Rigid Pavement Wheel Load Stresses (Westergaard)

Radius of relative stiffness and Westergaard wheel-load stresses at the interior, edge and corner of a concrete pavement slab on a Winkler subgrade.

Method: Westergaard analysis of slabs on a Winkler foundation

Input parameters

Unit system: SI

Parameter	Value	Unit
Wheel load	51.000	kN
Slab thickness	250.00	mm
Concrete elastic modulus	30.000	GPa
Poisson's ratio	0.15000	
Modulus of subgrade reaction	80.000	MN/m³
Tyre contact radius	150.00	mm

Calculated results

Parameter	Value	Unit
Radius of relative stiffness	840.69	mm
Equivalent contact radius	145.10	mm
Interior stress	1.0626	MPa
Edge stress	1.5921	MPa
Corner stress	1.3765	MPa

Notes for this case

• l = [Eh³/(12(1 − μ²)k)]^¼. Westergaard's stresses with Teller–Sutherland coefficients for μ = 0.15: interior 0.316P/h²[4log(l/b) + 1.069], edge 0.572P/h²[4log(l/b) + 0.359]; corner 3P/h²[1 − (a√2/l)^0.6] (Westergaard's original). b is the equivalent radius for thick slabs. Add temperature warping stresses separately; corner and edge usually govern.

Formula and method

$$l = \sqrt[4]{\frac{Eh^3}{12(1-\mu^2)k}}, \quad \sigma_e = \frac{0.572P}{h^2}\left[4\log\frac{l}{b} + 0.359\right], \quad \sigma_c = \frac{3P}{h^2}\left[1 - \left(\frac{a\sqrt{2}}{l}\right)^{0.6}\right]$$

Variables

P	Wheel load	N
h	Slab thickness	m
E	Concrete elastic modulus	Pa
μ	Poisson's ratio	-
k	Modulus of subgrade reaction	N/m³
a	Tyre contact radius	m
l	Radius of relative stiffness	m
b	Equivalent contact radius	m
σ_i	Interior stress	Pa
σ_e	Edge stress	Pa
σ_c	Corner stress	Pa

Method and standards

Slab stresses.

Assumptions and limits

- Infinite slab (interior), semi-infinite edge, single circular load; μ near 0.15.

References

Westergaard analysis of slabs on a Winkler foundation

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/roads/westergaard-slab-stress

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Reopens the calculator with the inputs of this report.