Design Calculation Sheet for WWD

Designer: asa

Location: ewe

City: ewawe

Country: aewe

Date: 2020-06-22 02:59:26

Table of Contents

Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
30	(23.7,4,6)	(23.7,8,6)	4	0.75	0.75
29	(23.7,0,6)	(23.7,4,6)	4	0.75	0.75
2	(0,4,6)	(0,8,6)	4	0.86	0.86
1	(0,0,6)	(0,4,6)	4	0.86	0.86

Design Limit state:

Combo: 1.4*D + 1*L

Md: 0.86 t.m

Vd: 0.86 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.13 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 23.92 < 81.98 => Compact Web

c/tf= 3.95 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 94.24 m => Supported (No LTB)

3-Check Bending Stress
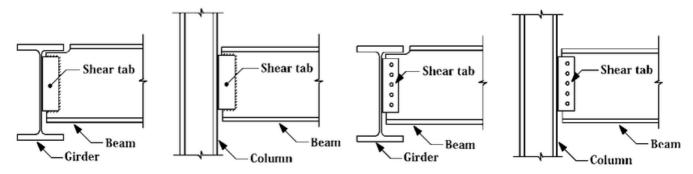
Section: IPE270

fact= 1.11 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.13 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.38 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 0.86 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)

$f = 0.06$ t/cm^2 & $q = 0.04$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.09$ t/cm^2 < $1.1 * 0.2Fu = 0.79$ t/cm^2 => OK

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

$q = 0.04$ t/cm^2 & $qmt = 0.06$ t/cm^2 => $qres = (q^2 + qmt^2)^{0.5} = 0.07$ t/cm^2 < $0.2Fu = 0.72$ t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*Vd*e)/(tp*L^2) = 0.07$ t/cm^2 < $0.72*Fy = 1.73$ t/cm^2 => OK

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
26	(21.1,4,6)	(21.1,8,6)	4	1.44	1.44
24	(19.8,4,6)	(19.8,8,6)	4	1.44	1.44
23	(19.8,0,6)	(19.8,4,6)	4	1.44	1.44
28	(22.4,4,6)	(22.4,8,6)	4	1.44	1.44
27	(22.4,0,6)	(22.4,4,6)	4	1.44	1.44
25	(21.1,0,6)	(21.1,4,6)	4	1.44	1.44
3	(1.5,0,6)	(1.5,4,6)	4	1.65	1.65
4	(1.5,4,6)	(1.5,8,6)	4	1.65	1.65
5	(3,0,6)	(3,4,6)	4	1.65	1.65

6	(3,4,6)	(3,8,6)	4	1.65	1.65
22	(18.5,4,6)	(18.5,8,6)	4	1.81	1.81
21	(18.5,0,6)	(18.5,4,6)	4	1.81	1.81
7	(4.5,0,6)	(4.5,4,6)	4	1.92	1.92
8	(4.5,4,6)	(4.5,8,6)	4	1.92	1.92

Design Limit state:

Combo: 1.4*D + 1*L

Md: 1.92 t.m

Vd: 1.92 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.26 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
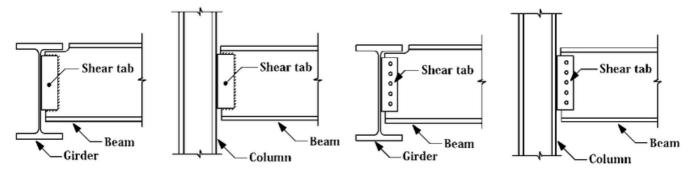
fact= 1.31 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

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

5-Check Deflection

dact= 0.31 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 1.92 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)

$f = 0.13$ t/cm^2 & $q = 0.09$ t/cm^2 => $f_{eq} = (f^2 + 3q^2)^{0.5} = 0.2$ 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)

$q = 0.09$ t/cm^2 & $q_{mt} = 0.13$ t/cm^2 => $q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.16$ t/cm^2 < $0.2F_u = 0.72$ t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*V_d*e)/(t_p*L^2) = 0.16$ t/cm^2 < $0.72*F_y = 1.73$ t/cm^2 => OK

