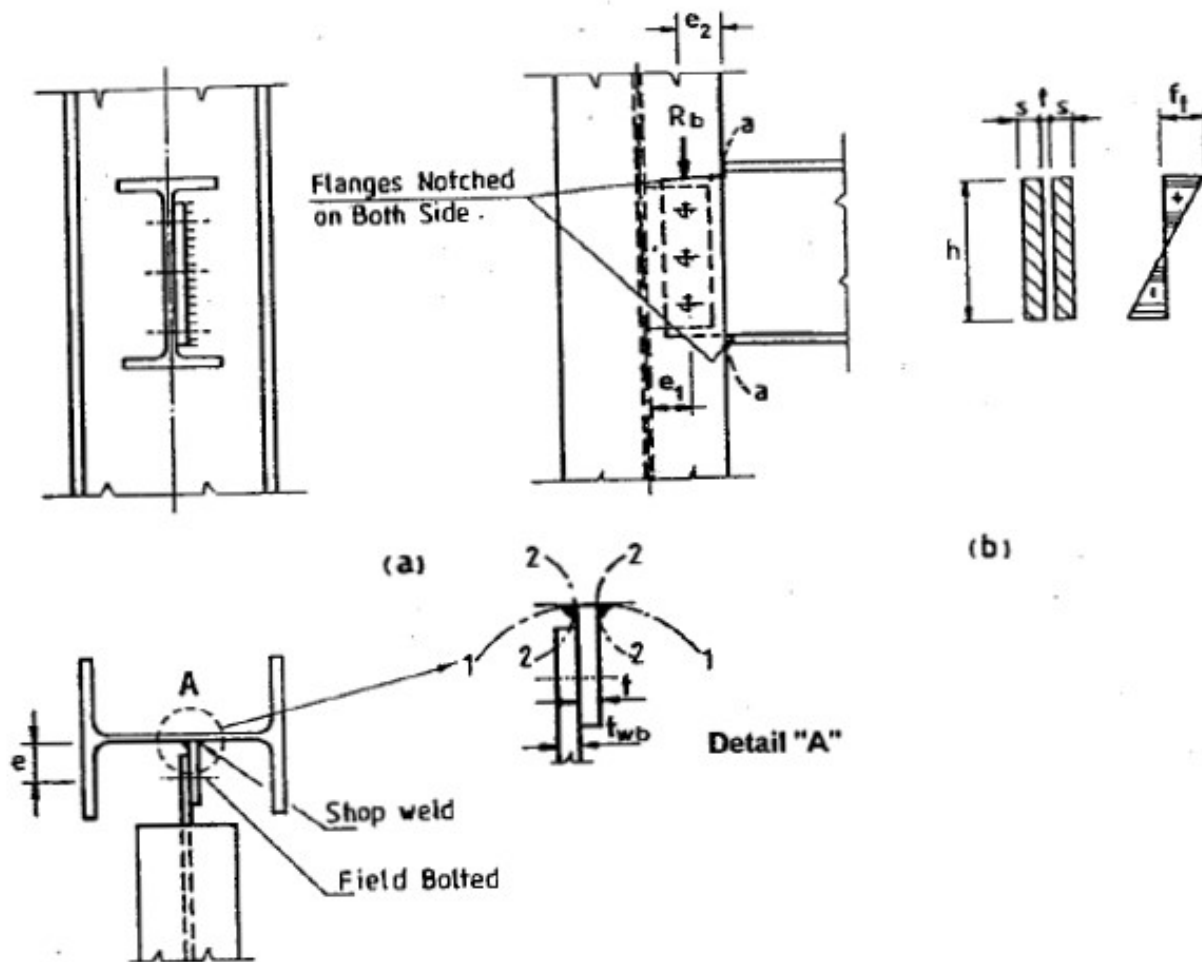


Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 4.18 ton

Rleast= 3.07 ton

N= 3 with Pitch= 70 mm & Full Layout: (35;70 70 35)

