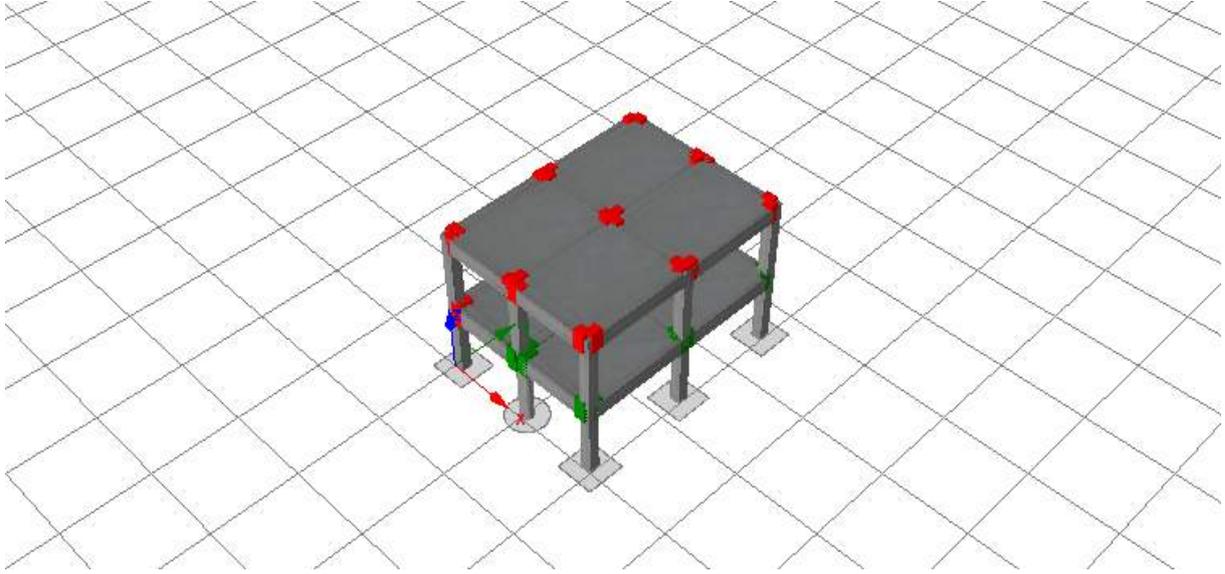
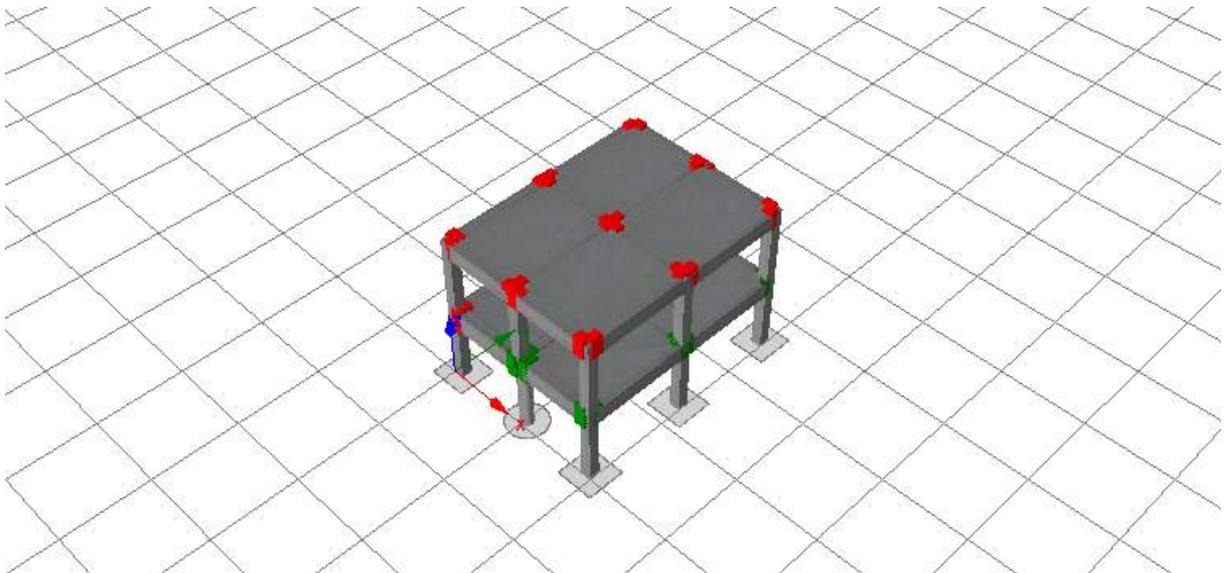


