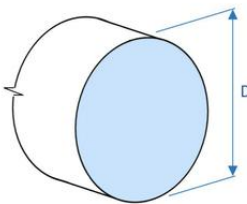


REFERENCES	CALCULATIONS	RESULTS
<p>Code: ENV 1992-1-1 :1991</p>	<p>MEMBER #1 (SECTION POSITION 0.0 mm) COLUMN DESIGN REPORT</p> <p>Project details</p> <p>Your LOGO Here</p> <p>Project Name: Project ID: Company: Designer: Client: Project Notes: Project Units: Metric</p> <p>General member design information</p> <p>Dimensions:</p>  <p>Diameter $D = 457.2$ mm Member length = 2250 mm</p> <p>Material properties: Concrete strength $f_{ck} = 25$ MPa Steel strength of longitudinal rebar $f_{yk} = 500$ MPa Steel strength of shear rebar $f_{ywk} = 500$ MPa Limiting crack width $w_{max} = 0.3$ mm</p> <p>Design Factors and Settings: Partial safety factor for concrete $\gamma_c = 1.50$ Partial safety factor for rebar $\gamma_s = 1.15$ Long term and unfavorable effects for concrete $\alpha_{cc} = 0.85$</p> <p>Load Combinations</p> <p>Ultimate Limit State: LC 1: ULS: 1. D (N = 26.73 kN, Mz = -0.28 kN-m, My = 0.27 kN-m) LC 2: ULS: 2. D + L (N = 23.22 kN, Mz = -6.56 kN-m, My = 0.50 kN-m) LC 3: ULS: 3. D + (S or Lr or R) (N = 26.73 kN, Mz = -0.28 kN-m, My = 0.27 kN-m) LC 4: ULS: 4. D + 0.75L + 0.75(S or Lr or R) (N = 24.10 kN, Mz = -4.99 kN-m, My = 0.44 kN-m) LC 5: ULS: 5a. D + 0.6W (N = 26.73 kN, Mz = -0.28 kN-m, My = 0.27 kN-m) LC 6: ULS: 5b. D + 0.7E (N = 26.73 kN, Mz = -0.28 kN-m, My = 0.27 kN-m) LC 7: ULS: 6a. D + 0.75L + 0.75(0.6)W + 0.75(S or Lr or R) (N = 24.10 kN, Mz = -4.99 kN-m, My = 0.44 kN-m) LC 8: ULS: 6b. D + 0.75L + 0.75(0.7)E + 0.75S (N = 24.10 kN, Mz = -4.99 kN-m, My = 0.44 kN-m) LC 9: ULS: 7. 0.6D + 0.6W (N = 16.04 kN, Mz = -0.17 kN-m, My = 0.16 kN-m) LC 10: ULS: 8. 0.6D + 0.7E (N = 16.04 kN, Mz = -0.17 kN-m, My = 0.16 kN-m)</p> <p>Serviceability Limit State: LC 1: LC-1 (N = 26.73 kN, Mz = -0.28 kN-m, My = 0.27 kN-m)</p> <p>DL - Dead Load LL - Live Load WL - Wind Load LrL - Roof Live Load RL - Rain Load SL - Snow Load EL - Earthquake Load</p>	
	<p>Detailing and strength check status of column section based on all load combinations</p>	

LC #	P (kN)	Mz (kN-m)	My (kN-m)	Vy (kN)	Vz (kN)	Ratio	Status
1	26.73	-0.44	-0.54	0.00	0.31	0.42	OK
2	23.22	-6.69	0.63	3.34	0.44	0.42	OK
3	26.73	-0.44	-0.54	0.00	0.31	0.42	OK
4	24.10	-5.13	0.58	2.50	0.41	0.42	OK
5	26.73	-0.44	-0.54	0.00	0.31	0.42	OK
6	26.73	-0.44	-0.54	0.00	0.31	0.42	OK
7	24.10	-5.13	0.58	2.50	0.41	0.42	OK
8	24.10	-5.13	0.58	2.50	0.41	0.42	OK
9	16.04	-0.26	-0.33	0.00	0.19	0.42	OK
10	16.04	-0.26	-0.33	0.00	0.19	0.42	OK

