Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
39	(24,10,3)	(24,15,3)	5	3.21	2.57
38	(24,5,3)	(24,10,3)	5	3.21	2.57
2	(0,5,3)	(0,10,3)	5	3.21	2.57
3	(0,10,3)	(0,15,3)	5	3.21	2.57
1	(0,0,3)	(0,5,3)	5	3.21	2.57
37	(24,0,3)	(24,5,3)	5	3.21	2.57

Design Limit state:

Combo: 1.2D+1.4L

Md: 3.21 t.m

Vd: 2.57 ton

Service Limit State

Combo: LIVE

Span: 5 m

Load: -0.5 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 31.06 < 81.98 => Compact Web

c/tf= 4.66 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 142.01 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270

fact= 1.27 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.2 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.7 cm < dall= 1.67 cm

Group Connection Design (Simple Shear Plate Connection)

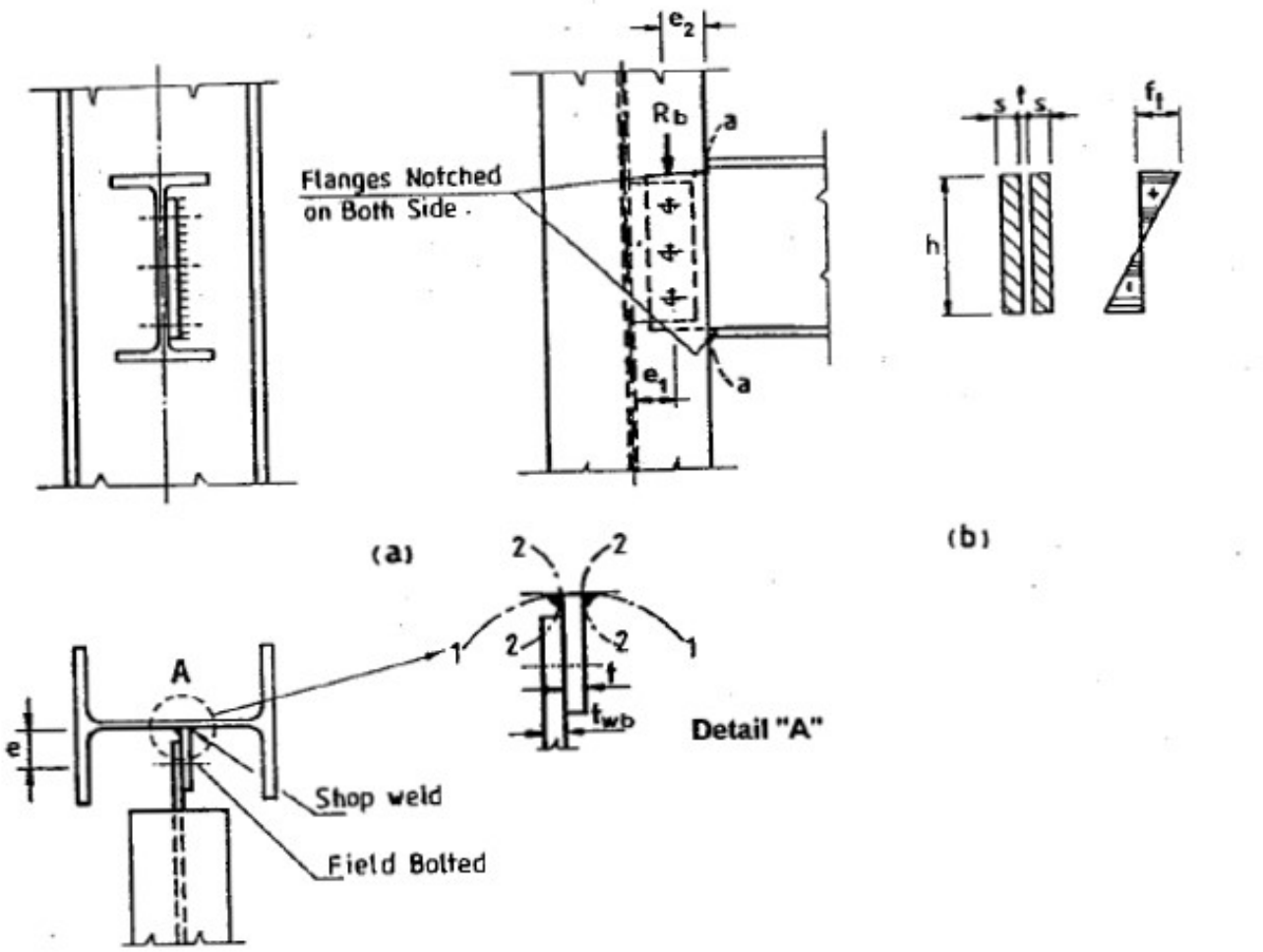

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.57 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 = 0.18 t/cm^2 & q = 0.12 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.27 t/cm^2 < 1.1 * 0.2Fu = 0.79 t/cm^2 => OK

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

q = 0.12 t/cm^2 & qmt = 0.18 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.21 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.22 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => 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)
34	(22,0,3)	(22,5,3)	5	6.33	5.07
9	(4,10,3)	(4,15,3)	5	6.33	5.07
15	(8,10,3)	(8,15,3)	5	6.33	5.07
14	(8,5,3)	(8,10,3)	5	6.33	5.07