## Overall Critical Joint Checks

Shear Capacity - Life Safety

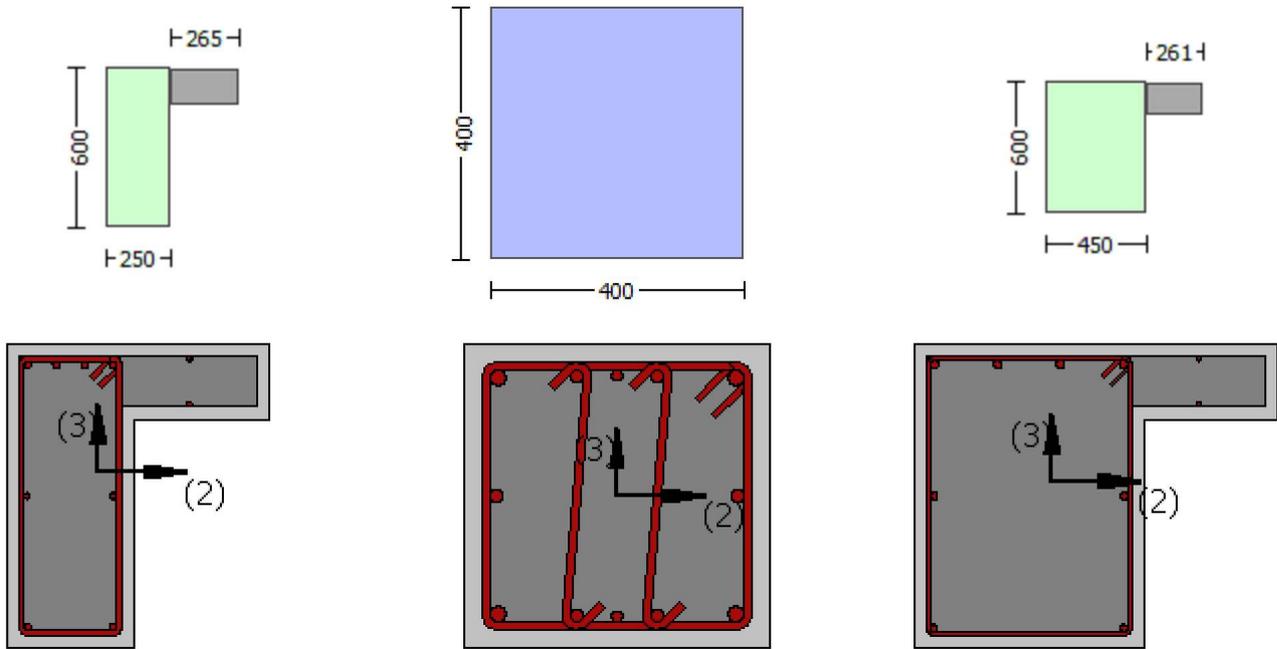


Shear Capacity - Collapse Prevention



# Beam - Column Joints Checks

Col. C4 - Beam B8 - Beam B7, Floor : 1



Classification : Interior Joint With Transverse Beams

## Geometrical and Material Properties

### ColumnC4 - Beam B8

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

### ColumnC4 - Beam B7

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.180000	16000.00	0.000804	0.000308	500000.00

## Joint Forces - Critical Analyses

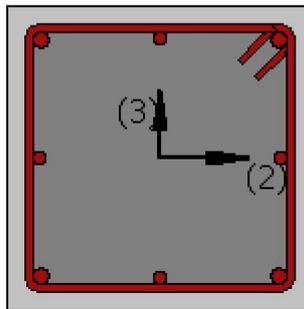
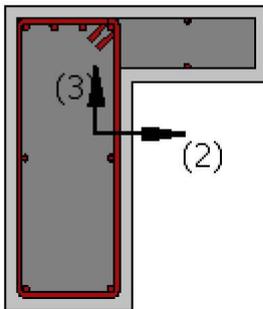
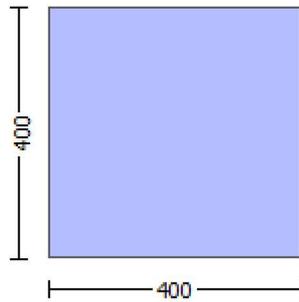
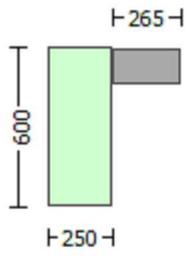
Limit State	Critical Analysis	VC (kN)	Vj (kN)
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3-C	Uniform +X	0.32	694.758
5-D	Uniform +X	0.11	694.969

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	694.76	498.23	1.394	Fail
5-D	Uniform +X	694.97	498.23	1.395	Fail

**Col. C7 - Beam B8, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC7 - Beam B8**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

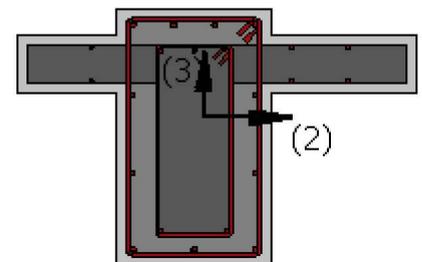
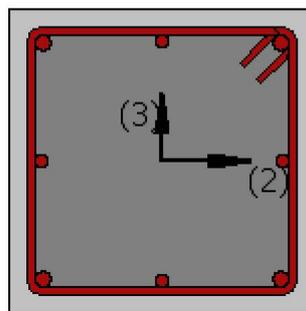
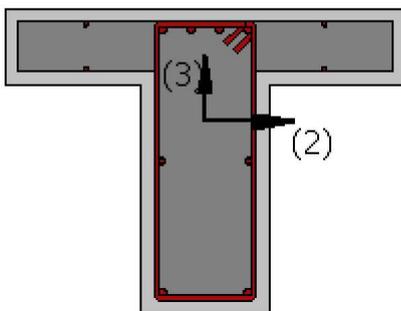
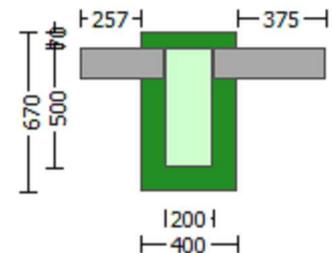
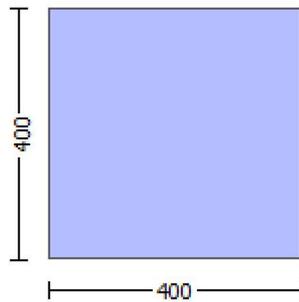
### Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	2.93	304.951
5-D	Uniform +X	3.39	304.488

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	304.95	373.67	0.816	Ok
5-D	Uniform +X	304.49	373.67	0.815	Ok

**Col. C5 - Beam B10 - Beam B9, Floor : 1**



**Classification : Interior Joint With Transverse Beams**

Geometrical and Material Properties

### ColumnC5 - Beam B10

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

### ColumnC5 - Beam B9

Aj (m2)	fc (KPa)	As1 (Jacket) (m2)	As2 (Jacket) (m2)	fy (Jacket) (kPa)	As1 (Core) (m2)	As2 (Core) (m2)	fy (Core) (KPa)
0.160000	16000.00	0.000616	0.000462	500000.00	0.000000	0.000000	400000.00

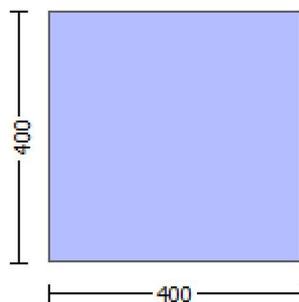
### Joint Forces - Critical Analyses

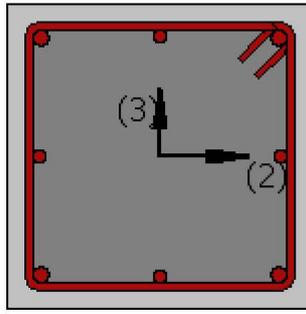
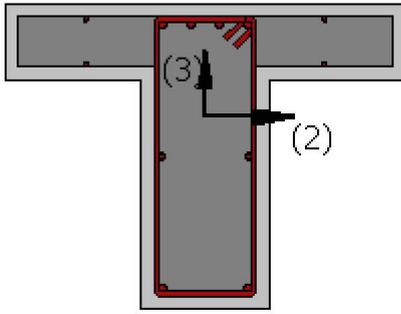
Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	0.07	956.155
5-D	Uniform +X	0.14	956.084

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	956.15	498.23	1.919	Fail
5-D	Uniform +X	956.08	498.23	1.919	Fail

### Col. C8 - Beam B10, Floor : 1





**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC8 - Beam B10**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

