Design Calculation Sheet for AUTRA2

Designer: AUTRA2

Location: Smart Village

City: Giza

Country: Egypt

Date: 2020-06-19 06:41:09

Table of Contents

Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
8	(0,20,6)	(4,20,6)	4	0.04	0.04
2	(4,0,6)	(8,0,6)	4	0.04	0.04
1	(0,0,6)	(4,0,6)	4	0.04	0.04

Design Limit state:

Combo: D+L

Md: 0.04 t.m

Vd: 0.04 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: 0 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 15.58 < 81.98 => Compact Web

c/tf= 3.06 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 59.39 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270

fact= 0.22 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.01 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 0.04 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 t/cm^2 & q = 0 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0 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 t/cm^2 & qmt = 0 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0 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)
13	(3,10,6)	(3,6,6)	4	2.04	2.04
12	(1,10,6)	(1,6,6)	4	2.04	2.04
11	(2,14,6)	(2,10,6)	4	2.04	2.04
10	(6,12,6)	(6,8,6)	4	2.04	2.04
7	(0,18,6)	(4,18,6)	4	2.04	2.04
6	(0,16,6)	(4,16,6)	4	2.04	2.04
5	(4,6,6)	(8,6,6)	4	2.04	2.04
4	(4,4,6)	(8,4,6)	4	2.04	2.04
3	(4,2,6)	(8,2,6)	4	2.04	2.04

Design Limit state:

Combo: D+L

Md: 2.04 t.m

Vd: 2.04 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -1 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
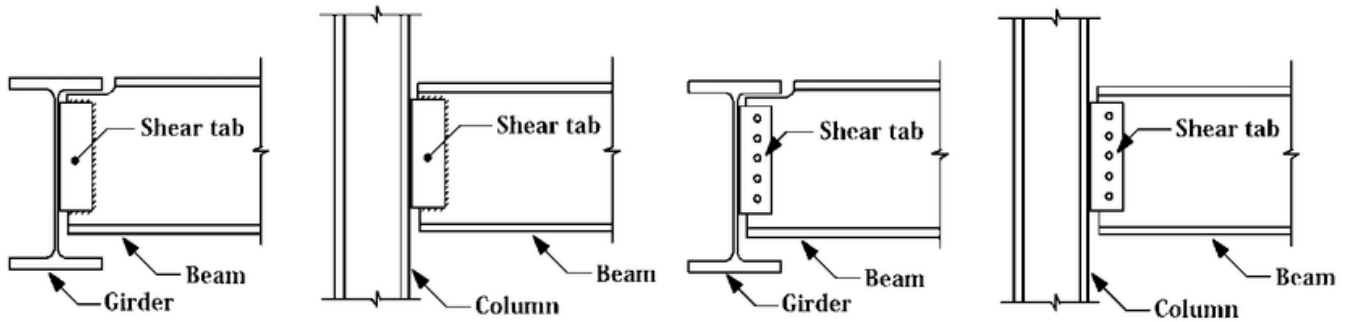
fact= 1.4 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

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

5-Check Deflection

dact= 1.2 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.04 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 => $feq = (f^2 + 3q^2)^{0.5} = 0.22$ 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

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
9	(6,14,6)	(6,20,6)	6	4.66	3.11

Design Limit state:

Combo: D+L

Md: 4.66 t.m

Vd: 3.11 ton

Service Limit State

Combo: LIVE

Span: 6 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= 1.09 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.17 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 1.39 cm < dall= 2 cm
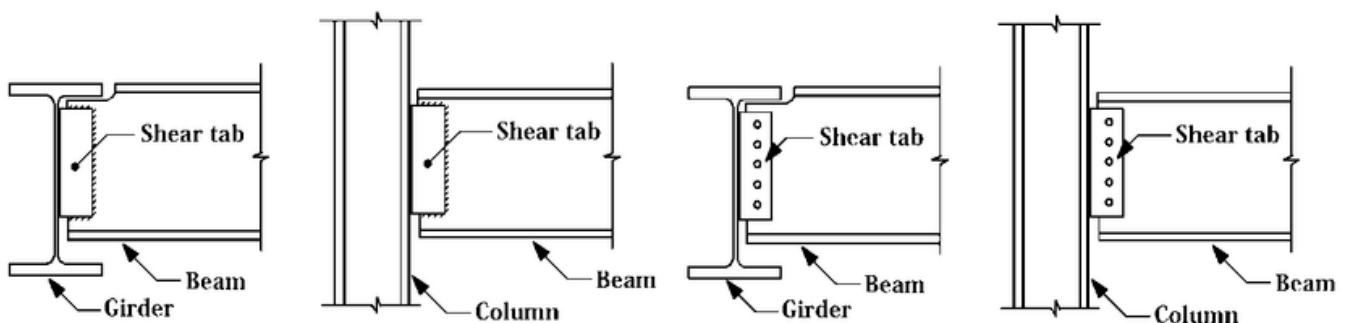
Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 3.11 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 = 0.22 t/cm^2 & q = 0.14 t/cm^2 => feq = (f^2 + 3q^2)^0.5 = 0.33 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 = 0.14 t/cm^2 & qmt = 0.22 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.26 t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

f = (6*Vd*e)/(tp*L^2) = 0.26 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)
16	(8,14,6)	(8,20,6)	6	0.16	0.11
8	(0,0,6)	(0,6,6)	6	0.16	0.11