13	(8,0,3)	(8,5,3)	5	6.33	5.07
12	(6,10,3)	(6,15,3)	5	6.33	5.07
11	(6,5,3)	(6,10,3)	5	6.33	5.07
10	(6,0,3)	(6,5,3)	5	6.33	5.07
8	(4,5,3)	(4,10,3)	5	6.33	5.07
33	(20,10,3)	(20,15,3)	5	6.33	5.07
7	(4,0,3)	(4,5,3)	5	6.33	5.07
6	(2,10,3)	(2,15,3)	5	6.33	5.07
5	(2,5,3)	(2,10,3)	5	6.33	5.07
4	(2,0,3)	(2,5,3)	5	6.33	5.07
36	(22,10,3)	(22,15,3)	5	6.33	5.07
16	(10,0,3)	(10,5,3)	5	6.33	5.07
17	(10,5,3)	(10,10,3)	5	6.33	5.07
18	(10,10,3)	(10,15,3)	5	6.33	5.07
19	(12,0,3)	(12,5,3)	5	6.33	5.07
35	(22,5,3)	(22,10,3)	5	6.33	5.07
21	(12,10,3)	(12,15,3)	5	6.33	5.07
22	(14,0,3)	(14,5,3)	5	6.33	5.07
23	(14,5,3)	(14,10,3)	5	6.33	5.07
24	(14,10,3)	(14,15,3)	5	6.33	5.07
25	(16,0,3)	(16,5,3)	5	6.33	5.07
26	(16,5,3)	(16,10,3)	5	6.33	5.07
27	(16,10,3)	(16,15,3)	5	6.33	5.07
28	(18,0,3)	(18,5,3)	5	6.33	5.07
29	(18,5,3)	(18,10,3)	5	6.33	5.07

30	(18,10,3)	(18,15,3)	5	6.33	5.07
31	(20,0,3)	(20,5,3)	5	6.33	5.07
32	(20,5,3)	(20,10,3)	5	6.33	5.07
20	(12,5,3)	(12,10,3)	5	6.33	5.07

Design Limit state:

Combo: 1.2D+1.4L

Md: 6.33 t.m

Vd: 5.07 ton

Service Limit State

Combo: LIVE

Span: 5 m

Load: -1 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 34.73 < 81.98 => Compact Web

c/tf= 5.3 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 174.28 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270

fact= 1.48 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.28 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.67 cm < dall= 1.67 cm

Group Connection Design (Simple Shear Plate Connection)

