Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
22	(20,4,6)	(20,8,6)	4	2.02	2.02
21	(20,0,6)	(20,4,6)	4	2.02	2.02
2	(0,4,6)	(0,8,6)	4	2.02	2.02
1	(0,0,6)	(0,4,6)	4	2.02	2.02

Design Limit state:

Combo: 1.2D+1.4L

Md: 2.02 t.m

Vd: 2.02 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.5 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 27.93 < 81.98 => Compact Web

c/tf= 4.36 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 117.48 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270

fact= 1.38 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= 0.6 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

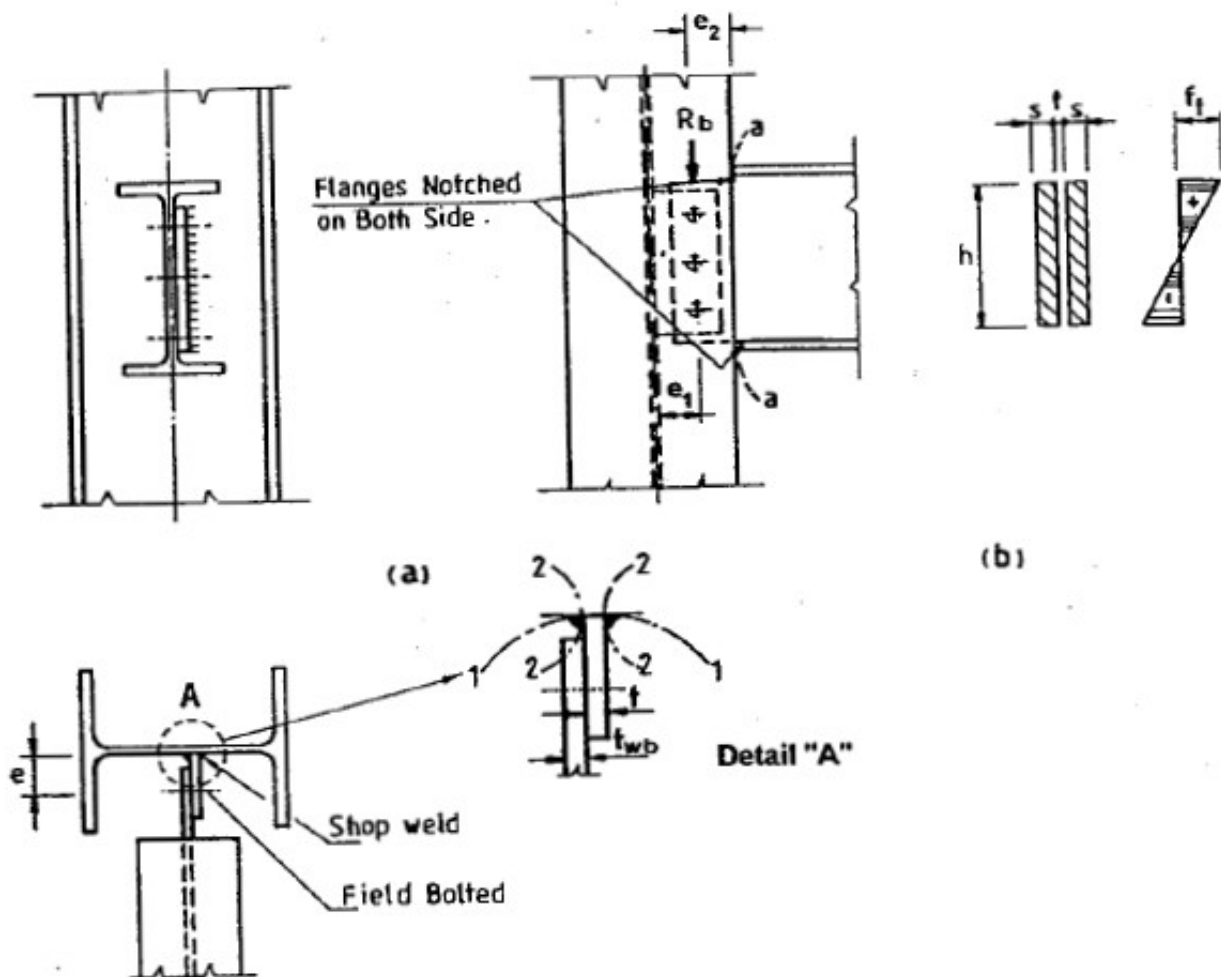Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.02 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 t/cm^2 & q = 0.09 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.21 