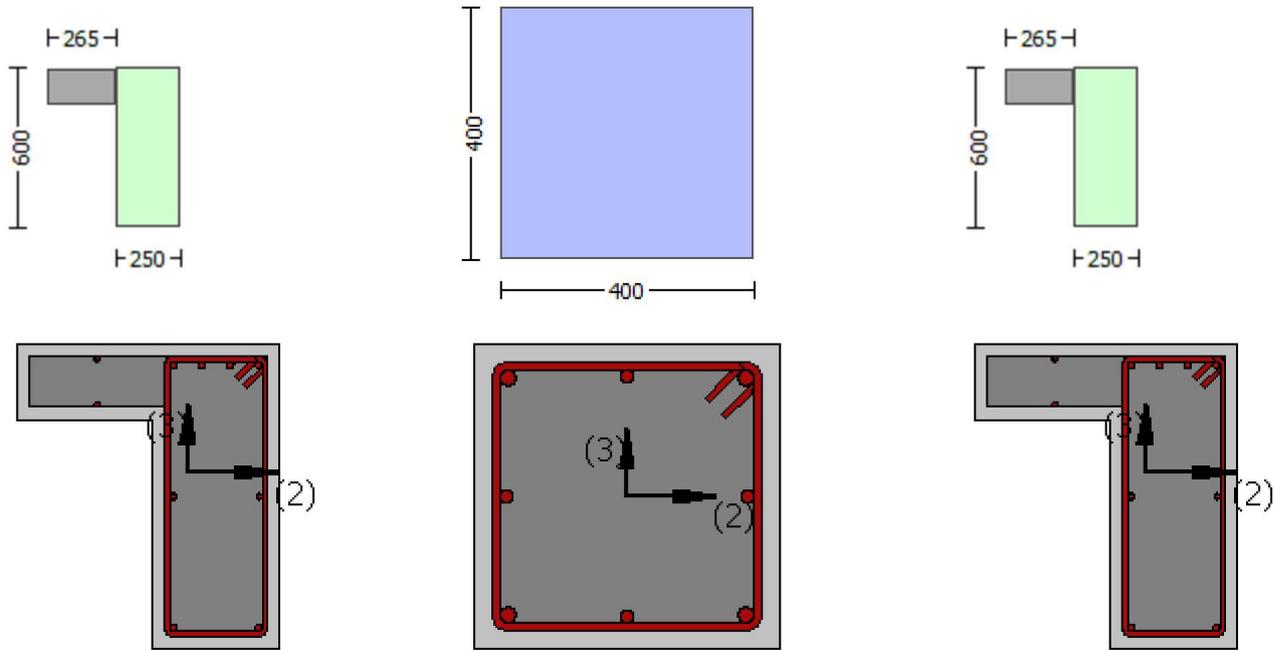
Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	1.39	306.483
5-D	Uniform +X	1.40	306.472

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	306.48	373.67	0.820	Ok
5-D	Uniform +X	306.47	373.67	0.820	Ok

**Col. C6 - Beam B12 - Beam B11, Floor : 1**



**Classification : Interior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC6 - Beam B12**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

**ColumnC6 - Beam B11**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

Joint Forces - Critical Analyses

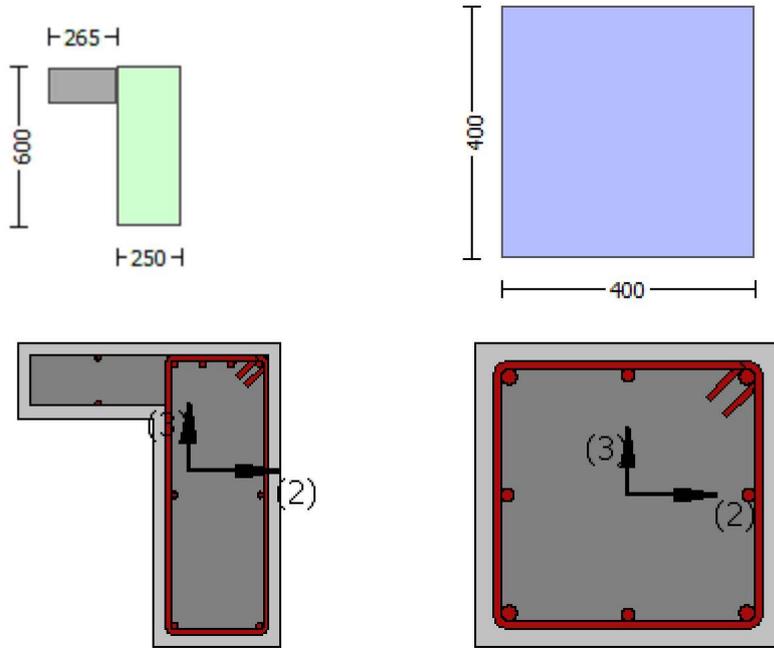
Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	0.68	461.130
5-D	Uniform +X	0.55	461.259

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
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3-C	Uniform +X	461.13	498.23	0.926	Ok
5-D	Uniform +X	461.26	498.23	0.926	Ok

**Col. C9 - Beam B12, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC9 - Beam B12**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

Joint Forces - Critical Analyses

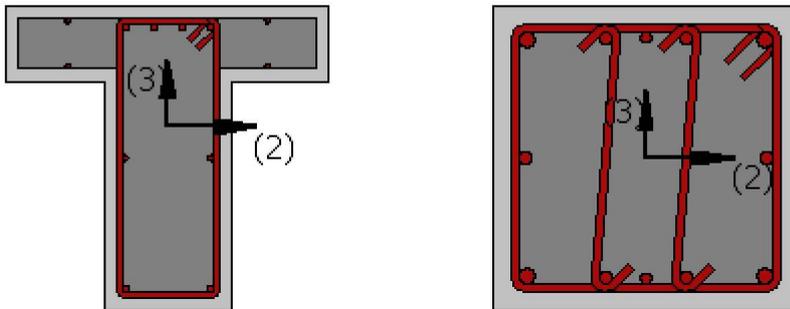
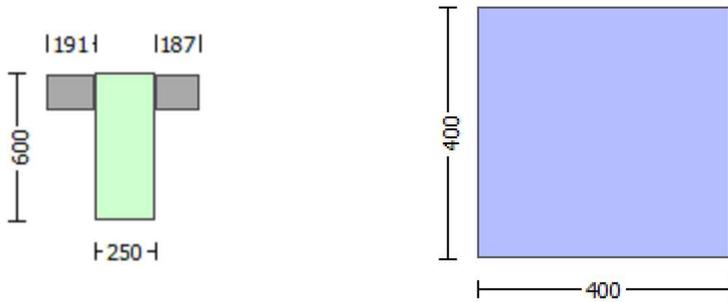
Limit State	Critical Analysis	VC (kN)	Vj (kN)
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3-C	Uniform +X	1.57	306.305
5-D	Uniform +X	1.64	306.231