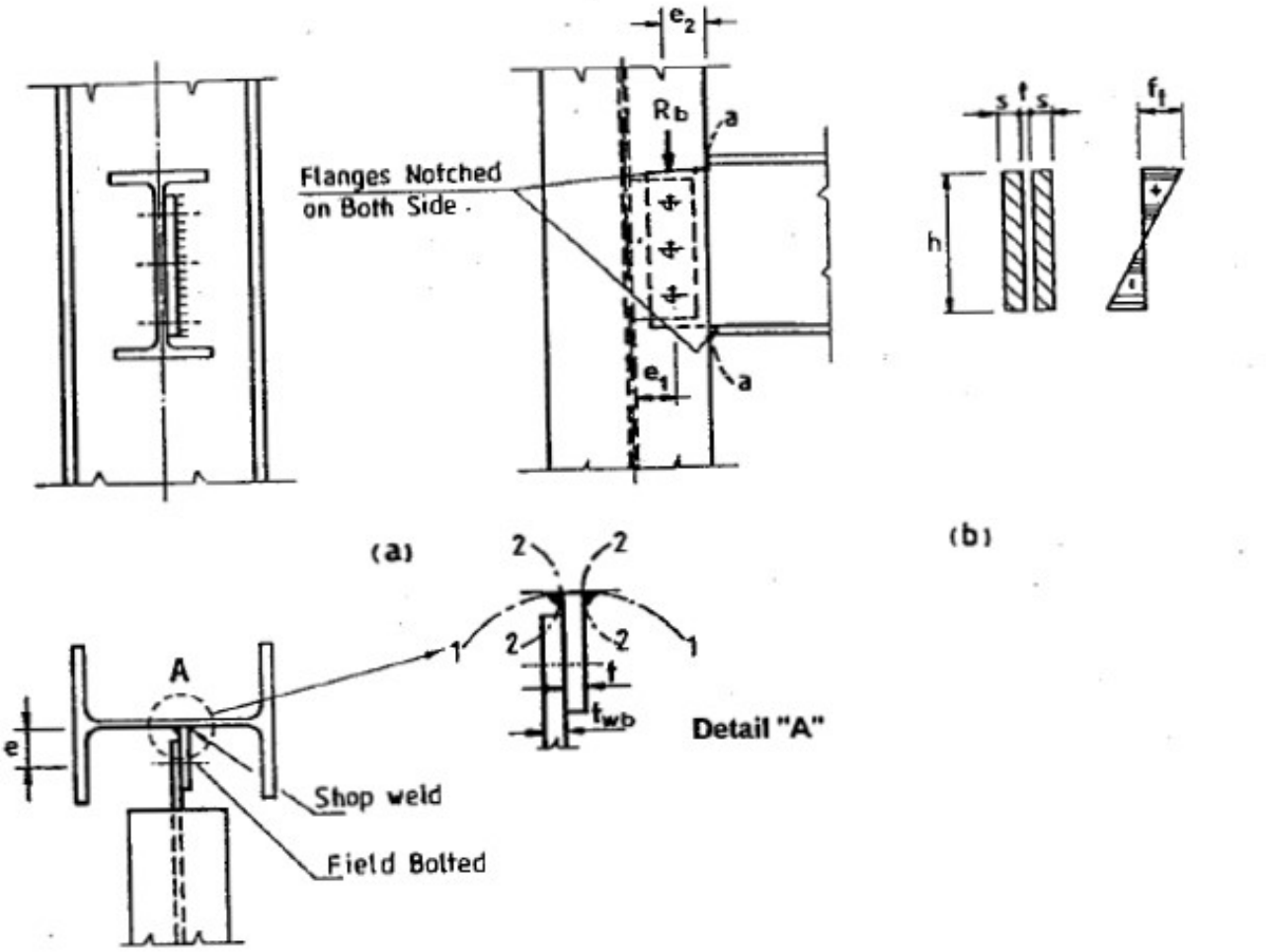

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 5.07 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 = 0.36 t/cm^2 & q = 0.23 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.53 t/cm^2 < 1.1 * 0.2Fu = 0.79 t/cm^2 => OK

