

## Design Calculation Sheet for ifi

Designer: kjk

Location:

City:

Country: kijnki

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## Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
31	(20,4,3)	(20,8,3)	4	0.74	0.74
11	(0,4,3)	(0,8,3)	4	0.74	0.74
10	(0,0,3)	(0,4,3)	4	0.74	0.74

### Design Limit state:

Combo: 1\*Dead + 1\*Live

Md: 0.74 t.m

Vd: 0.74 ton

### Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.2 t/m'

### Design Checks

#### 1-Check Local Buckling

$dw/tw = 21.55 < 81.98 \Rightarrow$  Compact Web

$c/tf = 3.74 < 10.91 \Rightarrow$  Compact Flange

#### 2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 82.62 \text{ m} \Rightarrow$  Supported (No LTB)

#### 3-Check Bending Stress

Section: IPE270

$f_{act} = 1.41 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

#### 4-Check Shear Stress

$q_{act} = 0.14 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

#### 5-Check Deflection

$d_{act} = 1 \text{ cm} < d_{all} = 1.33 \text{ cm}$



## Group Connection Design (Simple Shear Plate Connection)

### 1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 0.74$  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)

$f = 0.05$  t/cm<sup>2</sup> &  $q = 0.03$  t/cm<sup>2</sup>  $\Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.08$  t/cm<sup>2</sup>  $< 1.1 \cdot 0.2F_u = 0.79$  t/cm<sup>2</sup>  $\Rightarrow$  OK

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

$q = 0.03$  t/cm<sup>2</sup> &  $q_{mt} = 0.05$  t/cm<sup>2</sup>  $\Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.06$  t/cm<sup>2</sup>  $< 0.2F_u = 0.72$  t/cm<sup>2</sup>  $\Rightarrow$  OK

### 4-Check Thickness of Plate

$f = (6 \cdot V_d \cdot e) / (t_p \cdot L^2) = 0.06$  t/cm<sup>2</sup>  $< 0.72 \cdot F_y = 1.73$  t/cm<sup>2</sup>  $\Rightarrow$  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)
25	(14,4,3)	(14,8,3)	4	1.44	1.44
24	(14,0,3)	(14,4,3)	4	1.44	1.44
23	(12,4,3)	(12,8,3)	4	1.44	1.44
22	(12,0,3)	(12,4,3)	4	1.44	1.44
21	(10,4,3)	(10,8,3)	4	1.44	1.44
20	(10,0,3)	(10,4,3)	4	1.44	1.44
29	(18,4,3)	(18,8,3)	4	1.44	1.44
18	(8,0,3)	(8,4,3)	4	1.44	1.44
17	(6,4,3)	(6,8,3)	4	1.44	1.44

16	(6,0,3)	(6,4,3)	4	1.44	1.44
15	(4,4,3)	(4,8,3)	4	1.44	1.44
14	(4,0,3)	(4,4,3)	4	1.44	1.44
13	(2,4,3)	(2,8,3)	4	1.44	1.44
12	(2,0,3)	(2,4,3)	4	1.44	1.44
27	(16,4,3)	(16,8,3)	4	1.44	1.44
19	(8,4,3)	(8,8,3)	4	1.44	1.44

### Design Limit state:

Combo: 1\*Dead + 1\*Live

Md: 1.44 t.m

Vd: 1.44 ton

### Service Limit State

Combo: LIVE

Span: 4 m

Load: -0.4 t/m'