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	306.30	373.67	0.820	Ok
5-D	Uniform +X	306.23	373.67	0.820	Ok

**Col. C4 - Beam B3, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC4 - Beam B3**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

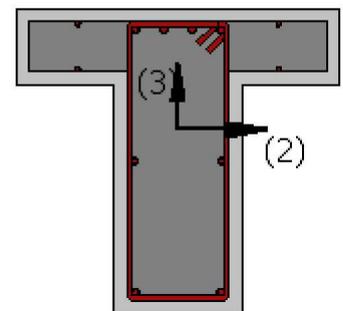
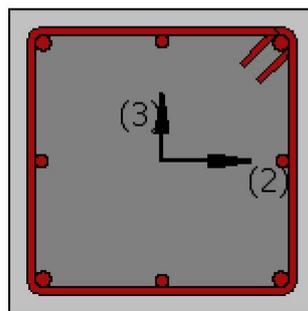
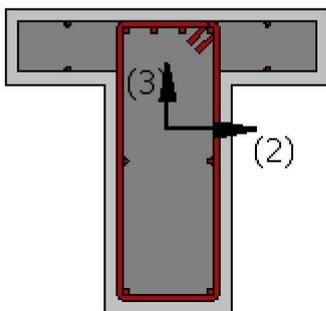
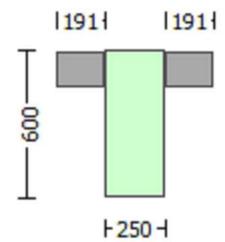
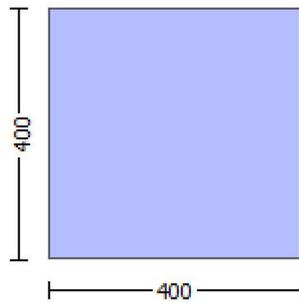
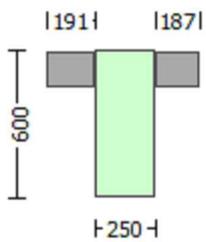
### Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	12.05	295.831
5-D	Uniform +X	16.13	291.745

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	295.83	373.67	0.792	Ok
5-D	Uniform +X	291.75	373.67	0.781	Ok

### Col. C5 - Beam B3 - Beam B4, Floor : 1



**Classification : Interior Joint With Transverse Beams**

### Geometrical and Material Properties

### ColumnC5 - Beam B3

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

### ColumnC5 - Beam B4

Aj (m2)	fc (KPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

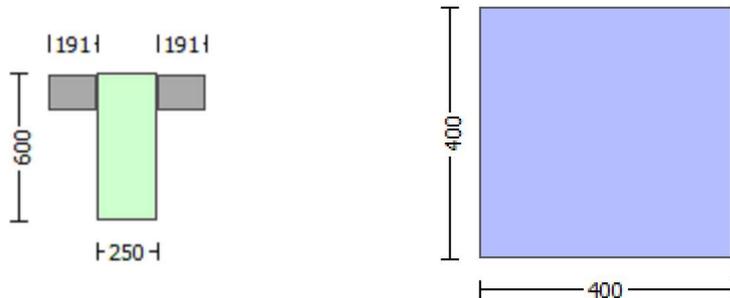
### Joint Forces - Critical Analyses

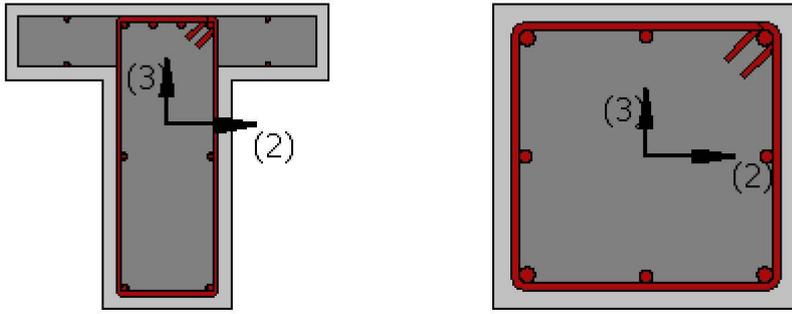
Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	19.14	442.670
5-D	Uniform +X	22.24	439.571

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	442.67	498.23	0.888	Ok
5-D	Uniform +X	439.57	498.23	0.882	Ok

### Col. C6 - Beam B4, Floor : 1





**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC6 - Beam B4**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

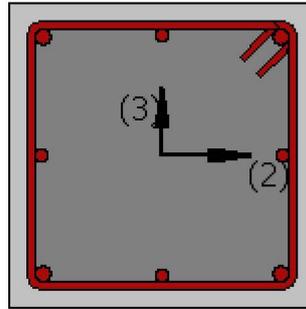
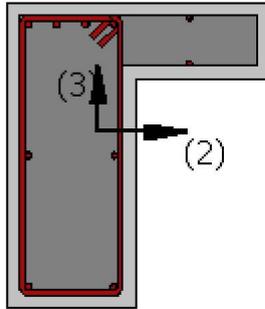
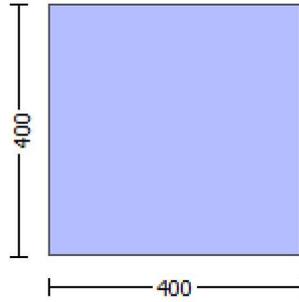
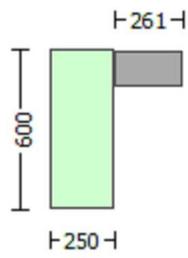
Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	18.42	289.461
5-D	Uniform +X	21.45	286.426

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	289.46	373.67	0.775	Ok
5-D	Uniform +X	286.43	373.67	0.767	Ok

**Col. C7 - Beam B5, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC7 - Beam B5**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