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

q = 0.23 t/cm^2 & qmt = 0.36 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.42 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.43 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => 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)
16	(18,15,3)	(24,15,3)	6	10.33	5.2
15	(12,15,3)	(18,15,3)	6	10.33	5.2
14	(6,15,3)	(12,15,3)	6	10.33	5.2
13	(0,15,3)	(6,15,3)	6	10.33	5.2
4	(18,0,3)	(24,0,3)	6	10.33	5.2
3	(12,0,3)	(18,0,3)	6	10.33	5.2
2	(6,0,3)	(12,0,3)	6	10.33	5.2
1	(0,0,3)	(6,0,3)	6	10.33	5.2

Design Limit state:

Combo: 1.2D+1.4L

Md: 10.33 t.m

Vd: 5.2 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -0.83 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 37.87 < 81.98 => Compact Web

c/tf= 5.64 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 206.56 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE330

fact= 1.45 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.21 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.57 cm < dall= 2 cm

Group Connection Design (Simple Shear Plate Connection)

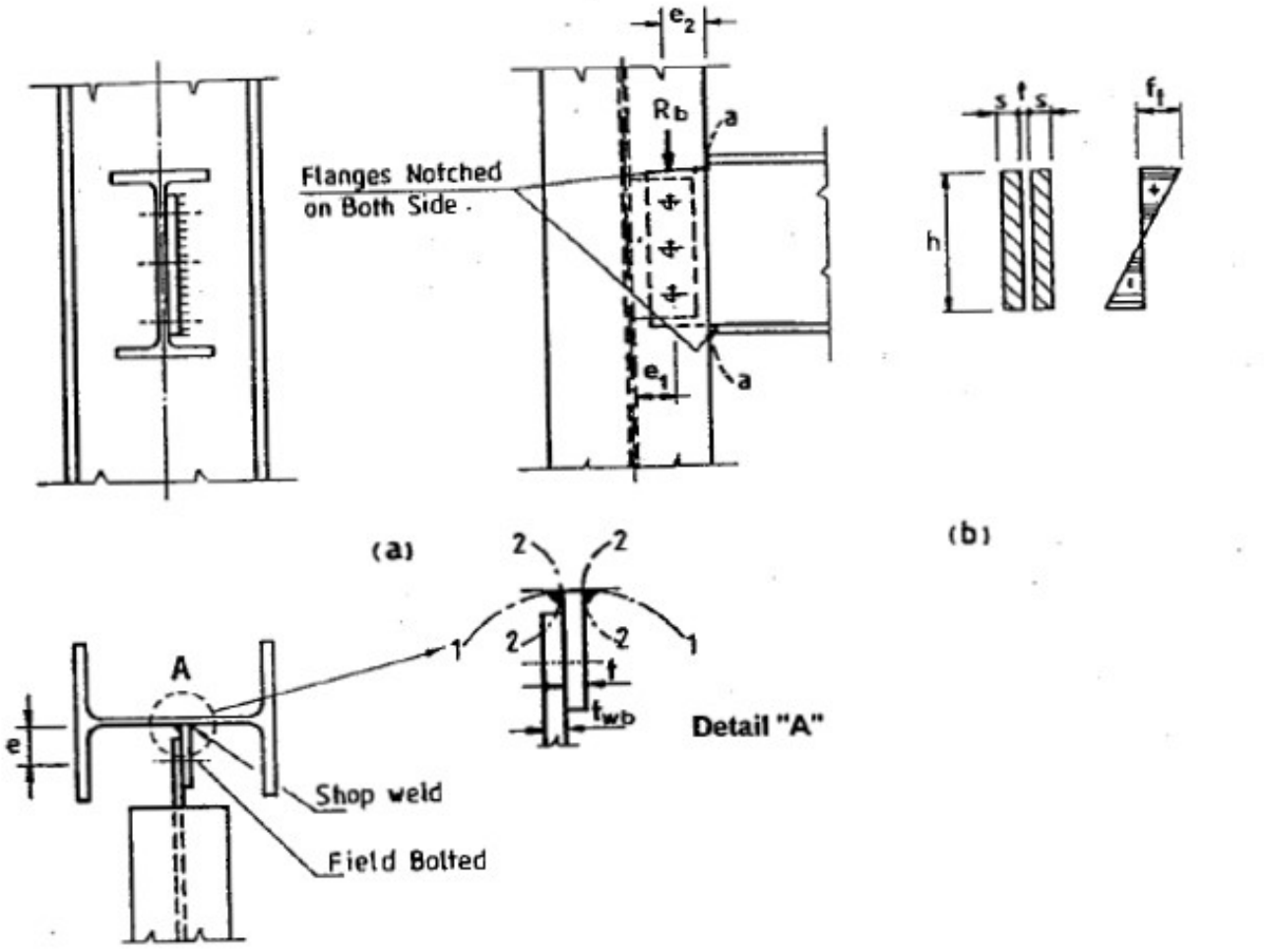

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 5.2 ton

Rleast= 3.24 ton

N= 3 with Pitch= 77 mm & Full Layout: (38;77 77 38.5)

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

f = 0.24 t/cm^2 & q = 0.19 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.41 t/cm^2 < 1.1 * 0.2Fu = 0.79 t/cm^2 => OK

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

q = 0.19 t/cm^2 & qmt = 0.24 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.31 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.29 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => OK IPE330

Plate Layout => L = 231 mm & tp = 10 mm & Sw = 6 mm

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
12	(18,10,3)	(24,10,3)	6	20.46	10.26
11	(12,10,3)	(18,10,3)	6	20.46	10.26
10	(6,10,3)	(12,10,3)	6	20.46	10.26
9	(0,10,3)	(6,10,3)	6	20.46	10.26
8	(18,5,3)	(24,5,3)	6	20.46	10.26
7	(12,5,3)	(18,5,3)	6	20.46	10.26
6	(6,5,3)	(12,5,3)	6	20.46	10.26
5	(0,5,3)	(6,5,3)	6	20.46	10.26

Design Limit state:

Combo: 1.2D+1.4L

Md: 20.46 t.m

Vd: 10.26 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -1.67 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 41.66 < 81.98 => Compact Web

c/tf= 5.19 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 245.29 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE450

fact= 1.36 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.24 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.4 cm < dall= 2 cm

Group Connection Design (Simple Shear Plate Connection)