Detailed report based on load combination: 10

Detailing of Members

DETAILING RULES FOR COLUMN (LONGITUDINAL REINFORCEMENT)

Section input data:

Design strength of rebar $f_{yd} = f_{yk}/\gamma_s = 500/1.15 = 434.78$ MPa

Mean width of tension zone $b_t = 457.2$ mm

Section concrete area $A_c = 164173.22$ mm²

Longitudinal rebar area $A_{st} = 785.40$ mm²

Given axial force $N_{ed} = 16.04$ kN

9.5.2(2), 9.5.2(3)

1. Calculation of maximum allowed longitudinal reinforcement (9.5.2(2), 9.5.2(3))

$$f_{ck} = 25 \text{ MPa} \leq 50 \text{ MPa}$$

$$f_{ctm} = 0.3 \cdot f_{ck}^{2/3} = 0.3 \cdot 25^{2/3} = 2.56 \text{ MPa}$$

$$A_{s,max} = 0.04 \cdot A_c = 0.04 \cdot 164173.22322758927 = 6566.93 \text{ mm}^2$$

9.2.1.1(1)

9.2.1.1(1)

2. Calculation of minimum allowed longitudinal reinforcement (9.2.1.1(1))

$$A_{s,min1} = 0.1 \cdot \frac{N_{ed}}{f_{yd}} = 0.1 \cdot \frac{16040.29}{434.78} = 3.69 \text{ mm}^2$$

$$A_{s,min2} = 0.002 \cdot A_c = 0.002 \cdot 164173.22 = 328.35 \text{ mm}^2$$

$$A_{s,min} = \max[A_{s,min1}, A_{s,min2}] = 328.35 \text{ mm}^2$$

3. Check of allowed longitudinal reinforcement

$$A_{st} = 785.40 \text{ mm}^2 \leq A_{s,max} = 6566.93 \text{ mm}^2 \text{ (Ratio: 0.120)}$$

$$A_{st} = 785.40 \text{ mm}^2 \geq A_{s,min} = 328.35 \text{ mm}^2 \text{ (Ratio: 0.418)}$$

STATUS OK!
Ratio: 0.120

STATUS OK!
Ratio: 0.418

Slenderness of column braced against sidesway

Section input data:

Effective Length factor $K_z = 1.00$

Effective Length factor $K_y = 1.00$

Unsupported length of the column $l = 2250.00$ mm

Section axial load based on current load combination $N_{ed} = 16.04$ kN

Section flexure about major axis based on current load combination $M_{edz} = -0.17$ kN-m

Section flexure about minor axis based on current load combination $M_{edy} = 0.16$ kN-m

Top column section moment about major axis $M_{ed,z,top} = -0.17$ kN-m
 Top column section moment about minor axis $M_{ed,y,top} = 0.16$ kN-m
 Bottom column section moment about major axis $M_{ed,z,bot} = -0.16$ kN-m
 Bottom column section moment about minor axis $M_{ed,y,bot} = -0.24$ kN-m
 Design compressive strength of concrete $f_{cd} = \alpha_{cc} \cdot f_{ck} / \gamma_c = 0.85 \cdot 25 / 1.5 = 14.17$ MPa
 Design strength of rebar $f_{yd} = f_{yk} / \gamma_s = 500 / 1.15 = 434.78$ MPa
 Section concrete area $A_c = 164173.22$ mm²
 Longitudinal rebar area $A_{st} = 785.40$ mm²