Joint Forces - Critical Analyses

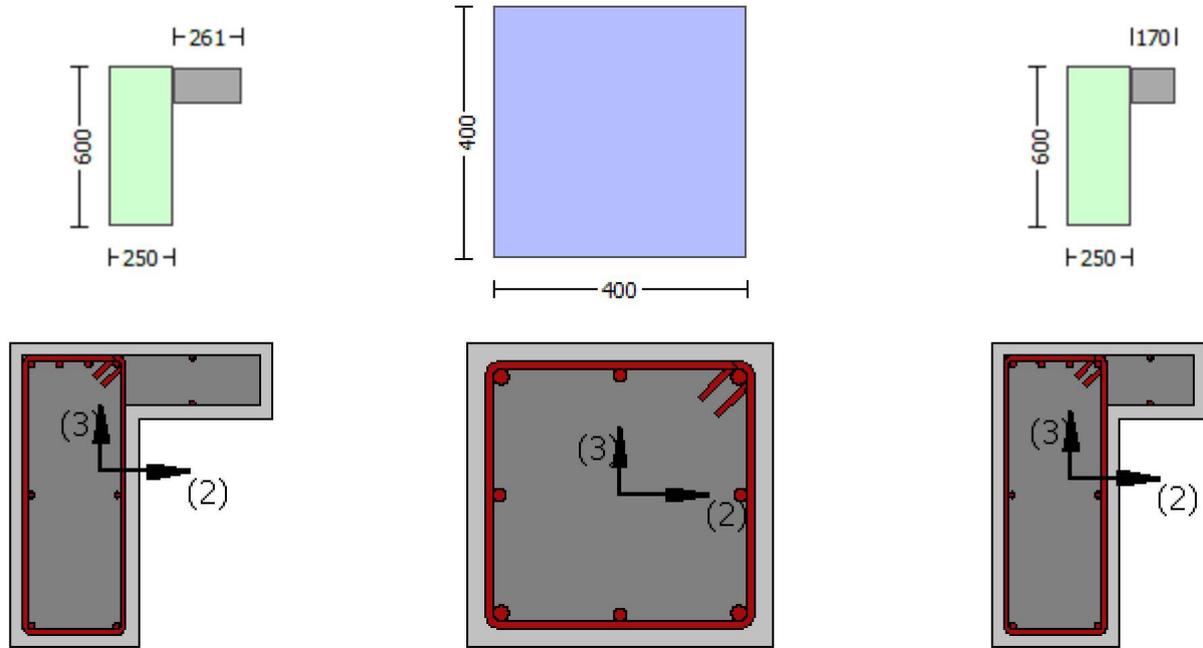
Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	9.87	298.004
5-D	Uniform +X	12.38	295.496

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
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3-C	Uniform +X	298.00	373.67	0.798	Ok
5-D	Uniform +X	295.50	373.67	0.791	Ok

**Col. C8 - Beam B5 - Beam B6, Floor : 1**



**Classification : Interior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC8 - Beam B5**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

**ColumnC8 - Beam B6**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

Joint Forces - Critical Analyses

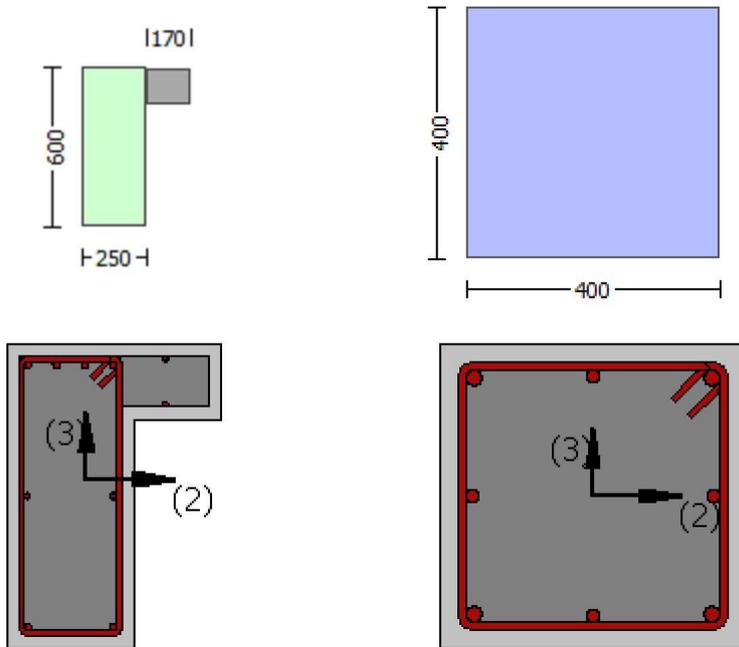
Limit State	Critical Analysis	VC (kN)	Vj (kN)
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3-C	Uniform +X	17.17	444.644
5-D	Uniform +X	20.52	441.298

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	444.64	498.23	0.892	Ok
5-D	Uniform +X	441.30	498.23	0.886	Ok

**Col. C9 - Beam B6, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC9 - Beam B6**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

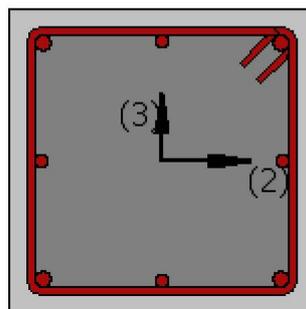
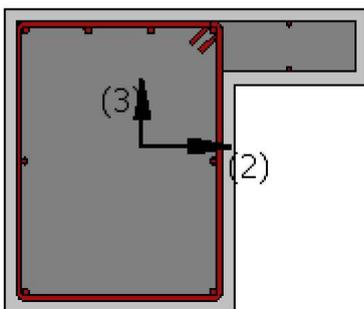
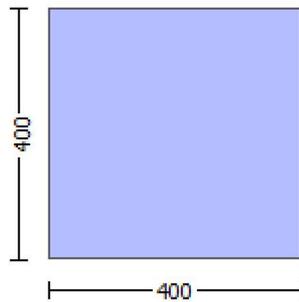
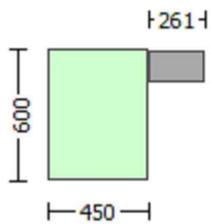
### Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	16.78	291.098
5-D	Uniform +X	19.72	288.153

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	291.10	373.67	0.779	Ok
5-D	Uniform +X	288.15	373.67	0.771	Ok

### Col. C1 - Beam B7, Floor : 1



**Classification : Exterior Joint With Transverse Beams**

### Geometrical and Material Properties

### ColumnC1 - Beam B7

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.180000	16000.00	0.000616	0.000308	500000.00

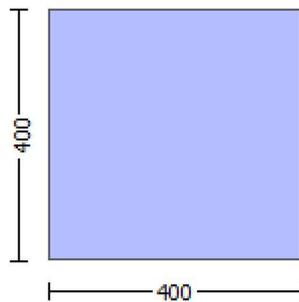
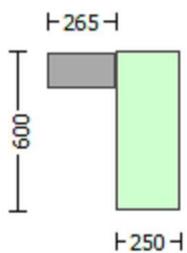
### Joint Forces - Critical Analyses