Design Limit state:

Combo: D+L

Md: 0.16 t.m

Vd: 0.11 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: 0 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 15.58 < 81.98 => Compact Web

c/tf= 3.06 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 59.39 m => Supported (No LTB)

3-Check Bending Stress

Section: IPE270

fact= 0.81 t/cm^2 < Fb= 1.54 t/cm^2
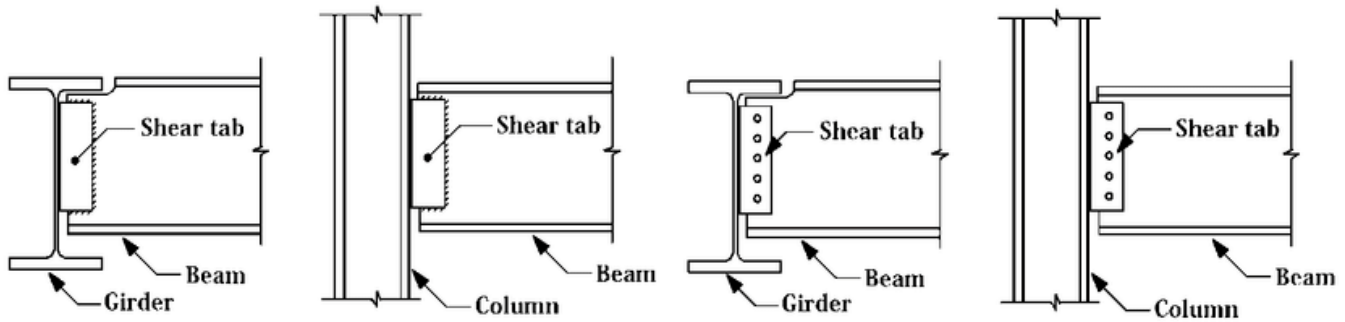
4-Check Shear Stress

qact= 0.04 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0 cm < dall= 2 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 0.11 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)

$f = 0.01$ t/cm^2 & $q = 0$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.01$ t/cm^2 < 1.1 * 0.2Fu = 0.79 t/cm^2 => OK

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

$q = 0$ t/cm^2 & $qmt = 0.01$ t/cm^2 => $qres = (q^2 + qmt^2)^{0.5} = 0.01$ t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*Vd*e)/(tp*L^2) = 0.01$ 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)
5	(4,12,6)	(8,12,6)	4	2.09	1.07
4	(4,8,6)	(8,8,6)	4	2.09	1.07
3	(0,14,6)	(4,14,6)	4	2.09	1.07
1	(0,6,6)	(4,6,6)	4	2.09	2.09
15	(8,6,6)	(8,14,6)	8	2.42	1.21

Design Limit state:

Combo: D+L

Md: 2.42 t.m

Vd: 1.21 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.25 t/m'

Design Checks

1-Check Local Buckling

d_w/t_w= 31.06 < 81.98 => Compact Web

c/t_f= 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= 0.96 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.09 t/cm^2 < qall= 0.84 t/cm^2
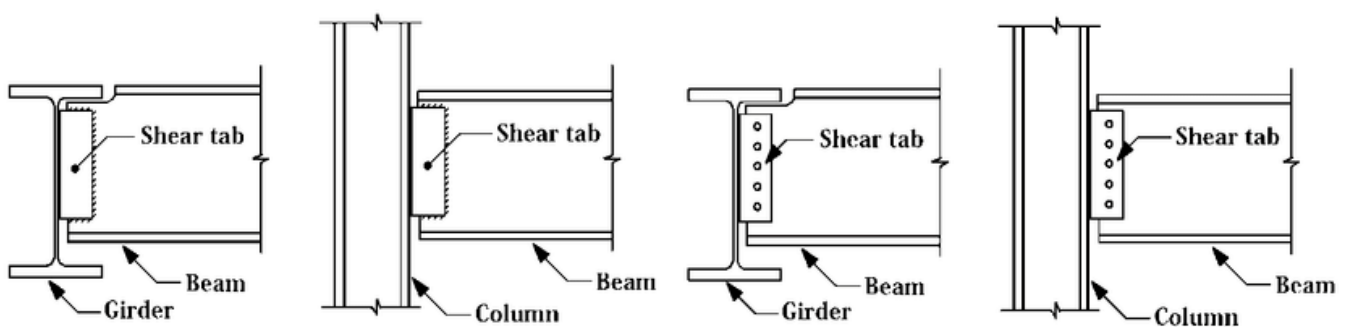
5-Check Deflection

dact= 2.29 cm < dall= 2.67 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 1.21 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)