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 = 0.09 t/cm^2 & qmt = 0.14 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.17 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.17 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)
18	(16,4,6)	(16,8,6)	4	4.02	4.02
17	(16,0,6)	(16,4,6)	4	4.02	4.02
20	(18,4,6)	(18,8,6)	4	4.02	4.02
3	(2,0,6)	(2,4,6)	4	4.02	4.02
4	(2,4,6)	(2,8,6)	4	4.02	4.02
5	(4,0,6)	(4,4,6)	4	4.02	4.02
6	(4,4,6)	(4,8,6)	4	4.02	4.02
7	(6,0,6)	(6,4,6)	4	4.02	4.02
8	(6,4,6)	(6,8,6)	4	4.02	4.02
9	(8,0,6)	(8,4,6)	4	4.02	4.02
10	(8,4,6)	(8,8,6)	4	4.02	4.02
19	(18,0,6)	(18,4,6)	4	4.02	4.02
12	(10,4,6)	(10,8,6)	4	4.02	4.02
13	(12,0,6)	(12,4,6)	4	4.02	4.02
14	(12,4,6)	(12,8,6)	4	4.02	4.02
15	(14,0,6)	(14,4,6)	4	4.02	4.02
16	(14,4,6)	(14,8,6)	4	4.02	4.02
11	(10,0,6)	(10,4,6)	4	4.02	4.02