Second-order moment about major axis Z

5.8.2, 5.8.3.1

1. Check if the column is long

$$e_i = \frac{l}{400} = \frac{2250}{400} = 5.63 \text{ mm}$$

$$N_{ed} \cdot e_i = 16.04 \cdot 5.63 \cdot 0.001 = 0.09 \text{ kN-m}$$

$$M_{01} = \min \{|M_{top}|, |M_{bot}|\} + N_{ed} \cdot e_i = 0.16 + 0.09 = 0.25 \text{ kN-m}$$

$$M_{02} = \max \{|M_{top}|, |M_{bot}|\} + N_{ed} \cdot e_i = 0.17 + 0.09 = 0.26 \text{ kN-m}$$

$$\text{Radius of gyration } r_z = 0.25 \cdot D = 0.25 \cdot 457.2 = 114.30 \text{ mm}$$

$$\omega = \left(\frac{A_{st} \cdot f_{yd}}{A_c \cdot f_{cd}} \right) = \left(\frac{785.40 \cdot 434.78}{164173.22 \cdot 14.17} \right) = 0.15$$

$$A = 0.7$$

$$B = \sqrt{1 + 2 \cdot \omega} = \sqrt{1 + 2 \cdot 0.15} = 1.14$$

$$C = 1.7 - \frac{M_{01}}{M_{02}} = 1.7 - \frac{0.25}{0.26} = 0.73$$

$$n = \frac{N_{Ed}}{A_c \cdot f_{cd}} = \frac{16.04 \cdot 1000}{164173.22 \cdot 14.17} = 0.01$$

$$\lambda_{lim} = \frac{20 \cdot A \cdot B \cdot C}{\sqrt{n}} = \frac{20 \cdot 0.70 \cdot 1.14 \cdot 0.73}{\sqrt{0.01}} = 140.19$$

$$\frac{K_y \cdot l}{r_z} = \frac{1 \cdot 2250}{114.30} = 19.69 \leq \lambda_{lim} = 140.19$$

Column is short. Second-order moment can be ignored.

$$0.6 \cdot M_{02} + 0.4 \cdot M_{01} = 0.6 \cdot 0.26 + 0.4 \cdot 0.25 = 0.26 \text{ kN-m} \geq 0.4 \cdot M_{02} = 0.4 \cdot 0.26 = 0.10 \text{ kN-m}$$

$$M_{0ed} = 0.26 \text{ kN-m}$$

$$M_{ed} = \max \{M_{02}, M_{0ed} + M_2, M_{01} - 0.5 \cdot M_2\} =$$

$$= \max \{0.26, 0.26, [0.25]\} = 0.26 \text{ kN-m}$$

Second-order moment about minor axis Y

5.8.2, 5.8.3.1

1. Check if the column is long

$$e_i = \frac{l}{400} = \frac{2250}{400} = 5.63 \text{ mm}$$

$$N_{ed} \cdot e_i = 16.0402870896 \cdot 5.63 \cdot 0.001 = 0.09 \text{ kN-m}$$

$$M_{01} = \min \{|M_{top}|, |M_{bot}|\} + N_{ed} \cdot e_i = -0.16 + 0.09 = -0.07 \text{ kN-m}$$

1. $\frac{1}{x^2} = x^{-2}$

2. $\frac{1}{x^3} = x^{-3}$

$$\frac{d}{dx} x^{-2} = -2x^{-3}$$

3. $\frac{1}{x^4} = x^{-4}$

$$\frac{d}{dx} x^{-3} = -3x^{-4}$$

$$\frac{d}{dx} x^{-4} = -4x^{-5}$$

$$\frac{d}{dx} x^{-5} = -5x^{-6}$$

$$\frac{d}{dx} x^{-6} = -6x^{-7}$$

$$\frac{d}{dx} x^{-7} = -7x^{-8}$$

4. $\frac{1}{x^8} = x^{-8}$

$$\frac{d}{dx} x^{-8} = -8x^{-9}$$

5. $\frac{1}{x^9} = x^{-9}$

$$\frac{d}{dx} x^{-9} = -9x^{-10}$$

$$\frac{d}{dx} x^{-10} = -10x^{-11}$$

Example 1

Problem

Find the derivative of $y = \frac{1}{x^2} + \frac{1}{x^3} + \frac{1}{x^4} + \frac{1}{x^5} + \frac{1}{x^6} + \frac{1}{x^7} + \frac{1}{x^8} + \frac{1}{x^9} + \frac{1}{x^{10}}$