$f = 0.08$ t/cm^2 & $q = 0.06$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.13$ t/cm^2 < 1.1 * 0.2Fu = 0.79 t/cm^2 => OK

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

$q = 0.06$ t/cm^2 & $qmt = 0.08$ t/cm^2 => $qres = (q^2 + qmt^2)^{0.5} = 0.1$ t/cm^2 < 0.2Fu = 0.72 t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*Vd*e)/(tp*L^2) = 0.1$ 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)
7	(4,14,6)	(8,14,6)	4	3.15	1.6
6	(4,20,6)	(8,20,6)	4	3.15	1.6
2	(0,10,6)	(4,10,6)	4	4.13	3.11
14	(8,0,6)	(8,6,6)	6	4.25	2.15
13	(4,14,6)	(4,20,6)	6	4.25	2.15
11	(4,0,6)	(4,6,6)	6	4.25	2.15
10	(0,14,6)	(0,20,6)	6	4.25	2.15

Design Limit state:

Combo: D+L

Md: 4.25 t.m

Vd: 2.15 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -0.67 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 32.39 < 81.98 => Compact Web

c/tf= 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= 1.31 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= 1.38 cm < dall= 2 cm
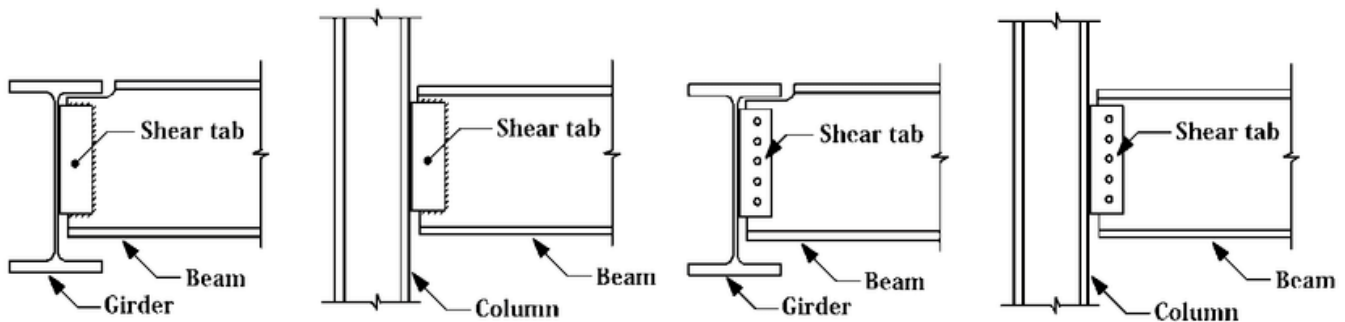
Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.15 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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)

9	(0,6,6)	(0,14,6)	8	6.51	1.7
12	(4,6,6)	(4,14,6)	8	8.65	2.77

Design Limit state:

Combo: D+L

Md: 8.65 t.m

Vd: 2.77 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.38 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= 1.21 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.11 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 0.81 cm < dall= 2.67 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 2.77 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)

$f = 0.13$ t/cm^2 & $q = 0.1$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.22$ 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 & $qmt = 0.13$ 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

$f = (6*Vd*e)/(tp*L^2) = 0.16$ t/cm^2 < $0.72*Fy = 1.73$ t/cm^2 => OK

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

Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
6	(4,6,0)	(4,6,6)	6	-9.31
7	(4,14,0)	(4,14,6)	6	-7.84
10	(8,6,0)	(8,6,6)	6	-5.66
3	(0,14,0)	(0,14,6)	6	-5.17
2	(0,6,0)	(0,6,6)	6	-4.15
8	(4,20,0)	(4,20,6)	6	-4.05
11	(8,14,0)	(8,14,6)	6	-3.17
5	(4,0,0)	(4,0,6)	6	-2.5

4	(0,20,0)	(0,20,6)	6	-2.45
9	(8,0,0)	(8,0,6)	6	-2.45
12	(8,20,0)	(8,20,6)	6	-1.96
1	(0,0,0)	(0,0,6)	6	-0.41

Design Limit state:

Combo: D+L

Nd: -9.31 ton

1-Check Local Buckling

d_w/t_w= 36.23 < 37.44 => Compact Web

c/t_f= 5.68 < 10.91 => Compact Flange

2-Check Normal Stress

Section: IPE300

lambda = 179.1 > 100

f_c= 0.17 t/cm^2 < F_c= 0.23 t/cm^2