### Design Checks

#### 1-Check Local Buckling

$dw/tw = 26.08 < 81.98 \Rightarrow$  Compact Web

$c/tf = 4.21 < 10.91 \Rightarrow$  Compact Flange

#### 2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 105.86 \text{ m} \Rightarrow$  Supported (No LTB)

#### 3-Check Bending Stress

Section: IPE270

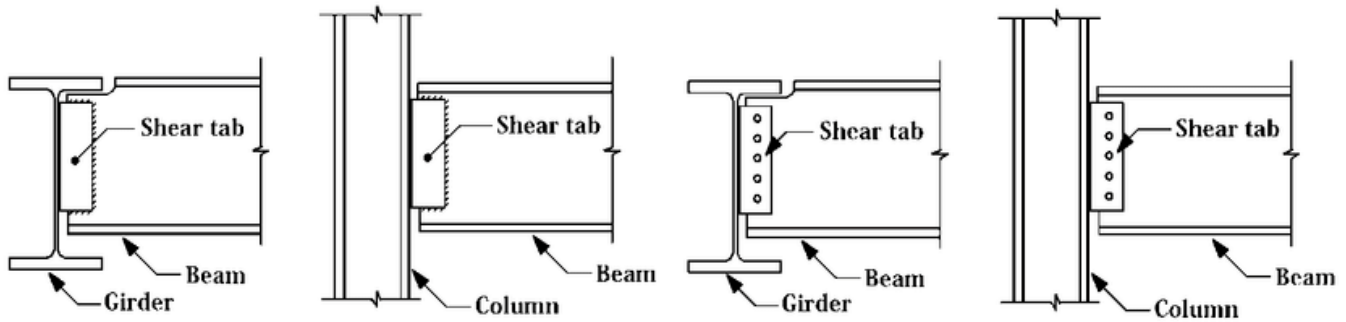
$f_{act} = 1.33 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

#### 4-Check Shear Stress

$q_{act} = 0.18 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

#### 5-Check Deflection

$d_{act} = 0.73 \text{ cm} < d_{all} = 1.33 \text{ cm}$



### Group Connection Design (Simple Shear Plate Connection)

#### 1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 1.44$  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)

$f = 0.1$  t/cm<sup>2</sup> &  $q = 0.07$  t/cm<sup>2</sup>  $\Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.15$  t/cm<sup>2</sup>  $< 1.1 * 0.2F_u = 0.79$  t/cm<sup>2</sup>  $\Rightarrow$  OK

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

$q = 0.07$  t/cm<sup>2</sup> &  $q_{mt} = 0.1$  t/cm<sup>2</sup>  $\Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.12$  t/cm<sup>2</sup>  $< 0.2F_u = 0.72$  t/cm<sup>2</sup>  $\Rightarrow$  OK

#### 4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.12$  t/cm<sup>2</sup>  $< 0.72 * F_y = 1.73$  t/cm<sup>2</sup>  $\Rightarrow$  OK

Plate Layout  $\Rightarrow L = 189$  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	(14,8,3)	(20,8,3)	6	3.05	1.55
7	(0,8,3)	(6,8,3)	6	3.05	1.55
6	(14,4,3)	(20,4,3)	6	3.05	1.55
1	(0,0,3)	(6,0,3)	6	3.05	1.55

#### Design Limit state:

Combo: 1\*Dead + 1\*Live

$M_d = 3.05$  t.m

Vd: 1.55 ton

### Service Limit State

Combo: LIVE

Span: 6 m

Load: -0.27 t/m'

### Design Checks

#### 1-Check Local Buckling

$d_w/t_w = 31.06 < 81.98 \Rightarrow$  Compact Web

$c/t_f = 4.66 < 10.91 \Rightarrow$  Compact Flange

#### 2-Check Lateral Torsional Buckling

$L_{uact} = 0 \text{ m} < L_{umax} = 142.01 \text{ m} \Rightarrow$  Supported (No LTB)

#### 3-Check Bending Stress

Section: IPE270

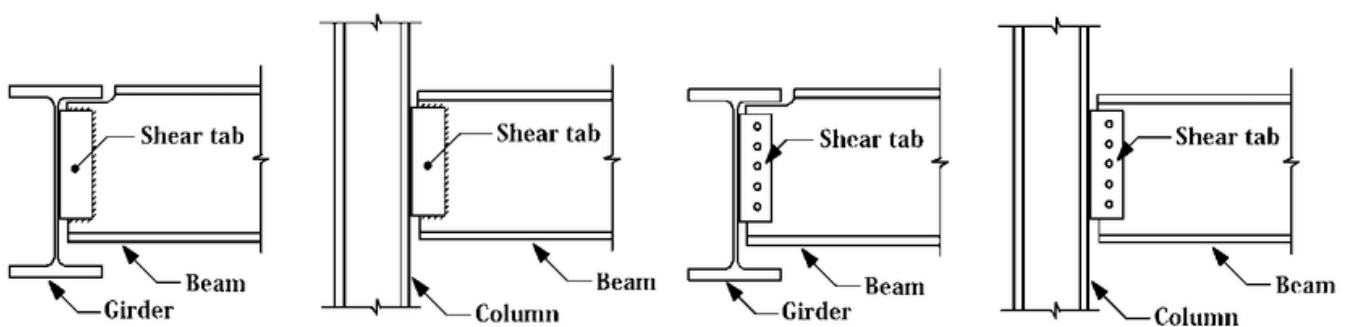
$f_{act} = 1.21 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