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
10	(6.5,4,6)	(6.5,8,6)	4	2.18	2.18
9	(6.5,0,6)	(6.5,4,6)	4	2.18	2.18
13	(10.5,0,6)	(10.5,4,6)	4	2.18	2.18
11	(8.5,0,6)	(8.5,4,6)	4	2.18	2.18
12	(8.5,4,6)	(8.5,8,6)	4	2.18	2.18
14	(10.5,4,6)	(10.5,8,6)	4	2.18	2.18
16	(12.5,4,6)	(12.5,8,6)	4	2.18	2.18
17	(14.5,0,6)	(14.5,4,6)	4	2.18	2.18
18	(14.5,4,6)	(14.5,8,6)	4	2.18	2.18

19	(16.5,0,6)	(16.5,4,6)	4	2.18	2.18
20	(16.5,4,6)	(16.5,8,6)	4	2.18	2.18
15	(12.5,0,6)	(12.5,4,6)	4	2.18	2.18

Design Limit state:

Combo: 1.4*D + 1*L

Md: 2.18 t.m

Vd: 2.18 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.4 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 29.65 < 81.98 => Compact Web

c/tf= 4.56 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 129.1 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270
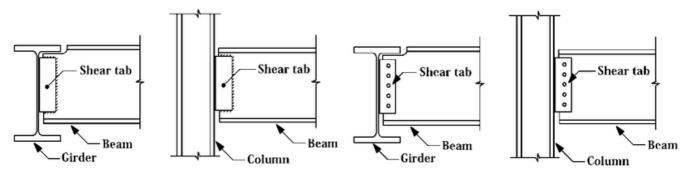
fact= 1.13 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

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

5-Check Deflection

dact= 0.33 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.18 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)

$f = 0.15$ t/cm^2 & $q = 0.1$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.23$ t/cm^2 < $1.1 * 0.2Fu = 0.79$ t/cm^2 => OK

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

$q = 0.1$ t/cm^2 & $qmt = 0.15$ t/cm^2 => $qres = (q^2 + qmt^2)^{0.5} = 0.18$ t/cm^2 < $0.2Fu = 0.72$ t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*Vd*e)/(tp*L^2) = 0.18$ t/cm^2 < $0.72*Fy = 1.73$ t/cm^2 => OK

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	(0,8,6)	(4.5,8,6)	4.5	2.61	1.77
1	(0,0,6)	(4.5,0,6)	4.5	2.61	1.77

Design Limit state:

Combo: 1.4*D + 1*L

Md: 2.61 t.m

Vd: 1.77 ton

Service Limit State

Combo: LIVE

Span: 4.5 m

Load: -0.27 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 29.65 < 81.98 => Compact Web

c/tf= 4.56 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 129.1 m => Supported (No LTB)

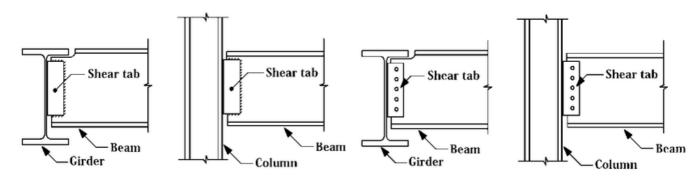### 3-Check Bending Stress

Section: IPE270

fact= 1.34 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.16 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.35 cm < dall= 1.5 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 1.77 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 = 0.12 t/cm^2 & q = 0.08 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.19 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 = 0.08 t/cm^2 & qmt = 0.12 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.15 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.15 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => OK

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
12	(18.5,8,6)	(23.7,8,6)	5.2	3.92	2.29
4	(18.5,0,6)	(23.7,0,6)	5.2	3.92	2.29
10	(4.5,8,6)	(10.5,8,6)	6	4.59	2.33
2	(4.5,0,6)	(10.5,0,6)	6	4.59	2.33
5	(0,4,6)	(4.5,4,6)	4.5	5.09	3.42

Design Limit state:

Combo: 1.4*D + 1*L

Md: 5.09 t.m

Vd: 3.42 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -0.27 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)
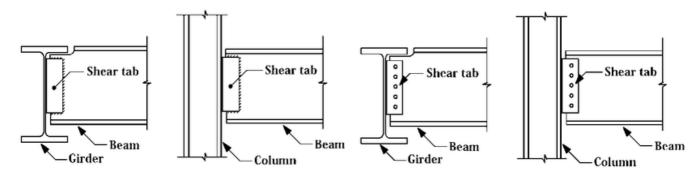
3-Check Bending Stress

