Design Calculation Sheet for ITI40

Designer: Civil

Location: Alex

City: Alex

Country: Japan

Date: 2020-06-20 03:34:16

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Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
22	(20,4,6)	(20,8,6)	4	1.04	1.04
21	(20,0,6)	(20,4,6)	4	1.04	1.04
2	(0,4,6)	(0,8,6)	4	1.04	1.04
1	(0,0,6)	(0,4,6)	4	1.04	1.04

Design Limit state:

Combo: D+L

Md: 1.04 t.m

Vd: 1.04 ton

Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.5 t/m'

Design Checks

1-Check Local Buckling

dw/tw= 26.08 < 81.98 => Compact Web

c/tf= 4.21 < 10.91 => Compact Flange

2-Check Lateral Torsional Buckling

Luact= 0 m < Lumax= 105.86 m => Supported (No LTB)

3-Check Bending Stress
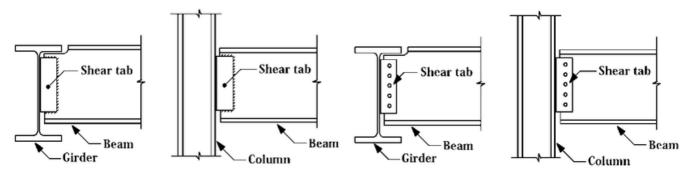
Section: IPE270

fact= 0.96 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

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

5-Check Deflection

dact= 0.91 cm < dall= 1.33 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 1.04 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)

$f = 0.07$ t/cm^2 & $q = 0.05$ t/cm^2 => $feq = (f^2 + 3q^2)^{0.5} = 0.11$ t/cm^2 < $1.1 * 0.2Fu = 0.79$ t/cm^2 => OK

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

$q = 0.05$ t/cm^2 & $qmt = 0.07$ t/cm^2 => $qres = (q^2 + qmt^2)^{0.5} = 0.09$ t/cm^2 < $0.2Fu = 0.72$ t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*Vd*e)/(tp*L^2) = 0.09$ 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)
18	(16,4,6)	(16,8,6)	4	2.04	2.04
17	(16,0,6)	(16,4,6)	4	2.04	2.04
20	(18,4,6)	(18,8,6)	4	2.04	2.04
3	(2,0,6)	(2,4,6)	4	2.04	2.04
4	(2,4,6)	(2,8,6)	4	2.04	2.04
5	(4,0,6)	(4,4,6)	4	2.04	2.04
6	(4,4,6)	(4,8,6)	4	2.04	2.04
7	(6,0,6)	(6,4,6)	4	2.04	2.04
8	(6,4,6)	(6,8,6)	4	2.04	2.04

9	(8,0,6)	(8,4,6)	4	2.04	2.04
10	(8,4,6)	(8,8,6)	4	2.04	2.04
19	(18,0,6)	(18,4,6)	4	2.04	2.04
12	(10,4,6)	(10,8,6)	4	2.04	2.04
13	(12,0,6)	(12,4,6)	4	2.04	2.04
14	(12,4,6)	(12,8,6)	4	2.04	2.04
15	(14,0,6)	(14,4,6)	4	2.04	2.04
16	(14,4,6)	(14,8,6)	4	2.04	2.04
11	(10,0,6)	(10,4,6)	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
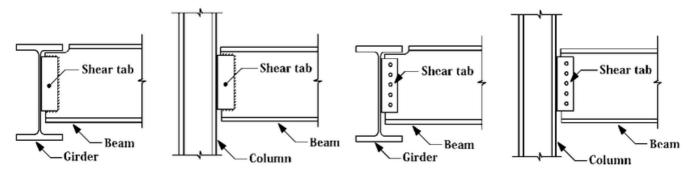
Section: IPE270

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

V_d = 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 => $f_{eq} = (f^2 + 3q^2)^{0.5} = 0.22$ 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 & $q_{mt} = 0.14$ t/cm^2 => $q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.17$ t/cm^2 < $0.2F_u = 0.72$ t/cm^2 => OK

