

Design Calculation Sheet for columns

Designer:

Location:

City:

Country:

Date: 2020-06-22 06:39:19

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Secondary Beams

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
1	(0,0,3)	(0,5,3)	5	0.89	0.71
2	(0,5,3)	(0,10,3)	5	0.89	0.71
3	(0,10,3)	(0,15,3)	5	0.89	0.71
35	(20,5,3)	(20,10,3)	5	1.16	0.93
36	(20,10,3)	(20,15,3)	5	1.16	0.93
34	(20,0,3)	(20,5,3)	5	1.16	0.93

Design Limit state:

Combo: 1*Dead + 1*Live

Md: 1.16 t.m

Vd: 0.93 ton

Service Limit State

Combo: LIVE

Span: 5 m

Load: -0.15 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 23.92 < 81.98 \Rightarrow$ Compact Web

$c/tf = 3.95 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 94.24 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE270

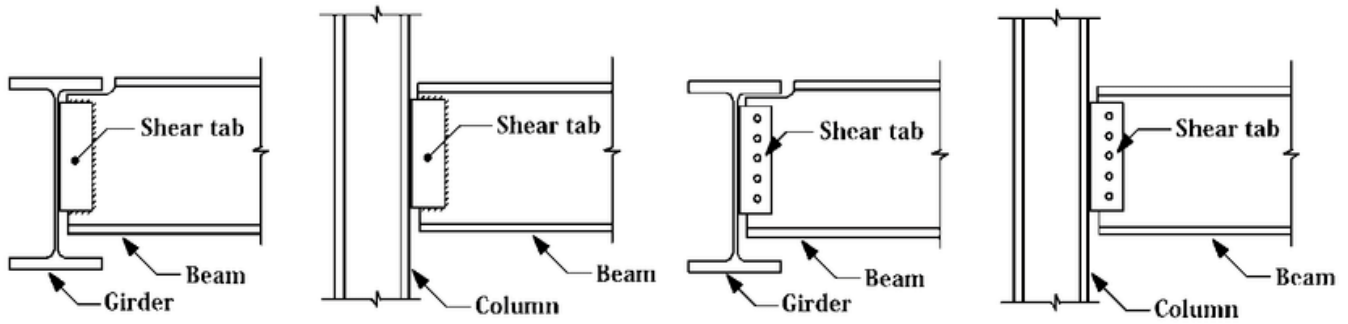
$f_{act} = 1.51 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

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

5-Check Deflection

$d_{act} = 1.07 \text{ cm} < d_{all} = 1.67 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 0.93$ 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)

$f = 0.07$ t/cm² & $q = 0.04$ t/cm² $\Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.1$ t/cm² $< 1.1 * 0.2F_u = 0.79$ t/cm² \Rightarrow OK

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

$q = 0.04$ t/cm² & $q_{mt} = 0.07$ t/cm² $\Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.08$ t/cm² $< 0.2F_u = 0.72$ t/cm² \Rightarrow OK

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.08$ 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)
4	(1.5,0,3)	(1.5,5,3)	5	1.71	1.37
5	(1.5,5,3)	(1.5,10,3)	5	1.71	1.37
6	(1.5,10,3)	(1.5,15,3)	5	1.71	1.37
7	(3,0,3)	(3,5,3)	5	1.71	1.37
8	(3,5,3)	(3,10,3)	5	1.71	1.37
9	(3,10,3)	(3,15,3)	5	1.71	1.37
10	(4.5,0,3)	(4.5,5,3)	5	1.71	1.37
11	(4.5,5,3)	(4.5,10,3)	5	1.71	1.37
12	(4.5,10,3)	(4.5,15,3)	5	1.71	1.37

15	(6,10,3)	(6,15,3)	5	1.99	1.59
13	(6,0,3)	(6,5,3)	5	1.99	1.59
14	(6,5,3)	(6,10,3)	5	1.99	1.59
31	(18,0,3)	(18,5,3)	5	2.26	1.81
33	(18,10,3)	(18,15,3)	5	2.26	1.81
16	(8,0,3)	(8,5,3)	5	2.26	1.81
30	(16,10,3)	(16,15,3)	5	2.26	1.81
17	(8,5,3)	(8,10,3)	5	2.26	1.81
32	(18,5,3)	(18,10,3)	5	2.26	1.81
19	(10,0,3)	(10,5,3)	5	2.26	1.81
20	(10,5,3)	(10,10,3)	5	2.26	1.81
21	(10,10,3)	(10,15,3)	5	2.26	1.81
22	(12,0,3)	(12,5,3)	5	2.26	1.81
23	(12,5,3)	(12,10,3)	5	2.26	1.81
24	(12,10,3)	(12,15,3)	5	2.26	1.81
25	(14,0,3)	(14,5,3)	5	2.26	1.81
26	(14,5,3)	(14,10,3)	5	2.26	1.81
27	(14,10,3)	(14,15,3)	5	2.26	1.81
28	(16,0,3)	(16,5,3)	5	2.26	1.81
29	(16,5,3)	(16,10,3)	5	2.26	1.81
18	(8,10,3)	(8,15,3)	5	2.26	1.81