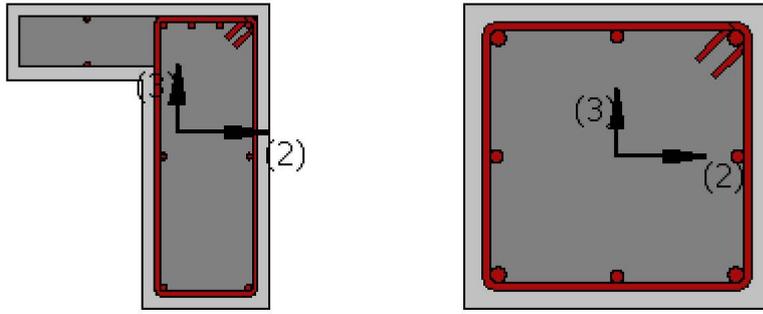
Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	1.28	383.568
5-D	Uniform +X	1.80	383.044

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	383.57	523.14	0.733	Ok
5-D	Uniform +X	383.04	523.14	0.732	Ok

### Col. C3 - Beam B11, Floor : 1





**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC3 - Beam B11**

Aj (m2)	fc (kPa)	As1 (m2)	As2 (m2)	fy (kPa)
0.160000	16000.00	0.000616	0.000308	400000.00

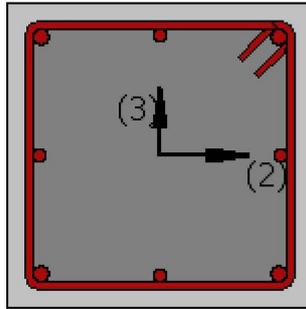
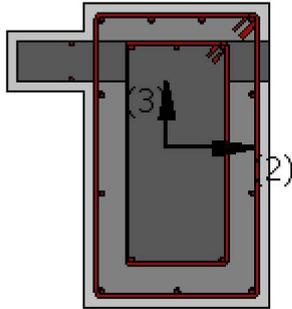
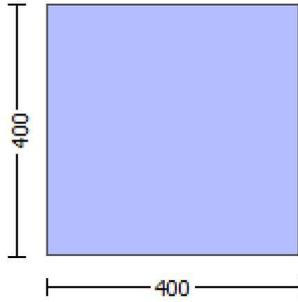
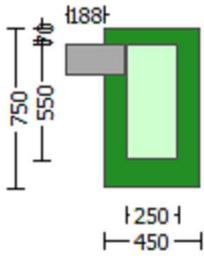
Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	2.86	305.017
5-D	Uniform +X	2.72	305.154

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	305.02	373.67	0.816	Ok
5-D	Uniform +X	305.15	373.67	0.817	Ok

**Col. C1 - Beam B1, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC1 - Beam B1**

Aj (m <sup>2</sup> )	fc (kPa)	As1 (Jacket) (m <sup>2</sup> )	As2 (Jacket) (m <sup>2</sup> )	fy (Jacket) (kPa)	As1 (Core) (m <sup>2</sup> )	As2 (Core) (m <sup>2</sup> )	fy (Core) (kPa)
0.180000	16000.00	0.000616	0.000462	500000.00	0.000339	0.000226	400000.00

Joint Forces - Critical Analyses

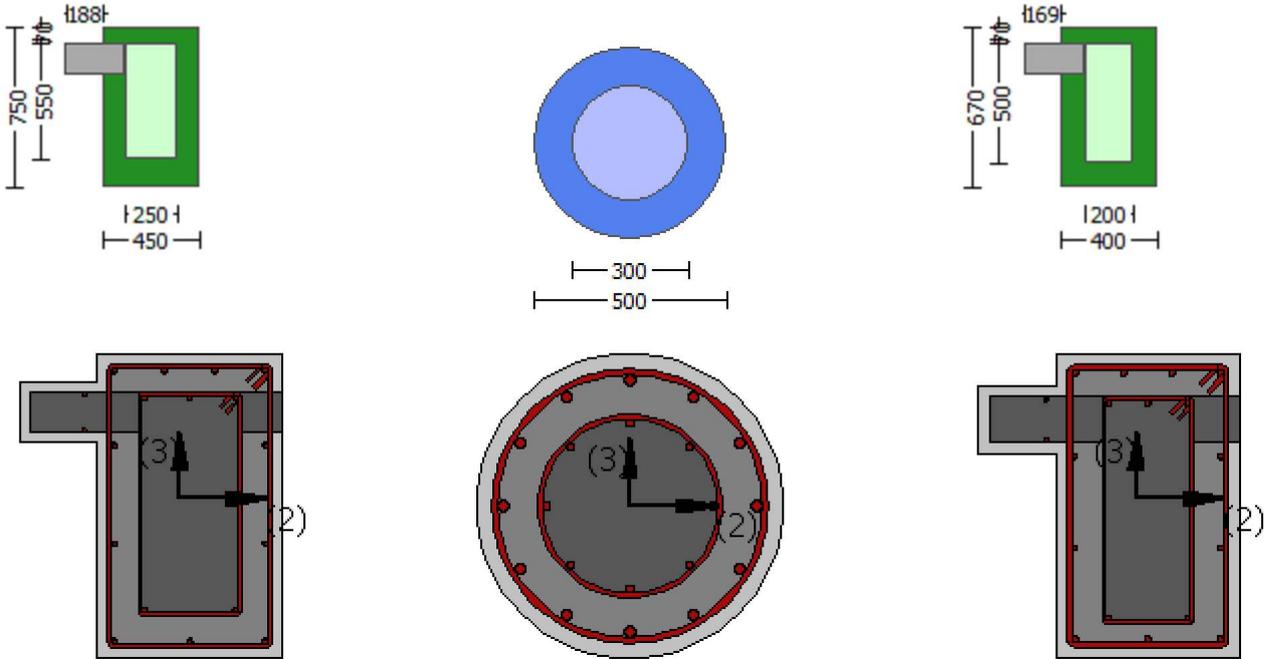
Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	15.31	539.183
5-D	Uniform +X	18.14	536.349

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
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3-C	Uniform +X	539.18	523.14	1.031	Fail
5-D	Uniform +X	536.35	523.14	1.025	Fail

**Col. C2 - Beam B1 - Beam B2, Floor : 1**



**Classification : Interior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC2 - Beam B1**

Aj (m2)	fc (kPa)	As1 (Jacket) (m2)	As2 (Jacket) (m2)	fy (Jacket) (kPa)	As1 (Core) (m2)	As2 (Core) (m2)	fy (Core) (kPa)
0.250000	16000.00	0.000616	0.000462	500000.00	0.000339	0.000226	400000.00

**ColumnC2 - Beam B2**

Aj (m2)	fc (kPa)	As1 (Jacket) (m2)	As2 (Jacket) (m2)	fy (Jacket) (kPa)	As1 (Core) (m2)	As2 (Core) (m2)	fy (Core) (kPa)
0.250000	16000.00	0.000616	0.000462	500000.00	0.000339	0.000226	400000.00