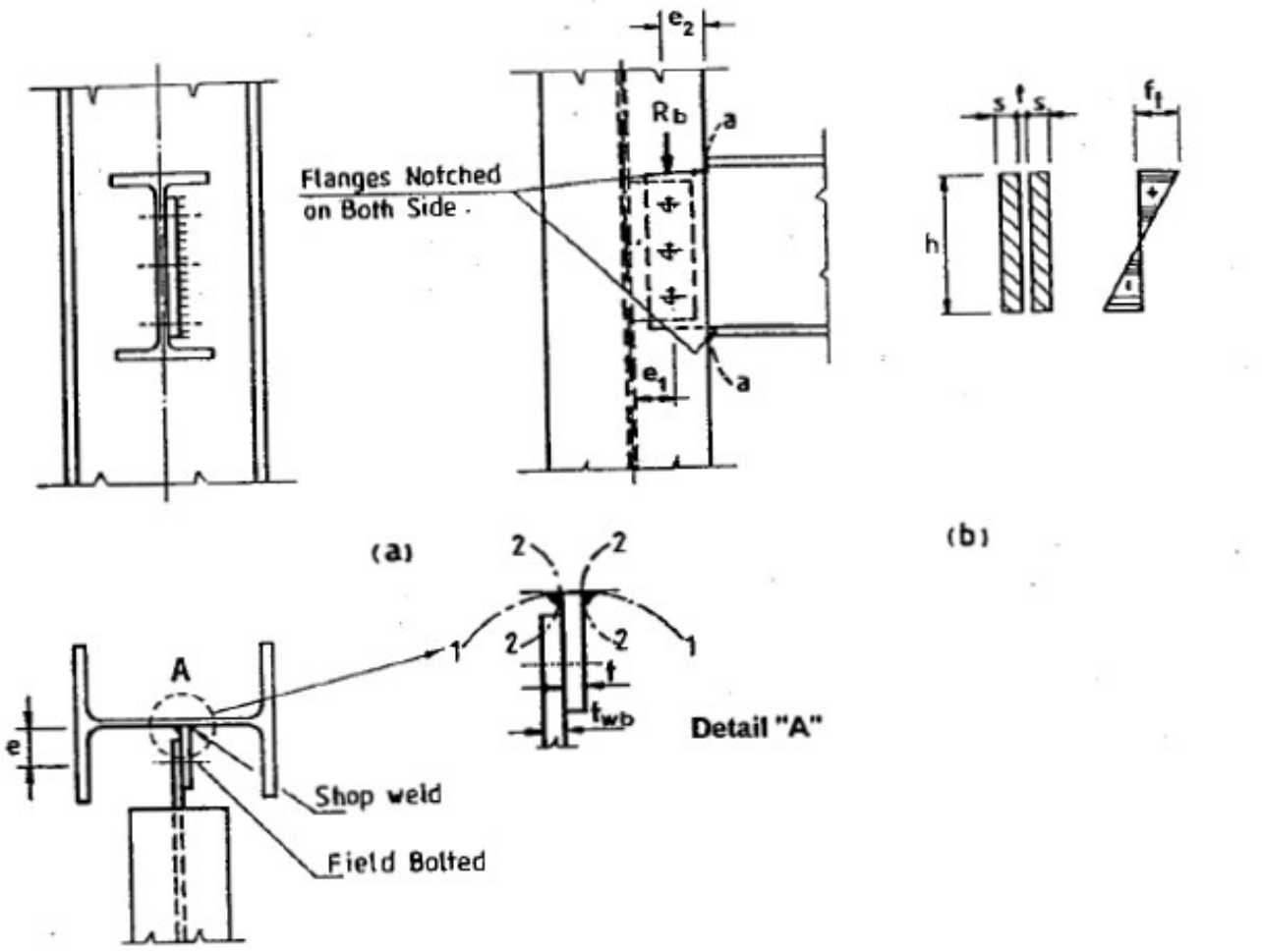

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 10.26 ton

Rleast= 4.06 ton

N= 3 with Pitch= 105 mm & Full Layout: (52;105 105 52.5)

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

f = 0.26 t/cm^2 & q = 0.28 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.55 t/cm^2 < 1.1 * 0.2Fu = 0.79

t/cm^2 => OK

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

q = 0.28 t/cm^2 & qmt = 0.26 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.38 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.31 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => OK IPE450

Plate Layout => L = 315 mm & tp = 10 mm & Sw = 6 mm

Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
7	(6,5,0)	(6,5,3)	3	-30.82
8	(12,5,0)	(12,5,3)	3	-30.82
9	(18,5,0)	(18,5,3)	3	-30.82
12	(6,10,0)	(6,10,3)	3	-30.82
13	(12,10,0)	(12,10,3)	3	-30.82
14	(18,10,0)	(18,10,3)	3	-30.82
2	(6,0,0)	(6,0,3)	3	-15.61
3	(12,0,0)	(12,0,3)	3	-15.61
4	(18,0,0)	(18,0,3)	3	-15.61
18	(12,15,0)	(12,15,3)	3	-15.61
19	(18,15,0)	(18,15,3)	3	-15.61
17	(6,15,0)	(6,15,3)	3	-15.61
10	(24,5,0)	(24,5,3)	3	-15.55
6	(0,5,0)	(0,5,3)	3	-15.55
11	(0,10,0)	(0,10,3)	3	-15.55
15	(24,10,0)	(24,10,3)	3	-15.55
1	(0,0,0)	(0,0,3)	3	-7.92
5	(24,0,0)	(24,0,3)	3	-7.92
16	(0,15,0)	(0,15,3)	3	-7.92
20	(24,15,0)	(24,15,3)	3	-7.92

Design Limit state:

Combo: 1.2D+1.4L

Nd: -30.82 ton

1-Check Local Buckling

dw/tw= 36.23 < 37.44 => Compact Web

c/tf= 5.68 < 10.91 => Compact Flange

2-Check Normal Stress

Section: IPE300

lambda = 89.55 < 100

fc= 0.57 t/cm^2 < Fc= 0.88 t/cm^2