Design Limit state:

Combo: 1.2D+1.4L

Md: 4.02 t.m

Vd: 4.02 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -1 t/m'

Design Checks

1-Check Local Buckling

d_w/t_w= 32.39 < 81.98 => Compact Web

c/t_f= 4.81 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 154.92 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270

fact= 1.24 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.27 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.41 cm < dall= 1.33 cm
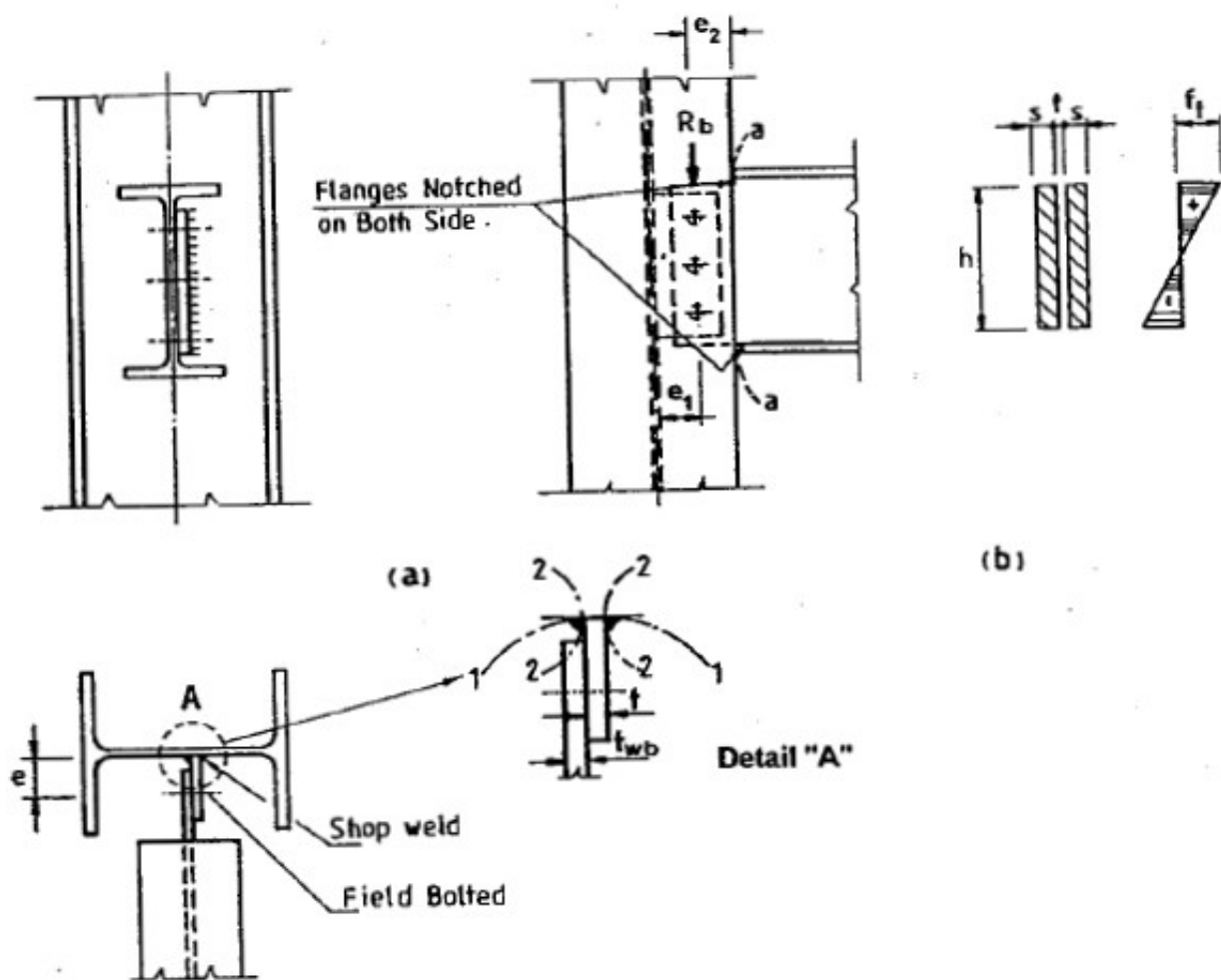
Group Connection Design (Simple Shear Plate Connection)