Joint Forces - Critical Analyses

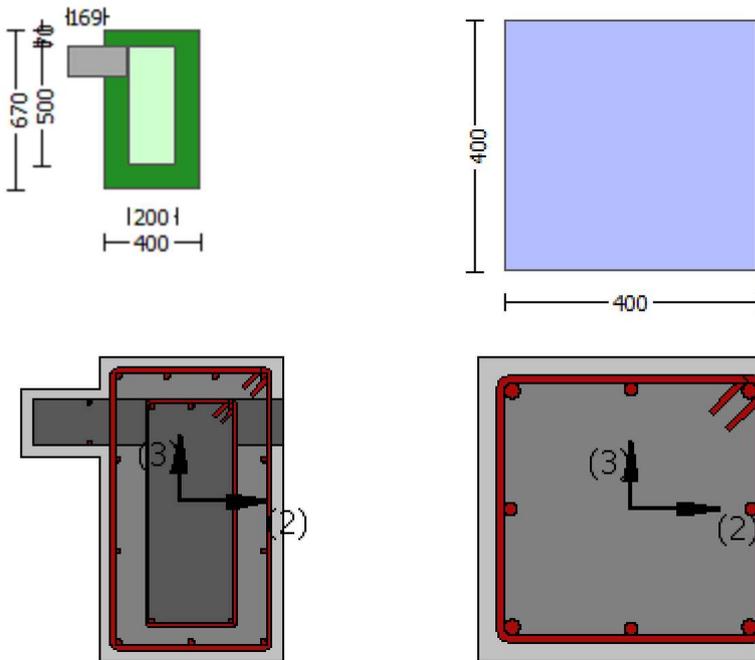
Limit State	Critical Analysis	VC (kN)	Vj (kN)
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3-C	Uniform +X	17.59	938.635
5-D	Uniform +X	20.92	935.304

Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	938.64	994.59	0.944	Ok
5-D	Uniform +X	935.30	994.59	0.940	Ok

**Col. C3 - Beam B2, Floor : 1**



**Classification : Exterior Joint With Transverse Beams**

Geometrical and Material Properties

**ColumnC3 - Beam B2**

Aj (m <sup>2</sup> )	fc (kPa)	As1 (Jacket) (m <sup>2</sup> )	As2 (Jacket) (m <sup>2</sup> )	fy (Jacket) (kPa)	As1 (Core) (m <sup>2</sup> )	As2 (Core) (m <sup>2</sup> )	fy (Core) (kPa)
0.160000	16000.00	0.000616	0.000462	500000.00	0.000339	0.000226	400000.00

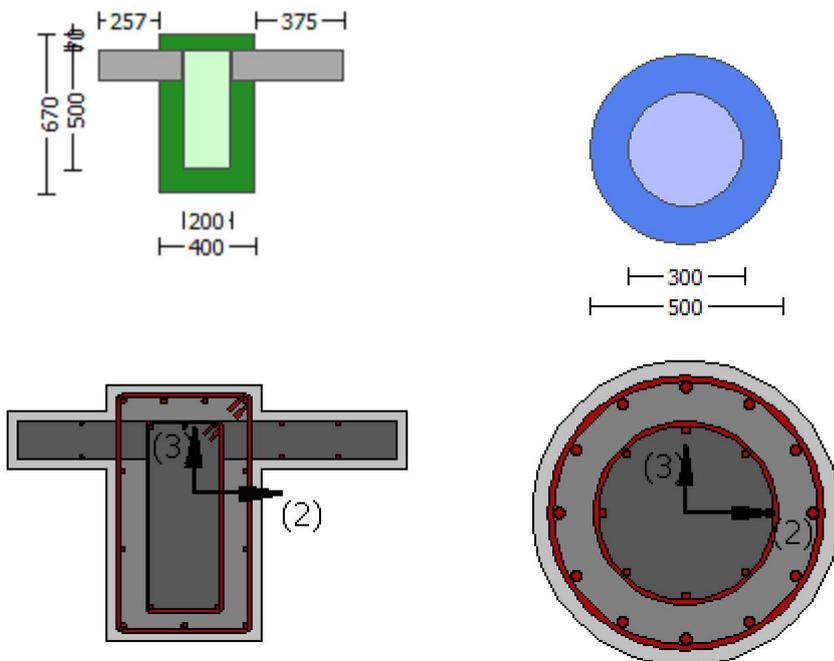
### Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	16.73	537.757
5-D	Uniform +X	19.95	534.538

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	537.76	597.82	0.900	Ok
5-D	Uniform +X	534.54	597.82	0.894	Ok

### Col. C2 - Beam B9, Floor : 1



**Classification : Exterior Joint With Transverse Beams**

### Geometrical and Material Properties

### ColumnC2 - Beam B9

Aj (m2)	fc (kPa)	As1 (Jacket) (m2)	As2 (Jacket) (m2)	fy (Jacket) (kPa)	As1 (Core) (m2)	As2 (Core) (m2)	fy (Core) (kPa)
0.250000	16000.00	0.000616	0.000462	500000.00	0.000339	0.000226	400000.00

### Joint Forces - Critical Analyses

Limit State	Critical Analysis	VC (kN)	Vj (kN)
3-C	Uniform +X	1.12	553.374
5-D	Uniform +X	1.10	553.392

### Joint Shear Force Check - Critical Analyses

Limit State	Pushover Analysis	Vj (kPa)	Vn (kPa)	Performance Level	Check Result
3-C	Uniform +X	553.37	770.24	0.718	Ok
5-D	Uniform +X	553.39	770.24	0.718	Ok

