Modulus of Subgrade Reaction for a Footing (Terzaghi and Vesić)

Modulus of subgrade reaction of a footing scaled from a 0.3 m plate load test (Terzaghi) and estimated from soil modulus and footing stiffness (Vesić).

Method: Terzaghi plate scaling; Vesić beam-on-elastic-solid

Input parameters

Unit system: SI

Parameter	Value	Unit
Soil type for plate scaling	Sand (granular)	
Plate (0.3 m) subgrade modulus	40.000	MN/m³
Footing width	2.0000	m
Footing length	3.0000	m
Soil elastic modulus	30.000	MPa
Soil Poisson's ratio	0.30000	
Footing elastic modulus	25.000	GPa
Footing thickness	600.00	mm

Calculated results

Parameter	Value	Unit
Terzaghi scaled modulus	13.225	MN/m³
Vesić modulus	10.167	MN/m³
Vesić spring per unit length of beam	20.335	MPa

Notes for this case

• Terzaghi: sand k = $k_1[(B + 0.3)/(2B)]^2$, clay k = $k_1(0.3/B)(L/B + 0.5)/(1.5L/B)$, B in metres. Vesić: k_sB = 0.65(E_sB⁴/E_fI_f)^(1/12)·E_s/(1 − ν²). Subgrade modulus is not a soil property: it depends on footing size, shape, stiffness and load level, so bracket results in design.

Formula and method

$$k_{sand} = k_1 \left(\frac{B+0.3}{2B}\right)^2, \quad k_{clay} = k_1 \frac{0.3}{B}\frac{L/B+0.5}{1.5L/B}, \quad k_sB = 0.65 \sqrt[12]{\frac{E_s B^4}{E_f I_f}} \frac{E_s}{1-\nu^2}$$

Variables

soil	Soil type for plate scaling	-
k_1	Plate (0.3 m) subgrade modulus	N/m³
B	Footing width	m
L	Footing length	m
E_s	Soil elastic modulus	Pa
ν	Soil Poisson's ratio	-
E_f	Footing elastic modulus	Pa
t	Footing thickness	m
k_T	Terzaghi scaled modulus	N/m³
k_V	Vesić modulus	N/m³
k_sB	Vesić spring per unit length of beam	Pa

Method and standards

Subgrade modulus.

Assumptions and limits

- Linear elastic soil; footing in full contact.

References

Terzaghi plate scaling; Vesić beam-on-elastic-solid

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/foundations/subgrade-modulus-footing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.