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 4.02 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 t/cm^2 & q = 0.18 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.42 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 = 0.18 t/cm^2 & qmt = 0.28 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.34 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.34 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)
9	(14,8,6)	(20,8,6)	6	8.2	4.13
7	(0,8,6)	(6,8,6)	6	8.2	4.13
3	(14,0,6)	(20,0,6)	6	8.2	4.13
1	(0,0,6)	(6,0,6)	6	8.2	4.13

Design Limit state:

Combo: 1.2D+1.4L

Md: 8.2 t.m

Vd: 4.13 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 => Compact Web

c/tf= 5.68 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 193.65 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE300

fact= 1.47 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.19 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.64 cm < dall= 2 cm

Group Connection Design (Simple Shear Plate Connection)

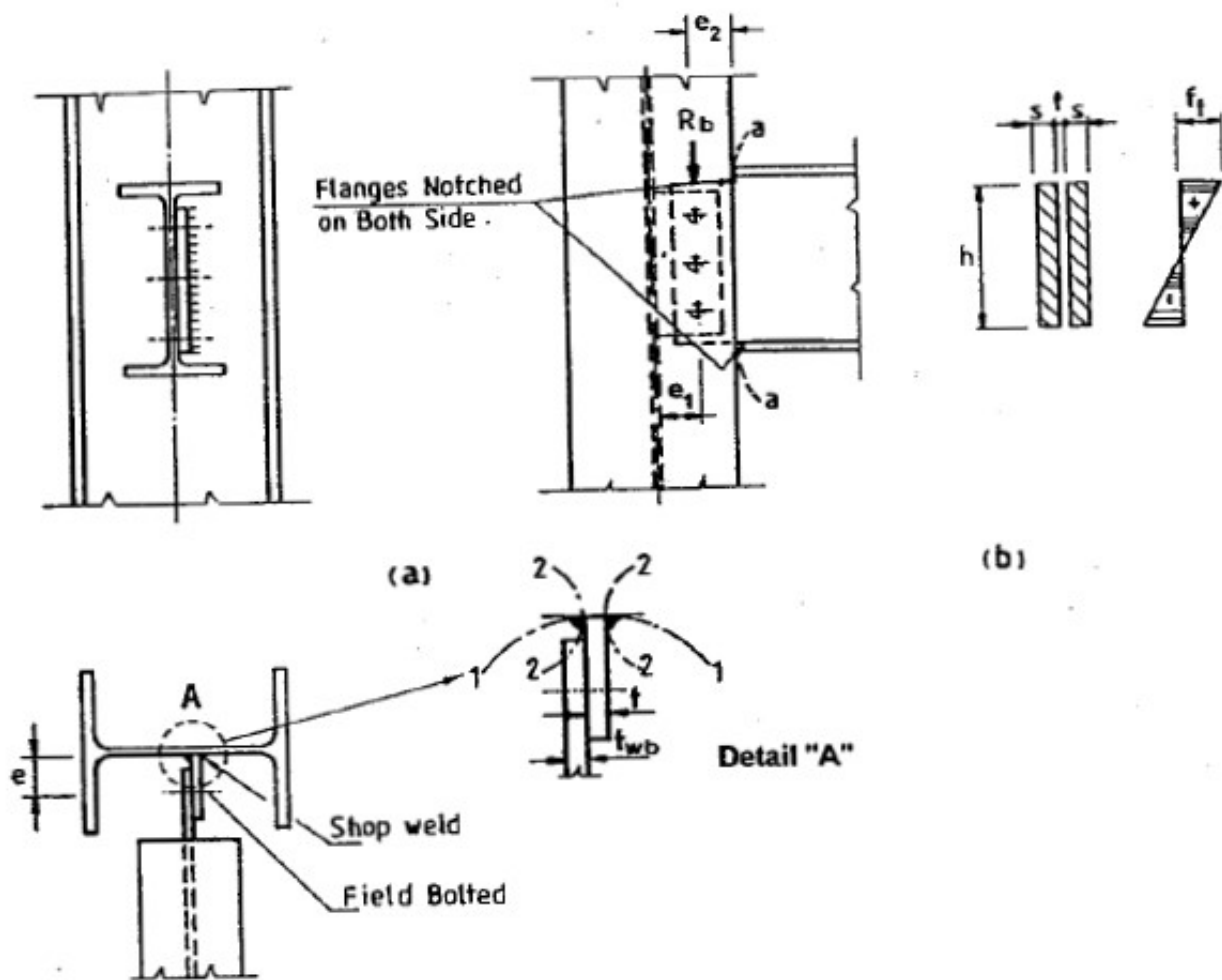Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 4.13 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 = 0.23 t/cm^2 & q = 0.17 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.37 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 = 0.17 t/cm^2 & qmt = 0.23 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.29 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.28 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => 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	16.24	8.15
4	(0,4,6)	(6,4,6)	6	16.24	8.15
8	(6,8,6)	(14,8,6)	8	16.37	6.18
2	(6,0,6)	(14,0,6)	8	16.37	6.18

Design Limit state:

Combo: 1.2D+1.4L

Md: 16.37 t.m

Vd: 6.18 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 => Compact Web

c/tf= 5.35 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 232.38 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE400

