

Design Calculation Sheet for df

Designer: xf

Location: fd

City: dfdf

Country: fdf

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Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
20	(18,5,3)	(18,10,3)	5	4.76	3.81
19	(18,0,3)	(18,5,3)	5	4.76	3.81
2	(0,5,3)	(0,10,3)	5	4.76	3.81
1	(0,0,3)	(0,5,3)	5	4.76	3.81

Design Limit state:

Combo: D+L

Md: 4.76 t.m

Vd: 3.81 ton

Service Limit State

Combo: LIVE

Span: 5 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

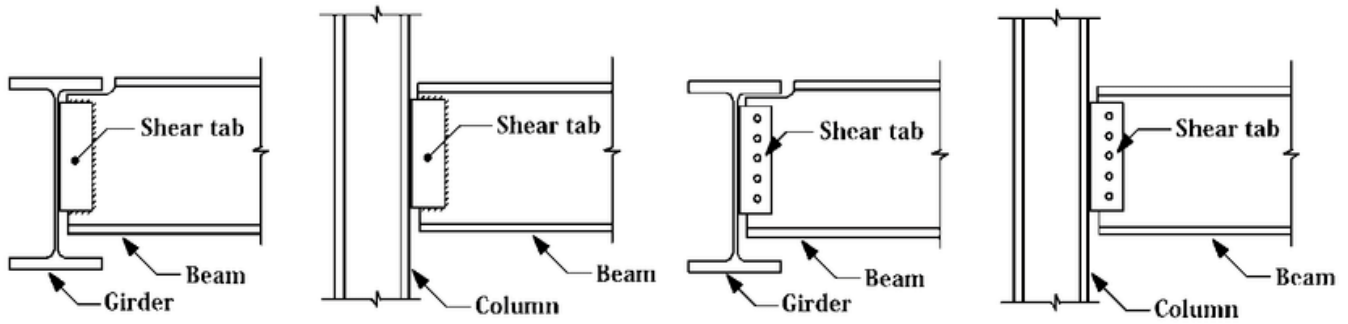
$f_{act} = 1.47 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.26 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 1 \text{ cm} < d_{all} = 1.67 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 3.81$ ton

$R_{least} = 2.85$ 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)

$f = 0.27$ t/cm² & $q = 0.17$ t/cm² $\Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.4$ t/cm² $< 1.1 * 0.2F_u = 0.79$ t/cm² \Rightarrow OK

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

$q = 0.17$ t/cm² & $q_{mt} = 0.27$ t/cm² $\Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.32$ t/cm² $< 0.2F_u = 0.72$ t/cm² \Rightarrow OK

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.32$ t/cm² $< 0.72 * F_y = 1.73$ t/cm² \Rightarrow OK

Plate Layout $\Rightarrow L = 189$ mm & $t_p = 10$ mm & $S_w = 6$ mm

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
16	(14,5,3)	(14,10,3)	5	9.44	7.56
15	(14,0,3)	(14,5,3)	5	9.44	7.56
14	(12,5,3)	(12,10,3)	5	9.44	7.56
13	(12,0,3)	(12,5,3)	5	9.44	7.56
12	(10,5,3)	(10,10,3)	5	9.44	7.56
11	(10,0,3)	(10,5,3)	5	9.44	7.56
17	(16,0,3)	(16,5,3)	5	9.44	7.56
9	(8,0,3)	(8,5,3)	5	9.44	7.56
8	(6,5,3)	(6,10,3)	5	9.44	7.56

7	(6,0,3)	(6,5,3)	5	9.44	7.56
6	(4,5,3)	(4,10,3)	5	9.44	7.56
5	(4,0,3)	(4,5,3)	5	9.44	7.56
4	(2,5,3)	(2,10,3)	5	9.44	7.56
3	(2,0,3)	(2,5,3)	5	9.44	7.56
18	(16,5,3)	(16,10,3)	5	9.44	7.56
10	(8,5,3)	(8,10,3)	5	9.44	7.56

Design Limit state:

Combo: D+L

Md: 9.44 t.m

Vd: 7.56 ton

Service Limit State

Combo: LIVE

Span: 5 m

Load: -2 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 37.87 < 81.98 \Rightarrow$ Compact Web

$c/tf = 5.64 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 206.56 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE330