#### 4-Check Shear Stress

$q_{act} = 0.12 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

#### 5-Check Deflection

$d_{act} = 0.77 \text{ cm} < d_{all} = 2 \text{ cm}$



### Group Connection Design (Simple Shear Plate Connection)

#### 1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 1.55 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)

$f = 0.11 \text{ t/cm}^2$  &  $q = 0.07 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.16 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

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

$q = 0.07 \text{ t/cm}^2$  &  $q_{mt} = 0.11 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.13 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

## 4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.13 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK}$

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
4	(0,4,3)	(6,4,3)	6	5.94	3
8	(6,8,3)	(14,8,3)	8	6.07	2.31
2	(6,0,3)	(14,0,3)	8	6.07	2.31

## Design Limit state:

Combo: 1\*Dead + 1\*Live

Md: 6.07 t.m

Vd: 2.31 ton

## Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.3 t/m'

## Design Checks

### 1-Check Local Buckling

$d_w/t_w = 34.73 < 81.98 \Rightarrow \text{Compact Web}$

$c/t_f = 5.3 < 10.91 \Rightarrow \text{Compact Flange}$

### 2-Check Lateral Torsional Buckling

$L_{uact} = 0 \text{ m} < L_{umax} = 174.28 \text{ m} \Rightarrow \text{Supported (No LTB)}$

### 3-Check Bending Stress

Section: IPE270

$f_{act} = 1.41 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

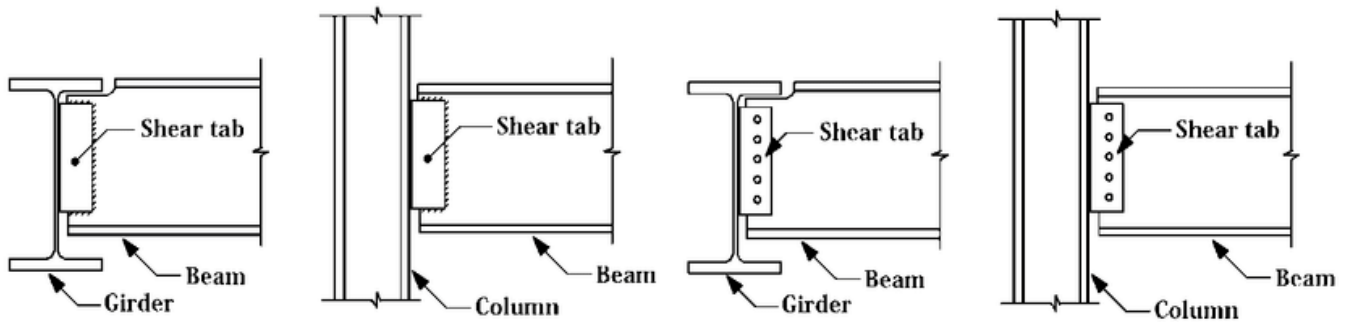


#### 4-Check Shear Stress

$$q_{act} = 0.13 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$$

#### 5-Check Deflection

$$\delta_{act} = 1.32 \text{ cm} < \delta_{all} = 2.67 \text{ cm}$$



### Group Connection Design (Simple Shear Plate Connection)

#### 1-Bolts Design

Bolts: M20 of Grade 8.8

$$V_d = 2.31 \text{ ton}$$

$$R_{least} = 2.85 \text{ ton}$$

$$N = 3 \text{ with Pitch} = 63 \text{ mm \& Full Layout: (31;63 63 31.5)}$$

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

$$f = 0.16 \text{ t/cm}^2 \text{ \& } q = 0.11 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.24 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$$

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

$$q = 0.11 \text{ t/cm}^2 \text{ \& } q_{mt} = 0.16 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.19 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$$

#### 4-Check Thickness of Plate

$$f = (6 * V_d * e) / (t_p * L^2) = 0.19 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK}$$