fact= 1.41 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.18 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.82 cm < dall= 2.67 cm
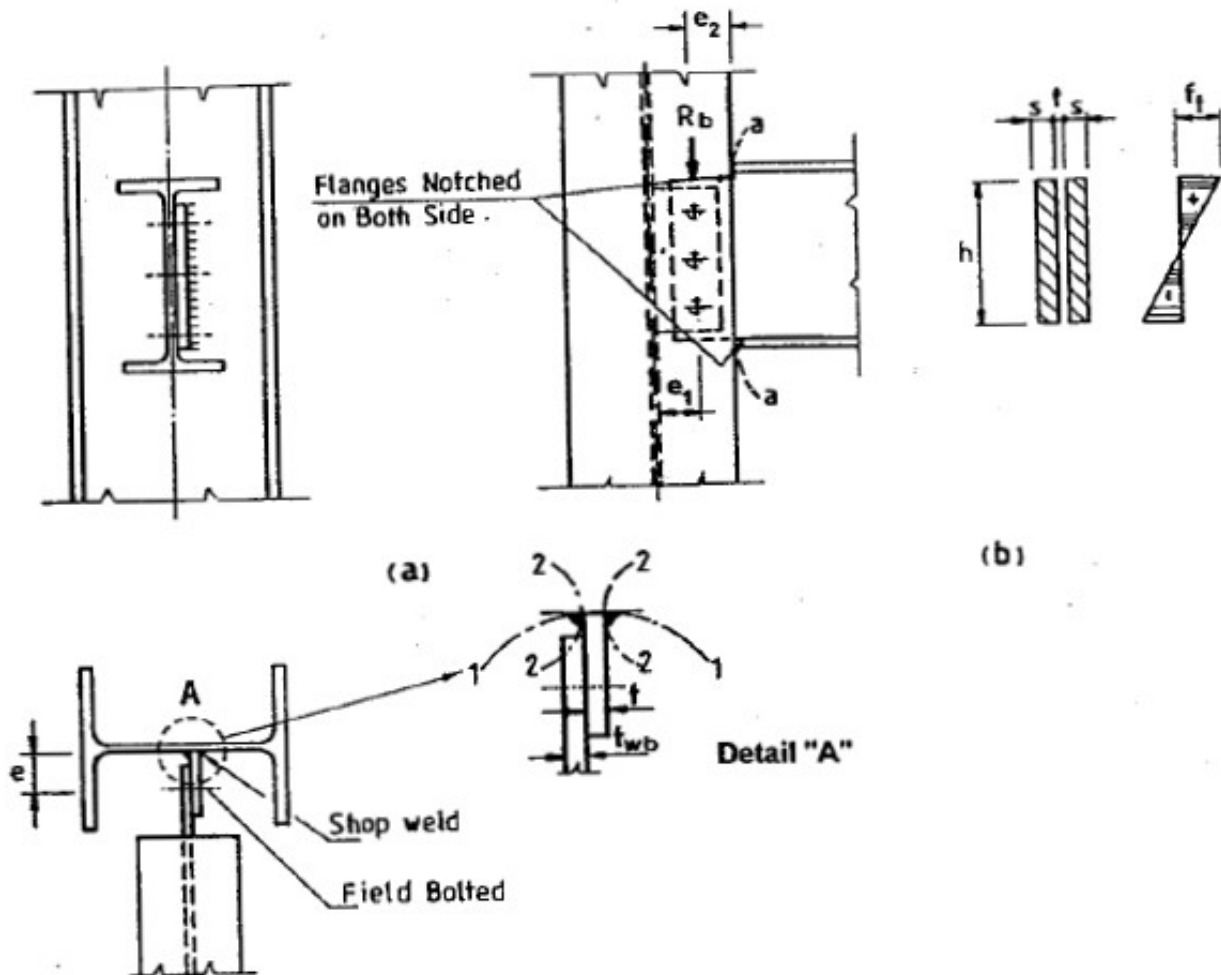
Group Connection Design (Simple Shear Plate Connection)

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 6.18 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)

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

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

$q = 0.19$ t/cm^2 & $q_{mt} = 0.2$ t/cm^2 => $q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.27$ t/cm^2 < $0.2F_u = 0.72$

t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.24 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => 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	32.45	12.21

Design Limit state:

Combo: 1.2D+1.4L

Md: 32.45 t.m

Vd: 12.21 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 => Compact Web

c/tf= 4.79 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 271.11 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE550

fact= 1.33 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= 0.57 cm < dall= 2.67 cm