Section: IPE270

fact= 1.19 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= 0.37 cm < dall= 2 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 3.42 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 = 0.24 t/cm^2 & q = 0.16 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.36 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 = 0.16 t/cm^2 & qmt = 0.24 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) = 0.29 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => OK

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
8	(18.5,4,6)	(23.7,4,6)	5.2	7.66	4.45
6	(4.5,4,6)	(10.5,4,6)	6	8.96	4.52
11	(10.5,8,6)	(18.5,8,6)	8	9.14	3.48
3	(10.5,0,6)	(18.5,0,6)	8	9.14	3.48

Design Limit state:

Combo: 1.4*D + 1*L

Md: 9.14 t.m

Vd: 3.48 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.3 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

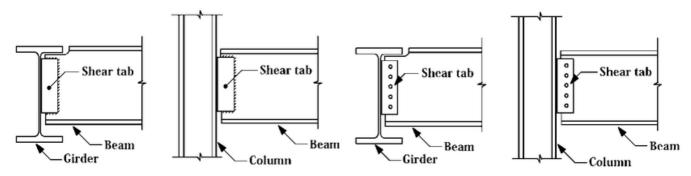Section: IPE330

fact= 1.28 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.14 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.65 cm < dall= 2.67 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 3.48 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)

$f = 0.16$ t/cm^2 & $q = 0.13$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.28$ t/cm^2 < $1.1 * 0.2Fu = 0.79$ t/cm^2 => OK

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

$q = 0.13$ t/cm^2 & $qmt = 0.16$ 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

$f = (6*Vd*e)/(tp*L^2) = 0.2$ t/cm^2 < $0.72*Fy = 1.73$ t/cm^2 => OK

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
7	(10.5,4,6)	(18.5,4,6)	8	17.87	6.75

Design Limit state:

Combo: 1.4*D + 1*L

Md: 17.87 t.m

Vd: 6.75 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.6 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)
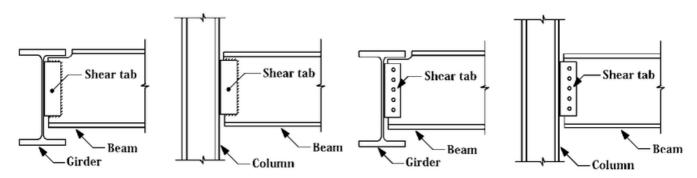
3-Check Bending Stress

Section: IPE450

fact= 1.19 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.16 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.45 cm < dall= 2.67 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 6.75 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 = 0.17 t/cm^2 & q = 0.18 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.36 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 = 0.17 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.25 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.2 t/cm^2 < 0.72*Fy = 1.73 t/cm^2 => OK

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

Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
8	(10.5,4,0)	(10.5,4,6)	6	-15.99
9	(18.5,4,0)	(18.5,4,6)	6	-15.18
7	(4.5,4,0)	(4.5,4,6)	6	-12.13
3	(10.5,0,0)	(10.5,0,6)	6	-8.35
13	(10.5,8,0)	(10.5,8,6)	6	-8.35
4	(18.5,0,0)	(18.5,0,6)	6	-7.93
14	(18.5,8,0)	(18.5,8,6)	6	-7.93
2	(4.5,0,0)	(4.5,0,6)	6	-6.37
12	(4.5,8,0)	(4.5,8,6)	6	-6.37
10	(23.7,4,0)	(23.7,4,6)	6	-6.31
6	(0,4,0)	(0,4,6)	6	-5.49
5	(23.7,0,0)	(23.7,0,6)	6	-3.4
15	(23.7,8,0)	(23.7,8,6)	6	-3.4
1	(0,0,0)	(0,0,6)	6	-2.98
11	(0,8,0)	(0,8,6)	6	-2.98

Design Limit state:

Combo: 1.4*D + 1*L

Nd: -15.99 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= 0.3 t/cm^2 < Fc= 0.23 t/cm^2