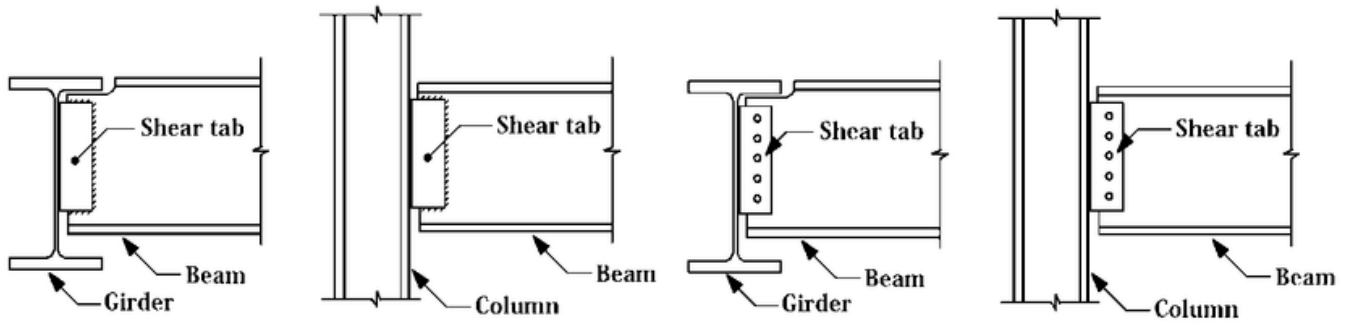
$f_{act} = 1.32 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.31 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.66 \text{ cm} < d_{all} = 1.67 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 7.56$ ton

$R_{least} = 3.24$ 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)

$f = 0.35 \text{ t/cm}^2$ & $q = 0.28 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.6 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

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

$q = 0.28 \text{ t/cm}^2$ & $q_{mt} = 0.35 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.45 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.43 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK}$

Plate Layout $\Rightarrow L = 231 \text{ mm}$ & $t_p = 10 \text{ mm}$ & $S_w = 6 \text{ mm}$

Main Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
9	(12,10,3)	(18,10,3)	6	15.27	7.66
8	(6,10,3)	(12,10,3)	6	15.27	7.66
7	(0,10,3)	(6,10,3)	6	15.27	7.66
3	(12,0,3)	(18,0,3)	6	15.27	7.66
2	(6,0,3)	(12,0,3)	6	15.27	7.66
1	(0,0,3)	(6,0,3)	6	15.27	7.66

Design Limit state:

Combo: D+L

Md: 15.27 t.m

Vd: 7.66 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -1.67 t/m'

Design Checks

1-Check Local Buckling

$d_w/t_w = 40.24 < 81.98 \Rightarrow$ Compact Web

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

2-Check Lateral Torsional Buckling

$L_{uact} = 0 \text{ m} < L_{umax} = 232.38 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE400

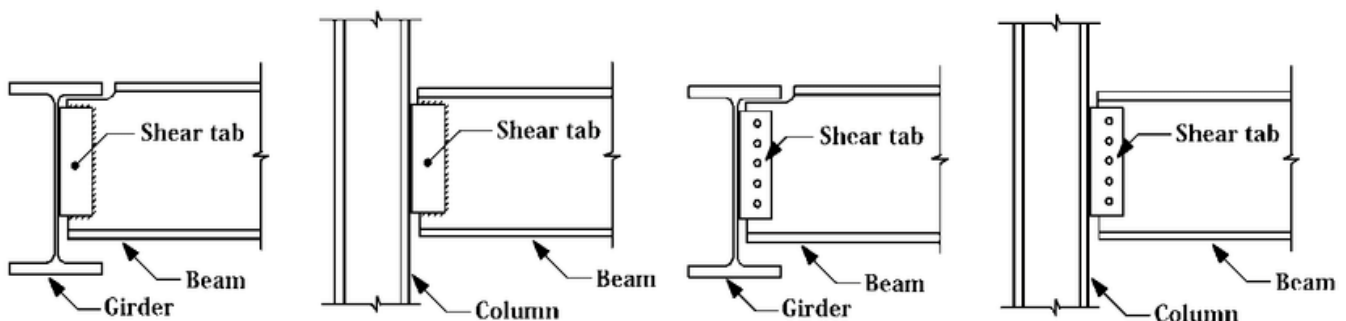
$f_{act} = 1.32 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.22 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.58 \text{ cm} < d_{all} = 2 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 7.66 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)

$f = 0.24 \text{ t/cm}^2$ & $q = 0.23 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.47 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

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

$q = 0.23 \text{ t/cm}^2$ & $q_{mt} = 0.24 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.34 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.29 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK}$