# Detailed Joint Calculations

Units: N&mm

Regulation: ASCE 41-17

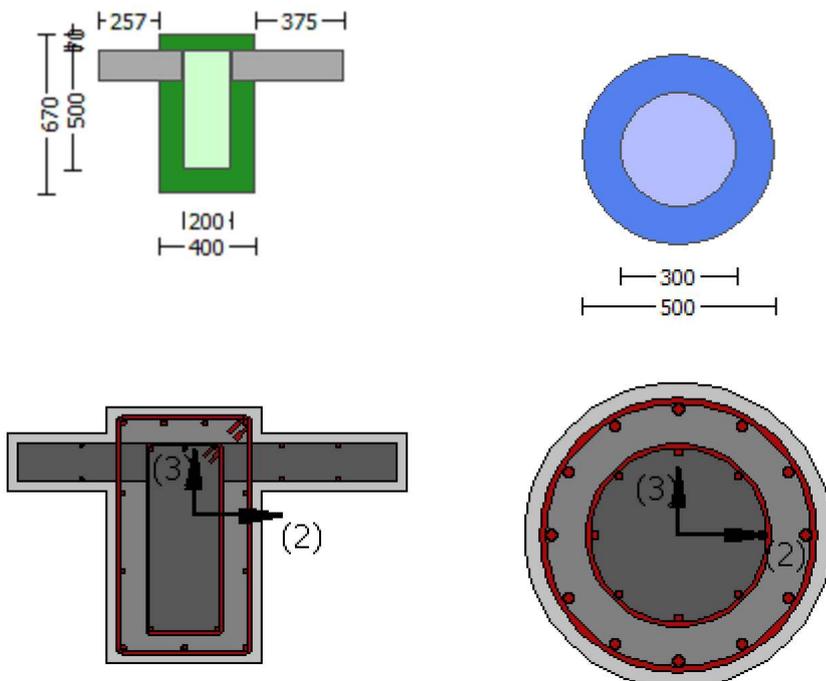
## Calculation No. 1

Col. C2 - Beam B9, Floor : 1

Limit State: Life Safety (data interpolation between analysis steps 3 and 4)

Analysis: Uniform +X

Check: Shear Force



Demanded Shear Force:  $V_e = 553373.799$  from TBDY, (7.11) and ACI 318-14, 18.8.2.1.

with

$$V_{kol} = \text{Min}(V_{kol, \text{above\_joint}}, V_{kol, \text{below\_joint}}) = 1117.304$$

$$A_{s2} = 0$$

$$A_{s1} * f_{yd} = A_{s1\_jacket} * f_{yd\_jacket} + A_{s1\_core} * f_{yd\_core}$$

$$A_{s1\_jacket} = 615.7522$$

$$A_{s1\_core} = 339.292$$

$$\text{New Material: } f_{yd\_jacket} = f_{s\_Lower\_bound\_jacket} = 500.00$$

Existing Material:  $f_{yd\_core} = f_{s\_Lower\_bound\_core} = 400.00$

knowledge factor,  $\gamma = 0.75$

Existing Joint: From table 7-7, ASCE 41-17: Final value  $V_{n,R} = \gamma V_n = 770238.125$

$V_n = 1.0270E+006$  from (10.4) ASCE 41-17

Demanded Shear Force:  $V_e = 553373.799$  from TBDY, (7.11) and ACI 318-14, 18.8.2.1.

with

$f_c = \text{Min}(f_{c\_beam}, f_{c\_Column}) = 16.00$

Existing Material:  $f_{c\_column} = f_{c\_lower\_bound\_column} = 16.00$

Existing Material:  $f_{c\_beam} = f_{c\_lower\_bound\_beam} = 16.00$

$A_j = 206127.402$

$h_c = 500.00$

$b_j = 412.2548$

column width = 500.00

beam width plus joint depth = 900.00

Min perpendicular distance of beam axis to column sides = 206.1274

= 15.00, from table 10-12, ASCE 41-17)

column hoops spacing = 100.00

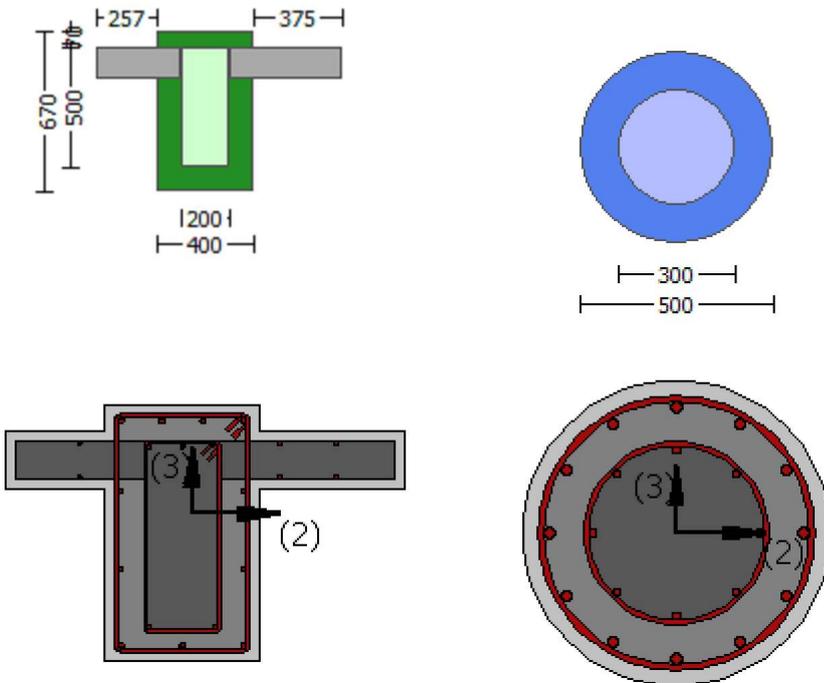
## Calculation No. 2

Col. C2 - Beam B9, Floor : 1

Limit State: Collapse Prevention (data interpolation between analysis steps 4 and 5)

Analysis: Uniform +X

Check: Shear Force



Demanded Shear Force:  $V_e = 553391.918$  from TBDY, (7.11) and ACI 318-14, 18.8.2.1.

with

$V_{kol} = \text{Min}(V_{kol,above\_joint}, V_{kol,below\_joint}) = 1099.185$

$As_2 = 0$

$As_1 * f_{yd} = As_1\_jacket * f_{yd\_jacket} + As_1\_core * f_{yd\_core}$

$As_1\_jacket = 615.7522$

$As_1\_core = 339.292$

New Material:  $f_{yd\_jacket} = f_{s\_Lower\_bound\_jacket} = 500.00$   
Existing Material:  $f_{yd\_core} = f_{s\_Lower\_bound\_core} = 400.00$

knowledge factor,  $\phi = 0.75$

Existing Joint: From table 7-7, ASCE 41-17: Final value  $V_n, R = \phi V_n = 770238.125$   
 $V_n = 1.0270E+006$  from (10.4) ASCE 41-17

Demanded Shear Force:  $V_e = 553391.918$  from TBDY, (7.11) and ACI 318-14, 18.8.2.1.

with

$f_c = \text{Min}(f_{c\_beam}, f_{c\_Column}) = 16.00$

Existing Material:  $f_{c\_column} = f_{c\_lower\_bound\_column} = 16.00$

Existing Material:  $f_{c\_beam} = f_{c\_lower\_bound\_beam} = 16.00$

$A_j = 206127.402$

$h_c = 500.00$

$b_j = 412.2548$

column width = 500.00

beam width plus joint depth = 900.00

Min perpendicular distance of beam axis to column sides = 206.1274

= 15.00, from table 10-12, ASCE 41-17)

column hoops spacing = 100.00