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

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
5	(6,4,3)	(14,4,3)	8	11.85	4.48

#### Design Limit state:

Combo: 1\*Dead + 1\*Live

$$M_d = 11.85 \text{ t.m}$$

Vd: 4.48 ton

### Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.6 t/m'

### Design Checks

#### 1-Check Local Buckling

$dw/tw = 38.65 < 81.98 \Rightarrow$  Compact Web

$c/tf = 5.38 < 10.91 \Rightarrow$  Compact Flange

#### 2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 219.47 \text{ m} \Rightarrow$  Supported (No LTB)

#### 3-Check Bending Stress

Section: IPE360

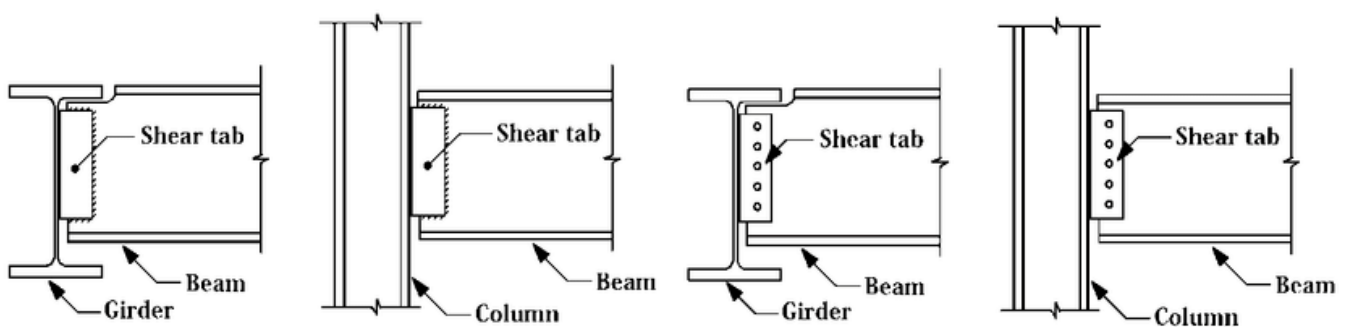
$f_{act} = 1.31 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

#### 4-Check Shear Stress

$q_{act} = 0.16 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

#### 5-Check Deflection

$\delta_{act} = 0.94 \text{ cm} < \delta_{all} = 2.67 \text{ cm}$



### Group Connection Design (Simple Shear Plate Connection)

#### 1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 4.48 ton

Rleast= 3.46 ton

N= 3 with Pitch= 84 mm & Full Layout: (42;84 84 42)

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

$f = 0.18 \text{ t/cm}^2$  &  $q = 0.15 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.31 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

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

$q = 0.15 \text{ t/cm}^2$  &  $q_{mt} = 0.18 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.23 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

## 4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.21 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow \text{OK}$

Plate Layout  $\Rightarrow L = 252 \text{ mm}$  &  $t_p = 10 \text{ mm}$  &  $S_w = 6 \text{ mm}$

# Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
37	(6,4,0)	(6,4,3)	3	-10.49
38	(14,4,0)	(14,4,3)	3	-9.05
33	(6,0,0)	(6,0,3)	3	-5.44
41	(6,8,0)	(6,8,3)	3	-5.44
42	(14,8,0)	(14,8,3)	3	-5.44
36	(0,4,0)	(0,4,3)	3	-4.61
34	(14,0,0)	(14,0,3)	3	-3.88
32	(0,0,0)	(0,0,3)	3	-2.42
39	(20,4,0)	(20,4,3)	3	-2.42
40	(0,8,0)	(0,8,3)	3	-2.42
43	(20,8,0)	(20,8,3)	3	-2.42

## Design Limit state:

Combo: 1\*Dead + 1\*Live

Nd: -10.49 ton

## 1-Check Local Buckling

$d_w/t_w = 36.23 < 37.44 \Rightarrow \text{Compact Web}$

$c/t_f = 5.68 < 10.91 \Rightarrow \text{Compact Flange}$

## 2-Check Normal Stress

Section: IPE300

$$\lambda = 89.55 < 100$$

$$f_c = 0.2 \text{ t/cm}^2 < F_c = 0.88 \text{ t/cm}^2$$

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