4-Check Thickness of Plate

$f = (6*V_d*e)/(t_p*L^2) = 0.17$ t/cm^2 < $0.72*F_y = 1.73$ t/cm^2 => OK

Plate Layout => L = 189 mm & t_p = 10 mm & S_w = 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	4.25	2.15
7	(0,8,6)	(6,8,6)	6	4.25	2.15
3	(14,0,6)	(20,0,6)	6	4.25	2.15
1	(0,0,6)	(6,0,6)	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)
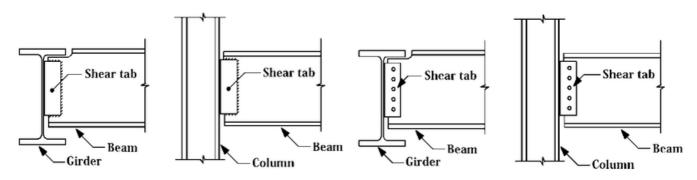
3-Check Bending Stress

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)
6	(14,4,6)	(20,4,6)	6	8.34	4.2
4	(0,4,6)	(6,4,6)	6	8.34	4.2
8	(6,8,6)	(14,8,6)	8	8.47	3.21
2	(6,0,6)	(14,0,6)	8	8.47	3.21

Design Limit state:

Combo: D+L

Md: 8.47 t.m

Vd: 3.21 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.75 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)
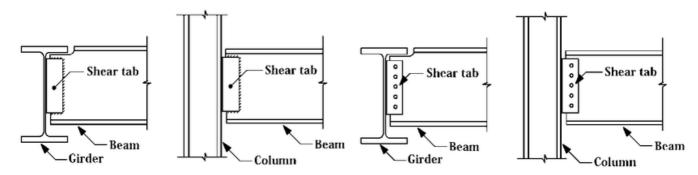
3-Check Bending Stress

Section: IPE300

fact= 1.52 t/cm^2 < Fb= 1.54 t/cm^2

4-Check Shear Stress

qact= 0.15 t/cm^2 < qall= 0.84 t/cm^2

5-Check Deflection

dact= 2.28 cm < dall= 2.67 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 3.21 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 = 0.18 t/cm^2 & q = 0.13 t/cm^2 => f_{eq} = $(f^2 + 3q^2)^{0.5}$ = 0.29 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 & q_{mt} = 0.18 t/cm^2 => q_{res} = $(q^2 + q_{mt}^2)^{0.5}$ = 0.22 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

Plate Layout => L = 210 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	16.65	6.28

Design Limit state:

Combo: D+L

Md: 16.65 t.m

Vd: 6.28 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -1.5 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)
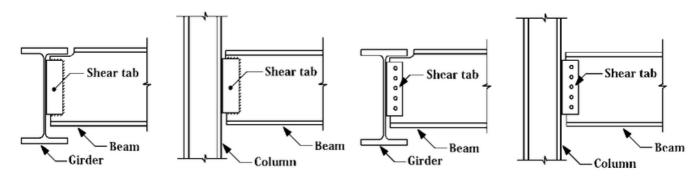
3-Check Bending Stress

Section: IPE400

fact= 1.44 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= 1.65 cm < dall= 2.67 cm

Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 6.28 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 => feq = (f^2 + 3q^2)^0.5 = 0.39 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 = 0.2 t/cm^2 => qres = (q^2 + qmt^2)^0.5 = 0.28 t/cm^2 < 0.2Fu = 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

Plate Layout => L = 280 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	-14.82
7	(14,4,0)	(14,4,6)	6	-14.82
2	(6,0,0)	(6,0,6)	6	-7.66
3	(14,0,0)	(14,0,6)	6	-7.66
10	(6,8,0)	(6,8,6)	6	-7.66
11	(14,8,0)	(14,8,6)	6	-7.66
8	(20,4,0)	(20,4,6)	6	-6.54
5	(0,4,0)	(0,4,6)	6	-6.54
4	(20,0,0)	(20,0,6)	6	-3.45
12	(20,8,0)	(20,8,6)	6	-3.45
1	(0,0,0)	(0,0,6)	6	-3.45
9	(0,8,0)	(0,8,6)	6	-3.45

Design Limit state:

Combo: D+L

Nd: -14.82 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 = 179.1 > 100

fc= 0.28 t/cm^2 < Fc= 0.23 t/cm^2