Solution

№	1. а) (мл)	2. а) (мл)	3. а) (мл)	4. а) (мл)
1	200	100	100	200
2	200	100	100	200
3	100	100	100	200
4	200	100	100	200
5	200	100	100	200
6	200	100	100	200
7	200	100	100	200
8	200	100	100	200
9	200	100	100	200
10	200	100	100	200
11	200	100	100	200
12	200	100	100	200
13	200	100	100	200
14	200	100	100	200
15	200	100	100	200
16	200	100	100	200
17	200	100	100	200
18	200	100	100	200
19	200	100	100	200
20	200	100	100	200

Вопросы к задаче



Решение задачи (вариант 1)

1. Найдем площадь основания цилиндра: $S_{осн} = \pi R^2 = \pi \cdot 5^2 = 25\pi$ см².

2. Найдем высоту цилиндра: $H = 10$ см.

3. Найдем объем цилиндра: $V_{осн} = S_{осн} \cdot H = 25\pi \cdot 10 = 250\pi$ см³.

4. Найдем площадь основания конуса: $S_{осн} = \pi R^2 = \pi \cdot 5^2 = 25\pi$ см².

5. Найдем высоту конуса: $H = 10$ см.

6. Найдем объем конуса: $V_{кон} = \frac{1}{3} S_{осн} \cdot H = \frac{1}{3} \cdot 25\pi \cdot 10 = \frac{250\pi}{3}$ см³.

7. Найдем площадь основания цилиндра: $S_{осн} = \pi R^2 = \pi \cdot 5^2 = 25\pi$ см².

8. Найдем высоту цилиндра: $H = 10$ см.

9. Найдем объем цилиндра: $V_{осн} = S_{осн} \cdot H = 25\pi \cdot 10 = 250\pi$ см³.

10. Найдем площадь основания конуса: $S_{осн} = \pi R^2 = \pi \cdot 5^2 = 25\pi$ см².



Решение задачи (вариант 2)

1. Найдем площадь основания цилиндра: $S_{осн} = \pi R^2 = \pi \cdot 5^2 = 25\pi$ см².

2. Найдем высоту цилиндра: $H = 10$ см.

3. Найдем площадь основания конуса: $S_{осн} = \pi R^2 = \pi \cdot 5^2 = 25\pi$ см².

4. Найдем высоту конуса: $H = 10$ см.

NO	1990	1995	2000	2005
1		201	20	20
2	20	2000	20	2000
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4	200	2000	20	2000
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100	1	1	1

Wiederholungsfragen

1. Wie wird die Ableitung einer Funktion bestimmt?

Die Ableitung einer Funktion $f(x)$ an der Stelle x_0 ist die Steigung der Tangente an den Punkt $(x_0, f(x_0))$. Sie wird durch den Grenzwert des Differenzenquotienten bestimmt:

$$f'(x_0) = \lim_{h \rightarrow 0} \frac{f(x_0 + h) - f(x_0)}{h}$$

Alternativ kann die Ableitung auch durch die Ableitungsregeln (Potenz-, Produkt-, Quotienten-, Kettenregel) bestimmt werden.

2. Wie wird die Ableitung einer Funktion bestimmt?

Die Ableitung einer Funktion $f(x)$ an der Stelle x_0 ist die Steigung der Tangente an den Punkt $(x_0, f(x_0))$.

$$f'(x_0) = \lim_{h \rightarrow 0} \frac{f(x_0 + h) - f(x_0)}{h}$$

$$f'(x_0) = \lim_{h \rightarrow 0} \frac{f(x_0 + h) - f(x_0)}{h}$$

Die Ableitung einer Funktion $f(x)$ an der Stelle x_0 ist die Steigung der Tangente an den Punkt $(x_0, f(x_0))$.

Die Ableitung einer Funktion $f(x)$ an der Stelle x_0 ist die Steigung der Tangente an den Punkt $(x_0, f(x_0))$.

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Die Ableitung einer Funktion $f(x)$ an der Stelle x_0 ist die Steigung der Tangente an den Punkt $(x_0, f(x_0))$.

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Die Ableitung einer Funktion $f(x)$ an der Stelle x_0 ist die Steigung der Tangente an den Punkt $(x_0, f(x_0))$.

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