Design Limit state:

Combo: 1*Dead + 1*Live

Md: 2.26 t.m

Vd: 1.81 ton

Service Limit State

Combo: LIVE

Span: 5 m

Load: -0.3 t/m'

Design Checks

1-Check Local Buckling

$dw/tw = 29.65 < 81.98 \Rightarrow$ Compact Web

$c/tf = 4.56 < 10.91 \Rightarrow$ Compact Flange

2-Check Lateral Torsional Buckling

$Lu_{act} = 0 \text{ m} < Lu_{max} = 129.1 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE270

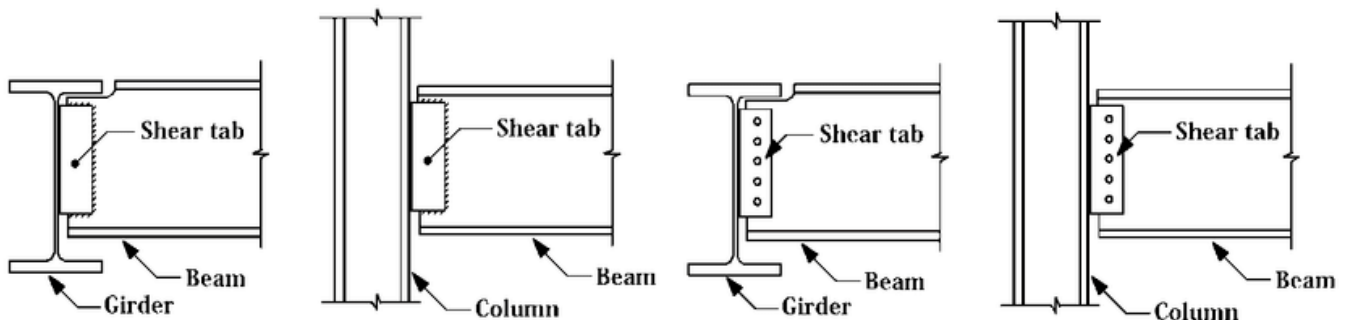
$f_{act} = 1.16 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

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

5-Check Deflection

$d_{act} = 0.6 \text{ cm} < d_{all} = 1.67 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 1.81 \text{ ton}$

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

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

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

$f = 0.13 \text{ t/cm}^2$ & $q = 0.08 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.19 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow$ OK

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

$q = 0.08 \text{ t/cm}^2$ & $q_{mt} = 0.13 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.15 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow$ OK

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.15 \text{ t/cm}^2 < 0.72 * F_y = 1.73 \text{ t/cm}^2 \Rightarrow$ 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)
12	(14,15,3)	(20,15,3)	6	3.77	1.91
3	(14,0,3)	(20,0,3)	6	3.77	1.91
10	(0,15,3)	(6,15,3)	6	4.27	2.16
1	(0,0,3)	(6,0,3)	6	4.27	2.16

Design Limit state:

Combo: 1*Dead + 1*Live

Md: 4.27 t.m

Vd: 2.16 ton

Service Limit State

Combo: LIVE

Span: 6 m

Load: -0.33 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

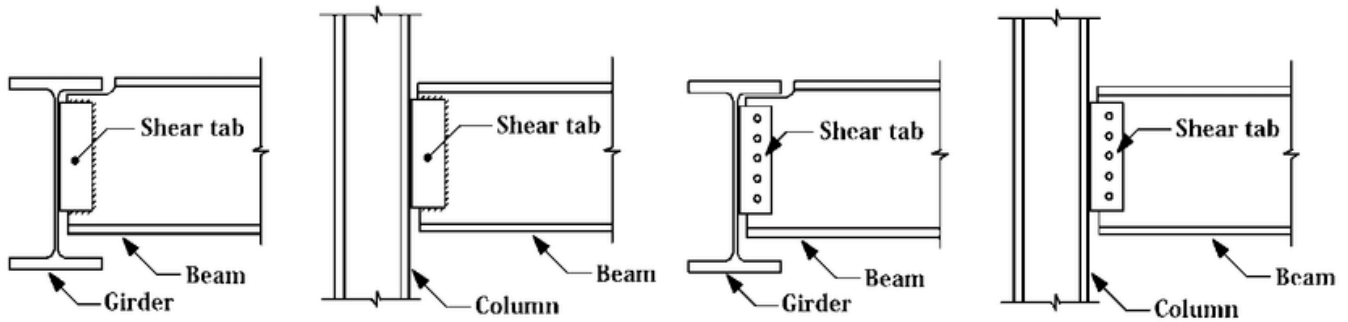
$f_{act} = 1.32 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.15 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$d_{act} = 0.69 \text{ cm} < d_{all} = 2 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$V_d = 2.16$ 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)