Plate Layout $\Rightarrow L = 280 \text{ mm}$ & $t_p = 10 \text{ mm}$ & $S_w = 6 \text{ mm}$

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
6	(12,5,3)	(18,5,3)	6	30.39	15.22
5	(6,5,3)	(12,5,3)	6	30.39	15.22
4	(0,5,3)	(6,5,3)	6	30.39	15.22

Design Limit state:

Combo: D+L

Md: 30.39 t.m

Vd: 15.22 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -3.33 t/m'

Design Checks

1-Check Local Buckling

$d_w/t_w = 43.36 < 81.98 \Rightarrow \text{Compact Web}$

$c/t_f = 4.79 < 10.91 \Rightarrow \text{Compact Flange}$

2-Check Lateral Torsional Buckling

$L_{uact} = 0 \text{ m} < L_{umax} = 271.11 \text{ m} \Rightarrow \text{Supported (No LTB)}$

3-Check Bending Stress

Section: IPE550

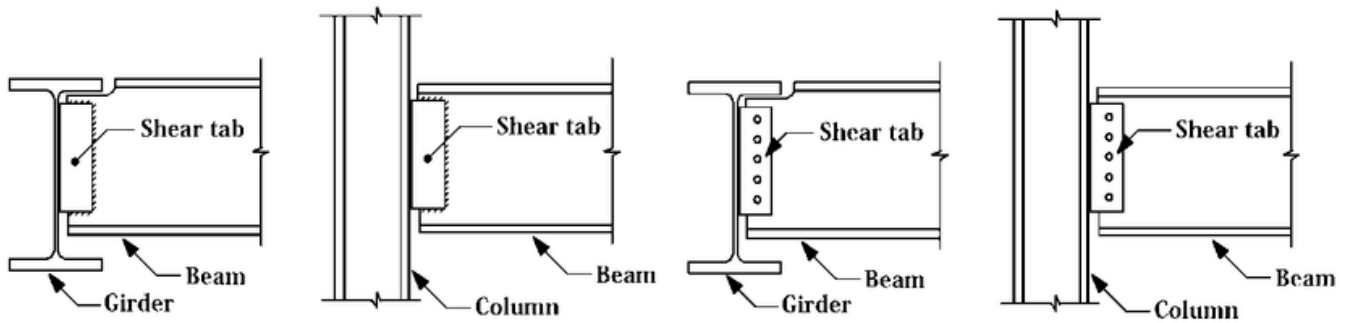
$$fact = 1.25 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$$

4-Check Shear Stress

$$q_{act} = 0.25 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$$

5-Check Deflection

$$d_{act} = 0.4 \text{ cm} < d_{all} = 2 \text{ cm}$$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$$V_d = 15.22 \text{ ton}$$

$$R_{least} = 4.8 \text{ ton}$$

$$N = 4 \text{ with Pitch} = 96 \text{ mm} \text{ \& Full Layout: (48;96 96 96 49)}$$

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

$$f = 0.26 \text{ t/cm}^2 \text{ \& } q = 0.33 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.63 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$$

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

$$q = 0.33 \text{ t/cm}^2 \text{ \& } q_{mt} = 0.26 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.42 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$$

4-Check Thickness of Plate

$$f = (6 * V_d * e) / (t_p * L^2) = 0.31 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK}$$

$$\text{Plate Layout} \Rightarrow L = 385 \text{ mm} \text{ \& } t_p = 10 \text{ mm} \text{ \& } S_w = 6 \text{ mm}$$

Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
6	(6,5,0)	(6,5,3)	3	-45.68

7	(12,5,0)	(12,5,3)	3	-45.68
2	(6,0,0)	(6,0,3)	3	-23.01
3	(12,0,0)	(12,0,3)	3	-23.01
10	(6,10,0)	(6,10,3)	3	-23.01
11	(12,10,0)	(12,10,3)	3	-23.01
5	(0,5,0)	(0,5,3)	3	-22.96
8	(18,5,0)	(18,5,3)	3	-22.96
1	(0,0,0)	(0,0,3)	3	-11.6
9	(0,10,0)	(0,10,3)	3	-11.6
4	(18,0,0)	(18,0,3)	3	-11.6
12	(18,10,0)	(18,10,3)	3	-11.6

Design Limit state:

Combo: D+L

Nd: -45.68 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

$\lambda = 89.55 < 100$

$f_c = 0.85 \text{ t/cm}^2 < F_c = 0.88 \text{ t/cm}^2$
