

Saw Cut Floor Calculation Proposal (Based On TR34)

1. Load Condition

UDL=60 kN/m²

Line Load=45 kN/m

Uniformly Distributed Load Partial Safety Factors $\gamma_{F,UDL}$ =1.00

Line Load Partial Safety Factors $\gamma_{F,Line}$ =1.00

2. Floor Information

Concrete Grade: C25/30

Floor Concrete Thickness: h=180 mm

Saw Cut Joint Spacing: 6000 mm

Separation Layer: Single Film

3. Subgrade Properties

Modulus of Subgrade Reaction k: k=0.100 N/mm³

4. Concrete Details

Cylinder Compressive Strength f_{ck} =25.0 N/mm²

Mean Axial Tensile Strength f_{ctm} =2.59 N/mm²

Secant Elastic Modulus E_{cm} =31476 N/mm²

Mean Axial Compressive Strength f_{cm} = $f_{ck}+8$ =33.0 N/mm²

Poisson Ratio ν =0.20

Concrete Material Partial Safety Factors $\gamma_{m,c}$ =1.50

Design Concrete Flexural Tensile Strength $f_{ctd,fl}$ =2.45 N/mm²

$$f_{ctd,fl} = f_{ctm} \times (1.6 - h/1000) / \gamma_m$$

Radius of Relative Stiffness l =632 mm

$$l = [(E_{cm}h^3)/(12(1 - \nu^2)k)]^{0.25}$$

5. Fiber Details

Fiber Type: HicFiber® 80/60 1100 MPa

Steel Fiber Dosage: 25 kg/m³

Residual Flexural Strength(CMOD=0.5 mm) f_{R1} =3.20 N/mm²

Residual Flexural Strength(CMOD=1.5 mm) f_{R2} =3.20 N/mm²

Residual Flexural Strength(CMOD=2.5 mm) f_{R3} =3.00 N/mm²

Residual Flexural Strength(CMOD=3.5 mm) $f_{R4}=2.80 \text{ N/mm}^2$

6. Flexural Capacity of Concrete Slabs on Ground

Negative Resistance Moment of the Slab $M_n=13.25 \text{ kN}\cdot\text{m/m}$

$$M_n = f_{ctd,fl} \times (h^2/6)$$

Mean Axial Tensile Strength (at CMOD=0.5 mm) $\sigma_{r1}=1.44 \text{ N/mm}^2$

Mean Axial Tensile Strength (at CMOD=3.5 mm) $\sigma_{r4}=1.04 \text{ N/mm}^2$

$$\sigma_{r1} = 0.45f_{R1} \quad \sigma_{r4} = 0.37f_{R4}$$

Positive Resistance Moment of Fiber Reinforced Slab Bottom $M_p=13.25 \text{ kN}\cdot\text{m/m}$

$$M_p = \frac{h^2}{\gamma_m} (0.29\sigma_{r4} + 0.16\sigma_{r1}) \geq f_{ctd,fl} \times (h^2/6)$$

