Calculation Description

234rwesdfsdv

Concrete Dowels Calculation

According to Norwegian "Betongelementboken"
Calculation Date: 10/15/2025, 9:46:52 AM

INPUT PARAMETERS

Load Parameters

V_{Ed} = 27.5 kN
f_{dowel} = 1.4

Material Properties

f_{ck} = 35 MPa
f_{yk} = 500 MPa
α_{cc} = 0.85
γ_c = 1.5
γ_s = 1.15
n-factor = 14

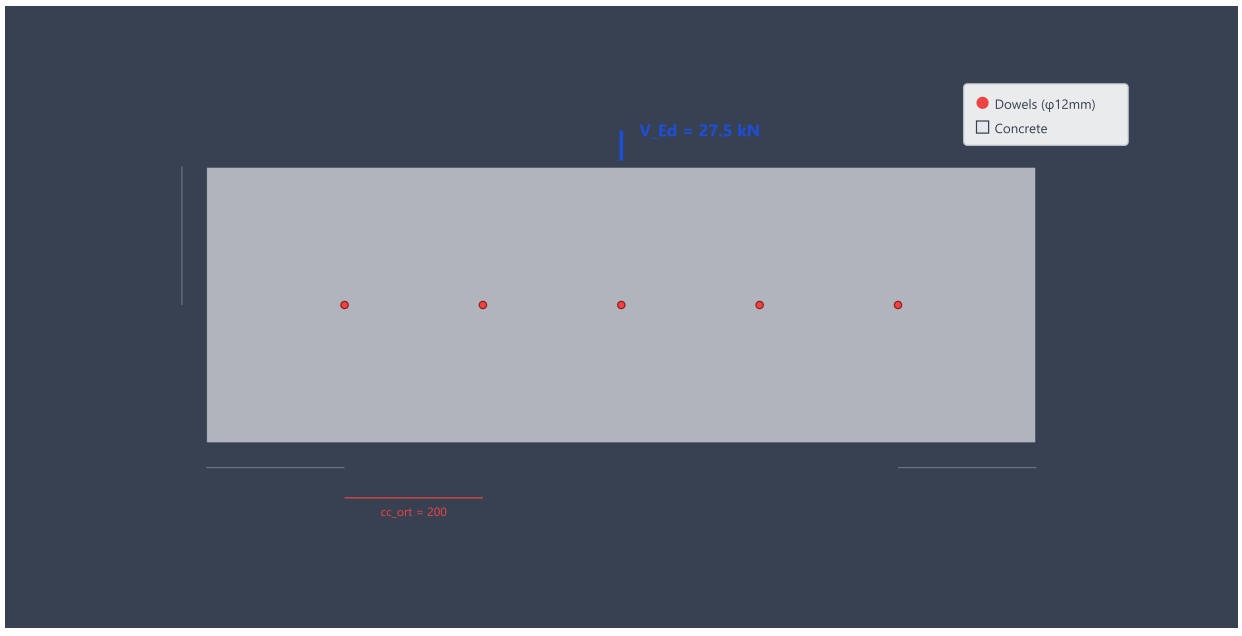
Dowel Configuration

Diameter = 12 mm
$n_{V,parallel}$ = 1
$c/c_{parallel}$ = 200 mm
$n_{V,ortagonal}$ = 5
$c/c_{ortagonal}$ = 200 mm

Edge Distances

Eccentricity = 0 mm
a_1 = 200 mm
$a_{2,h}$ = 200 mm
$a_{2,v}$ = 200 mm

PLOT



RESULTS SUMMARY

V_{Rd} = 66.9 kN

Shear Capacity of Dowel Group

Concrete Utilization

41.1%

$v_c = V_{Ed} / V_{Rd}$

Steel Utilization

19.4%

$v_s = V_{Ed} / V_{Rd,s}$

Bending Utilization

39.5%

$m_s = M_{max} / M_{Rd,s0}$

DETAILED CALCULATIONS

Basic Calculations

$n_{V,tot} = n_{V,parallel} \times n_{V,ortagonal} = 1 \times 5 = 5$
$A_s = \pi \times ø^2 / 4 = \pi \times 12^2 / 4 = 113.1\ mm^2$
$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_c = 0.85 \times 35 / 1.5 = 19.83\ MPa$
$f_{yd} = f_{yk} / \gamma_s = 500 / 1.15 = 434.78\ MPa$
$\sigma_{cd} = 3 \times f_{cd} = 3 \times 19.83 = 59.5\ MPa$

Steel Shear Capacity

$V_{Rd,s} = (n_{V,tot} \times A_s \times f_{yd}) / \sqrt{3} = 141.9\ kN$

Plastic Moment Capacity

$M_{Rd,s0} = f_{yd} \times ø^3 / 6 = 434.78 \times 12^3 / 6 = 0.125\ kNm$

Concrete Shear Capacity (Single Dowel)

$V_{Rd,e} = 1.5 \times \sqrt{((f_{cd} \times e \times ø)^2 + f_{cd} \times f_{yd} \times ø^4)} - 1.5 \times f_{cd} \times e \times ø$
$V_{Rd,e} = 20.06\ kN$
$V_{Rd,c0} = V_{Rd,e} = 20.06\ kN$

Distance Factors

$k_a = (\min(n \times ø, a_1) - ø) / (n \times ø - ø) = 1$
$k_s = (a_{2,v} + (n_{V,ort}-1) \times cc_{ort} + a_{2,h}) / (3 \times \min(n \times ø, a_1)) = 2.381$
$k = \min(n_{V,ortagonal}, k_a \times k_s) = 2.381$
$\psi_{f,V} = 1$

Final Shear Capacity

$V_{Rd} = f_{dowel} \times k \times \psi_{f,V} \times V_{Rd,c0}$
$V_{Rd} = 1.4 \times 2.381 \times 1 \times 20.06 = 66.9\ kN$

Utilization Checks

Concrete: $v_c = V_{Ed} / V_{Rd} = 27.5 / 66.9 = 41.1\%$
Steel: $v_s = V_{Ed} / V_{Rd,s} = 27.5 / 141.9 = 19.4\%$
Bending: $m_s = M_{max} / M_{Rd,s0} = 0.05 / 0.125 = 39.5\%$