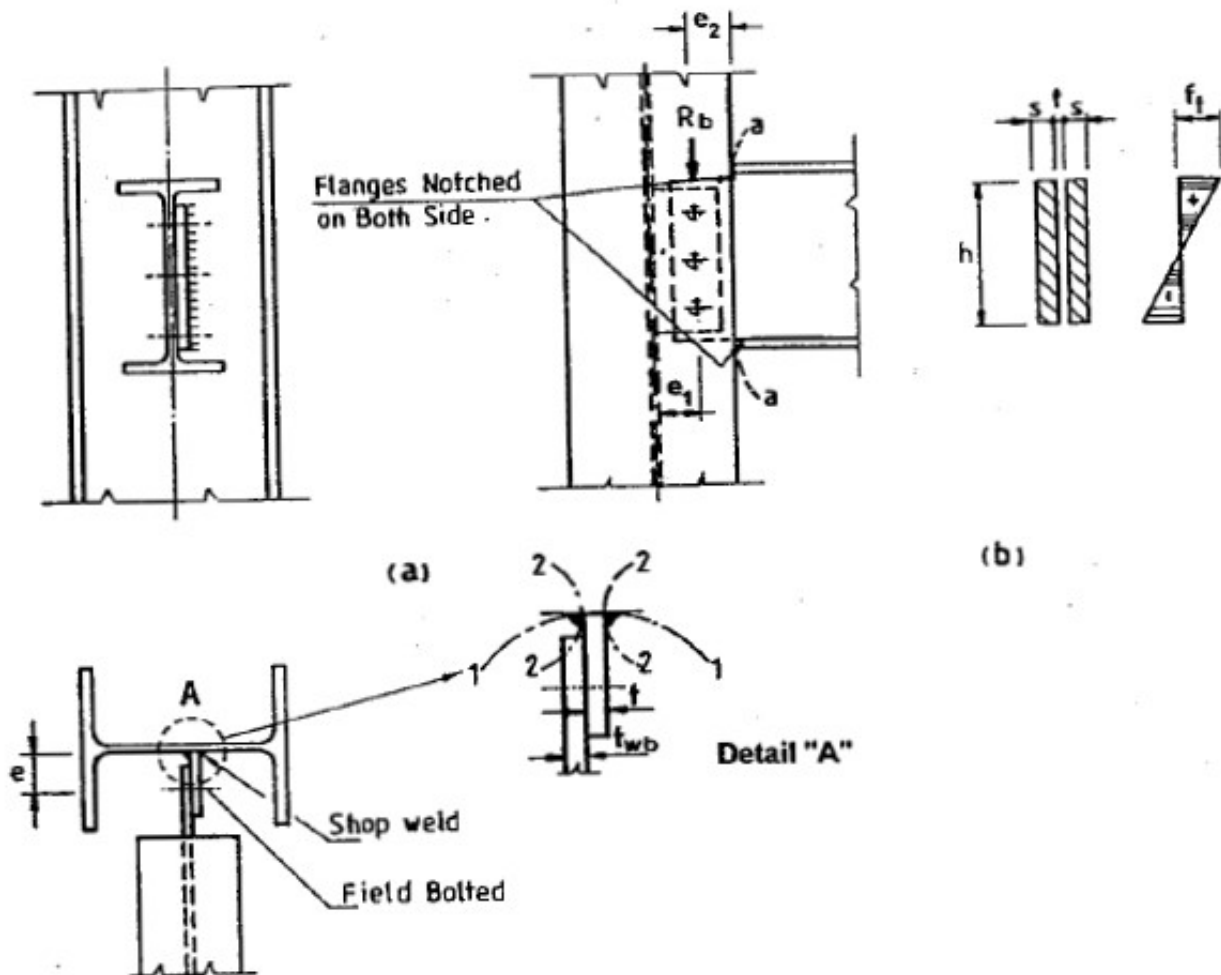## Group Connection Design (Simple Shear Plate Connection)

Fig. 4.8 Cleat Plate

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 12.21 ton

Rleast= 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 t/cm^2 & q = 0.32 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.63 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 = 0.32 t/cm^2 & qmt = 0.3 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.44 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.36 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => 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	-28.7
7	(14,4,0)	(14,4,6)	6	-28.7
2	(6,0,0)	(6,0,6)	6	-14.63
3	(14,0,0)	(14,0,6)	6	-14.63
10	(6,8,0)	(6,8,6)	6	-14.63
11	(14,8,0)	(14,8,6)	6	-14.63
5	(0,4,0)	(0,4,6)	6	-12.49
8	(20,4,0)	(20,4,6)	6	-12.49
1	(0,0,0)	(0,0,6)	6	-6.45
4	(20,0,0)	(20,0,6)	6	-6.45
9	(0,8,0)	(0,8,6)	6	-6.45
12	(20,8,0)	(20,8,6)	6	-6.45

Design Limit state:

Combo: 1.2D+1.4L

Nd: -28.7 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 = 179.1 > 100

fc= 0.53 t/cm^2 < Fc= 0.23 t/cm^2