$f = 0.15$ t/cm² & $q = 0.1$ t/cm² $\Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.23$ t/cm² $< 1.1 * 0.2F_u = 0.79$ t/cm² \Rightarrow OK

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

$q = 0.1$ t/cm² & $q_{mt} = 0.15$ t/cm² $\Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.18$ t/cm² $< 0.2F_u = 0.72$ t/cm² \Rightarrow OK

4-Check Thickness of Plate

$f = (6 * V_d * e) / (t_p * L^2) = 0.18$ 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)
9	(14,10,3)	(20,10,3)	6	7.39	3.72
6	(14,5,3)	(20,5,3)	6	7.39	3.72
11	(6,15,3)	(14,15,3)	8	7.51	2.85
2	(6,0,3)	(14,0,3)	8	7.51	2.85
7	(0,10,3)	(6,10,3)	6	8.37	4.21
4	(0,5,3)	(6,5,3)	6	8.37	4.21

Design Limit state:

Combo: 1*Dead + 1*Live

Md: 8.37 t.m

Vd: 4.21 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.38 t/m'

Design Checks

1-Check Local Buckling

$d_w/t_w = 36.23 < 81.98 \Rightarrow$ Compact Web

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

2-Check Lateral Torsional Buckling

$L_{uact} = 0 \text{ m} < L_{umax} = 193.65 \text{ m} \Rightarrow$ Supported (No LTB)

3-Check Bending Stress

Section: IPE300

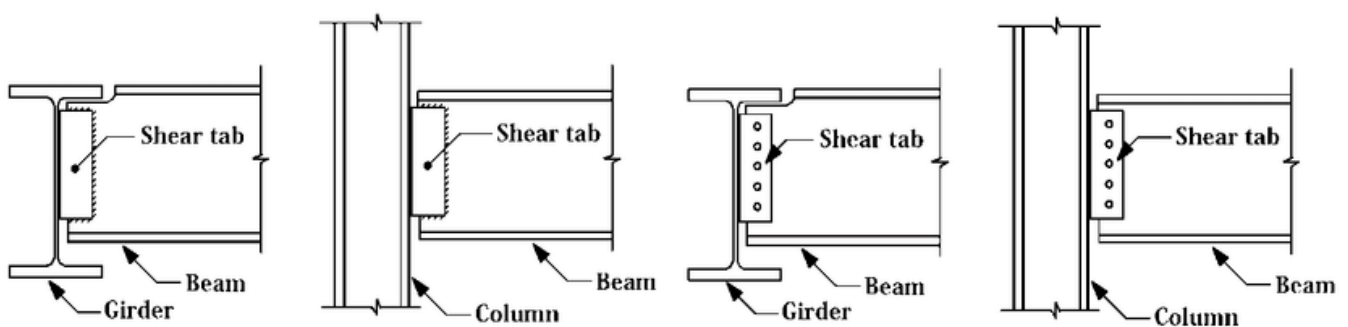
$f_{act} = 1.5 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

$q_{act} = 0.2 \text{ t/cm}^2 < q_{all} = 0.84 \text{ t/cm}^2$

5-Check Deflection

$\delta_{act} = 1.14 \text{ cm} < \delta_{all} = 2.67 \text{ cm}$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

Vd= 4.21 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)

$f = 0.24 \text{ t/cm}^2$ & $q = 0.17 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.38 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$

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

$q = 0.17 \text{ t/cm}^2$ & $q_{mt} = 0.24 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.29 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$

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 $\Rightarrow L = 210 \text{ mm}$ & $t_p = 10 \text{ mm}$ & $S_w = 6 \text{ mm}$

Beam ID	Start Point	End Point	Span (m)	Mmax (t.m)	Vmax (ton)
8	(6,10,3)	(14,10,3)	8	14.74	5.56
5	(6,5,3)	(14,5,3)	8	14.74	5.56

Design Limit state:

Combo: 1*Dead + 1*Live

Md: 14.74 t.m

Vd: 5.56 ton

Service Limit State

Combo: LIVE

Span: 8 m

Load: -0.75 t/m'

Design Checks

1-Check Local Buckling

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

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

2-Check Lateral Torsional Buckling

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

3-Check Bending Stress

Section: IPE400

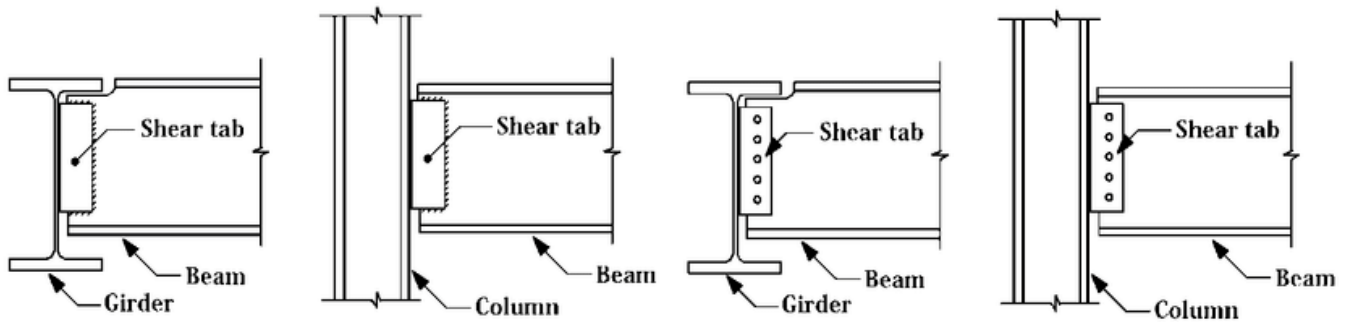
$f_{act} = 1.27 \text{ t/cm}^2 < F_b = 1.54 \text{ t/cm}^2$

4-Check Shear Stress

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

5-Check Deflection

$$\delta_{act} = 0.82 \text{ cm} < \delta_{all} = 2.67 \text{ cm}$$



Group Connection Design (Simple Shear Plate Connection)

1-Bolts Design

Bolts: M20 of Grade 8.8

$$V_d = 5.56 \text{ ton}$$

$$R_{least} = 3.72 \text{ ton}$$

$$N = 3 \text{ with Pitch} = 93 \text{ mm \& Full Layout: (46;93 93 47.5)}$$

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

$$f = 0.18 \text{ t/cm}^2 \text{ \& } q = 0.17 \text{ t/cm}^2 \Rightarrow f_{eq} = (f^2 + 3q^2)^{0.5} = 0.34 \text{ t/cm}^2 < 1.1 * 0.2F_u = 0.79 \text{ t/cm}^2 \Rightarrow \text{OK}$$

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

$$q = 0.17 \text{ t/cm}^2 \text{ \& } q_{mt} = 0.18 \text{ t/cm}^2 \Rightarrow q_{res} = (q^2 + q_{mt}^2)^{0.5} = 0.24 \text{ t/cm}^2 < 0.2F_u = 0.72 \text{ t/cm}^2 \Rightarrow \text{OK}$$

4-Check Thickness of Plate

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

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

Columns

Column ID	Start Point	End Point	Height (m)	Nmax (ton)
6	(6,5,0)	(6,5,3)	3	-13.08
10	(6,10,0)	(6,10,3)	3	-13.08
7	(14,5,0)	(14,5,3)	3	-13.02
11	(14,10,0)	(14,10,3)	3	-13.02

2	(6,0,0)	(6,0,3)	3	-6.73
14	(6,15,0)	(6,15,3)	3	-6.73
3	(14,0,0)	(14,0,3)	3	-6.7
15	(14,15,0)	(14,15,3)	3	-6.7
5	(0,5,0)	(0,5,3)	3	-5.76
9	(0,10,0)	(0,10,3)	3	-5.76
8	(20,5,0)	(20,5,3)	3	-5.71
12	(20,10,0)	(20,10,3)	3	-5.71
1	(0,0,0)	(0,0,3)	3	-3
13	(0,15,0)	(0,15,3)	3	-3
4	(20,0,0)	(20,0,3)	3	-2.97
16	(20,15,0)	(20,15,3)	3	-2.97

Design Limit state:

Combo: 1*Dead + 1*Live

Nd: -13.08 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

$\lambda = 89.55 < 100$

$f_c = 0.24 \text{ t/cm}^2 < F_c = 0.88 \text{ t/cm}^2$