2-Stresses Induced in Fillet Weld Lines at Plane(1-1)

$f = 0.24 \text{ t/cm}^2$ & $q = 0.17 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.37 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

3-Stresses Induced in Fillet Weld Lines at Plane(2-2)

$q = 0.17 \text{ t/cm}^2$ & $q_{mt} = 0.24 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.29 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.28 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK IPE300}$

Plate Layout => L = 210 mm & tp = 10 mm & Sw = 6 mm

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
6	(14,4,6)	(20,4,6)	6	16.41	8.24
4	(0,4,6)	(6,4,6)	6	16.41	8.24
8	(6,8,6)	(14,8,6)	8	16.56	6.25
2	(6,0,6)	(14,0,6)	8	16.56	6.25

Design Limit state:

Combo: 1.2D+1.4L

Md: 16.56 t.m

Vd: 6.25 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.75 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 40.24 < 81.98 \Rightarrow$ Compact Web

$c/tf = 5.35 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 232.38 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE400

$f_{act} = 1.43 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.18 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.82 \text{ cm} < d_{all} = 2.67 \text{ cm}$

Group Connection Design (Simple Shear Plate Connection)

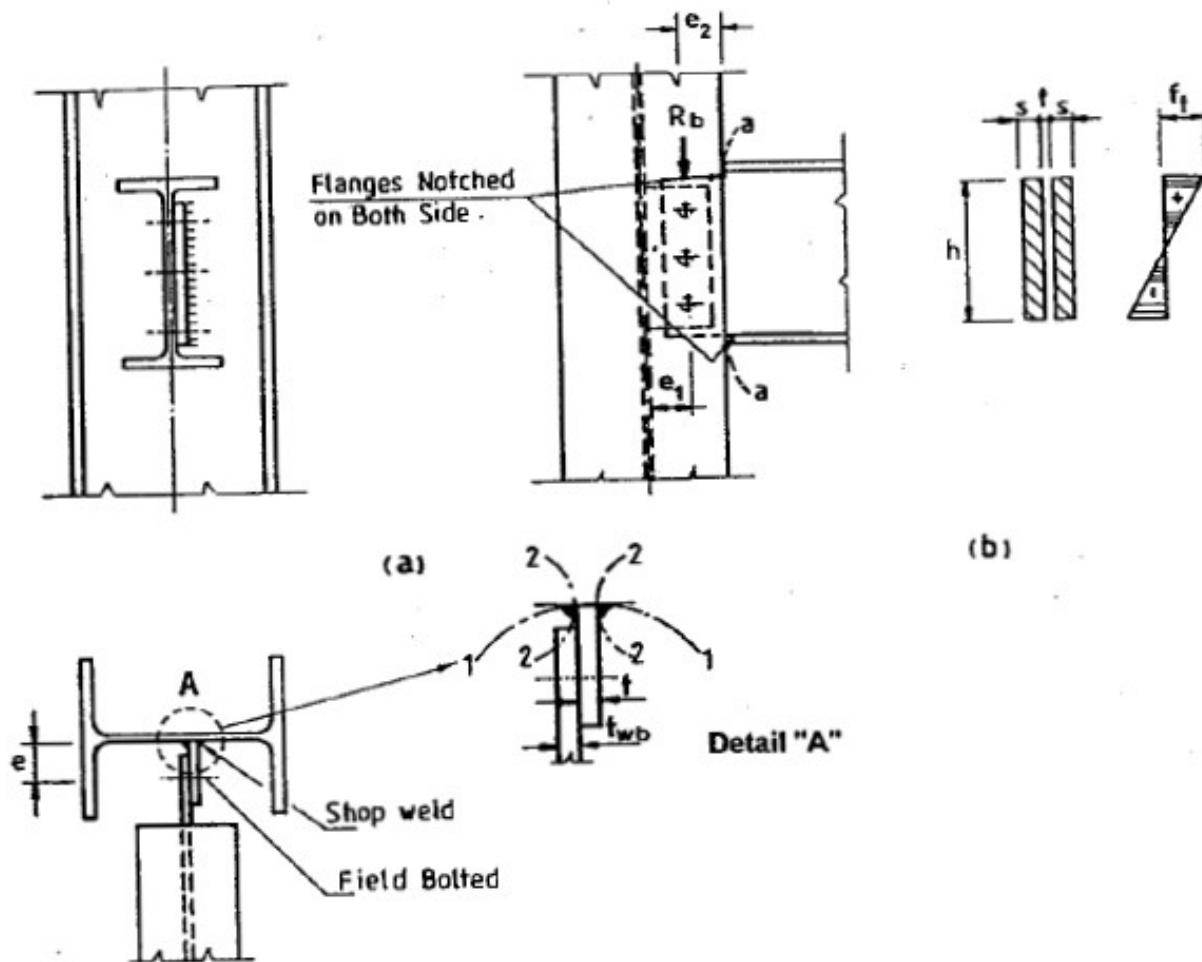


Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 6.25 ton

Rleast= 3.72 ton

N= 3 with Pitch= 93 mm & Full Layout: (46;93 93 47.5)

2-Stresses Induced in Fillet Weld Lines at Plane(1-1)

$f = 0.2 \text{ t/cm}^2$ & $q = 0.19 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.38 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

3-Stresses Induced in Fillet Weld Lines at Plane(2-2)

$q = 0.19 \text{ t/cm}^2$ & $q_{mt} = 0.2 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.28 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.24 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK IPE400}$

Plate Layout => L = 280 mm & tp = 10 mm & Sw = 6 mm

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
5	(6,4,6)	(14,4,6)	8	32.78	12.33

Design Limit state:

Combo: 1.2D+1.4L

Md: 32.78 t.m

Vd: 12.33 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -1.5 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 43.36 < 81.98 \Rightarrow$ Compact Web

$c/tf = 4.79 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 271.11 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE550

$f_{act} = 1.34 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.2 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.57 \text{ cm} < d_{all} = 2.67 \text{ cm}$

Group Connection Design (Simple Shear Plate Connection)