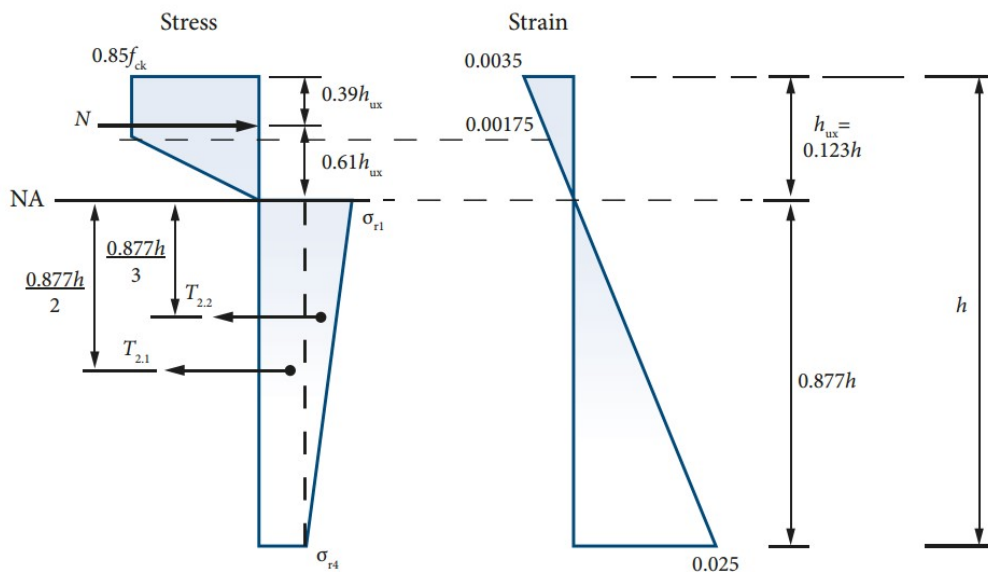


Figure 1: Stress-Deformation Curve for Fiber Reinforced Concrete

7. UDL Verification

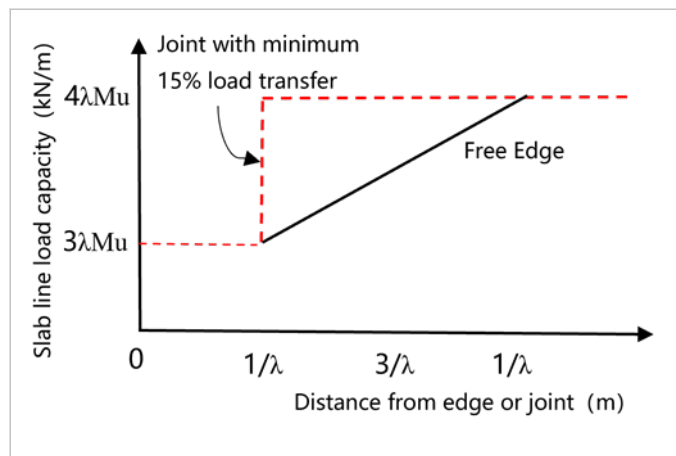


Figure 2: Line Load Capacity Near Free Edges or Joints

Design Line Load P_{lin} : 45.0 kN/m

Characteristic Length Coefficient λ : 1.131 m⁻¹

$$\lambda = \left(\frac{3k}{E_{cm}h^3} \right)^{0.25}$$

Ultimate Load of Internal Line Load $P_{lin,u,i}$: 59.94 kN/m

Ultimate Load of Edge Line Load $P_{lin,u,e}$: 45.0 kN/m

$P_{lin}/P_{lin,u}$: 100.0%

Line load verification meet the design requirements.

8. UDL Verification

A common example of UDL is block stacking. For the general case where the slab will be subjected to a random pattern of UDL, it has been found that the maximum positive (sagging) bending moment in the slab is caused by a load of breadth $\pi/2\lambda$. The maximum negative (hogging) moment is induced between a pair of patch loads each of breadth π/λ spaced a distance $\pi/2\lambda$ apart. This spacing is commonly known as the critical aisle width.

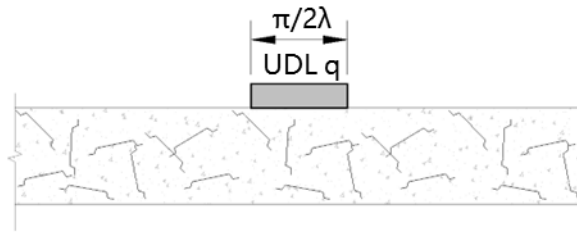


Figure 3: Loading Patterns for UDL q Causing Maximum Positive Bending Moment

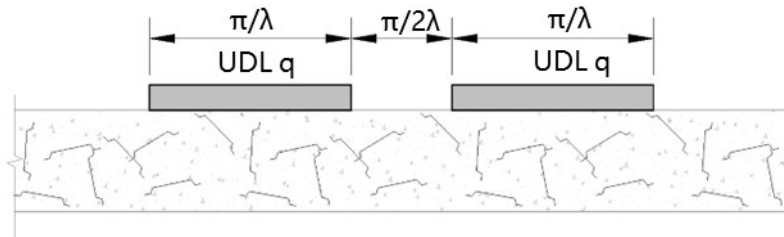


Figure 4: Loading Patterns for UDL q Causing Maximum Negative Bending Moment

Design UDL Load q : 60.0 kN/m²

Ultimate UDL q_u : 100.81 kN/m²

$$q_u = \min(q_{u1}, q_{u2})$$

$$q_{u1} = 5.95\lambda^2 M_n$$

$$q_{u2} = \frac{2}{B_{\lambda c}} \lambda^2 M_p = 6.21\lambda^2 M_p$$

$$B_{\lambda c} = e^{-\lambda c} \sin \lambda c$$

$$2c = \frac{\pi}{2\lambda}$$

$$q/q_i: \underline{59.52\%} < 100\%$$

UDL verification meet the design requirements.

8. Based On

'Design standard for steel fiber reinforced concrete structures' JGJT465-2019

'Specification for building ground design' GB50037-2013

'Concrete Industrial Ground Floors' TR34, The Concrete Society

EN14651: Test methods for steel fiber reinforced concrete

ACI 360R-10, Guide to Design of Slabs-on-Ground, American Concrete Institute

EuroCode2: Design of Concrete Structures