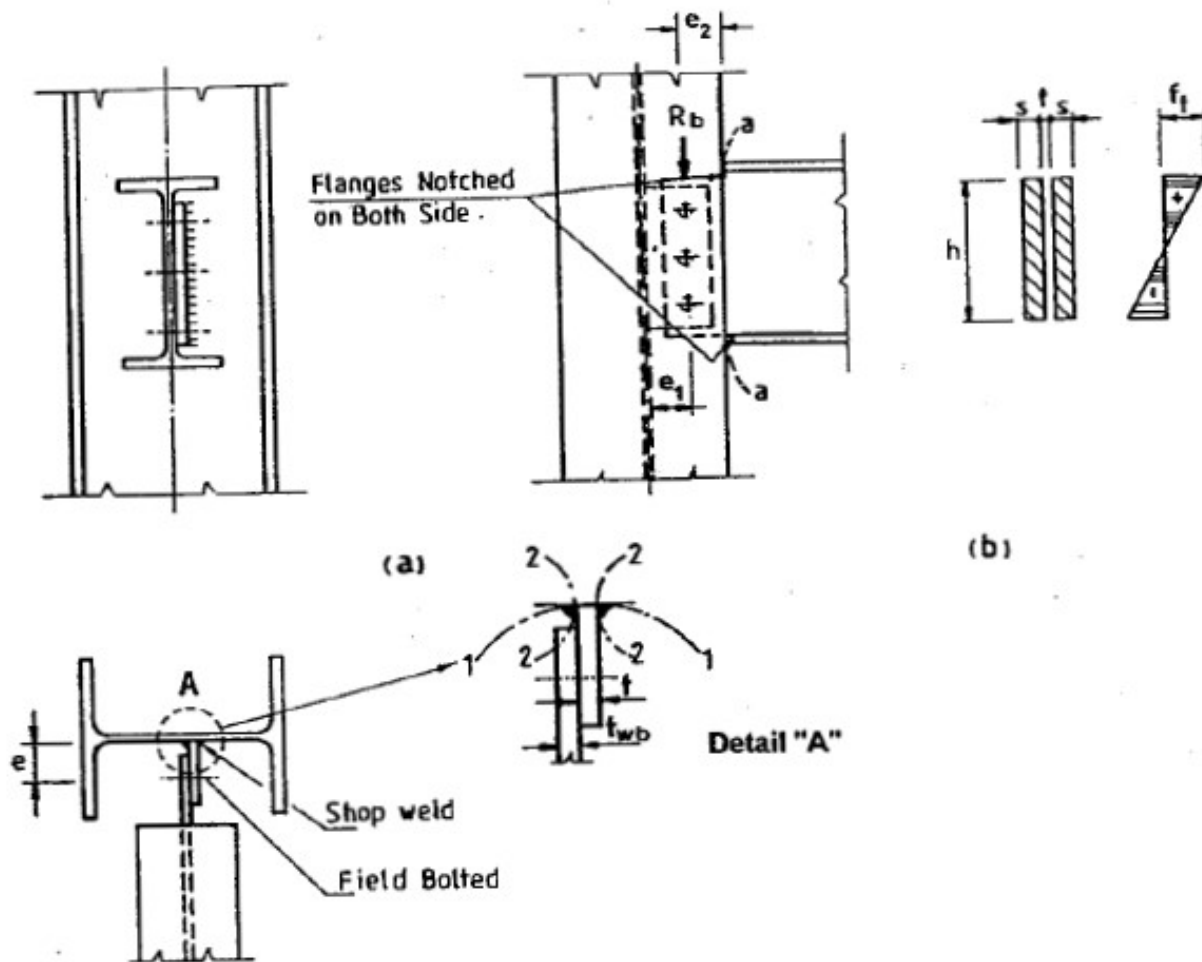


Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 12.33$ ton

$R_{least} = 4.8$ ton

$N = 4$ with Pitch = 80 mm & Full Layout: (40;80 80 80 40)

2-Stresses Induced in Fillet Weld Lines at Plane(1-1)

$f = 0.3 \text{ t/cm}^2$ & $q = 0.32 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.64 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

3-Stresses Induced in Fillet Weld Lines at Plane(2-2)

$q = 0.32 \text{ t/cm}^2$ & $q_{mt} = 0.3 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.44 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.36 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK IPE550}$

Plate Layout => L = 320 mm & tp = 10 mm & Sw = 6 mm

Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
6	(6,4,0)	(6,4,6)	6	-28.98
7	(14,4,0)	(14,4,6)	6	-28.98
2	(6,0,0)	(6,0,6)	6	-14.8
3	(14,0,0)	(14,0,6)	6	-14.8
10	(6,8,0)	(6,8,6)	6	-14.8
11	(14,8,0)	(14,8,6)	6	-14.8
5	(0,4,0)	(0,4,6)	6	-12.65
8	(20,4,0)	(20,4,6)	6	-12.65
1	(0,0,0)	(0,0,6)	6	-6.54
4	(20,0,0)	(20,0,6)	6	-6.54
9	(0,8,0)	(0,8,6)	6	-6.54
12	(20,8,0)	(20,8,6)	6	-6.54

Design Limit state:

Combo: 1.2D+1.4L

Nd: -28.98 ton

1-Check Local Buckling

$dw/tw = 36.23 < 37.44 \Rightarrow$ Compact Web

$c/tf = 5.68 < 10.91 \Rightarrow$ Compact Flange

2-Check Normal Stress

Section: IPE300

$\lambda = 179.1 > 100$

$f_c = 0.54 \text{ t/cm}^2 < F_c = 0.23 \text{ t/cm}^2$