Vertical Stress below a Uniformly Loaded Rectangle (Newmark)

Vertical stress increase below the corner or centre of a uniformly loaded rectangular area at a depth, by Newmark's integration of the Boussinesq solution.

Method: Newmark's integration of Boussinesq's solution

Input parameters

Unit system: SI

Parameter	Value	Unit
Uniform pressure	150.00	kPa
Width	3.0000	m
Length	5.0000	m
Depth below the loaded surface	4.0000	m
Point below	Centre	

Calculated results

Parameter	Value	Unit
Influence factor (corner of the sub-rectangle)	0.077897	
Vertical stress increase	46.738	kPa
Stress ratio	31.159	%

Notes for this case

• Newmark's closed form for the corner of a flexible rectangle B × L on an elastic half-space, with m = B/z, n = L/z (the arctangent branch is corrected when $m^2n^2 > m^2 + n^2 + 1$). The centre uses four sub-rectangles meeting at the centre. Results feed settlement calculations layer by layer.

Formula and method

$$I = \frac{1}{4\pi}\left[\frac{2mn\sqrt{s}}{s + m^2n^2}\frac{s+1}{s} + \tan^{-1}\frac{2mn\sqrt{s}}{s - m^2n^2}\right], \quad s = m^2 + n^2 + 1$$

Variables

q	Uniform pressure	Pa
B	Width	m
L	Length	m
z	Depth below the loaded surface	m
point	Point below	-
I	Influence factor (corner of the sub-rectangle)	-
$\Delta\sigma_z$	Vertical stress increase	Pa
$\Delta\sigma_z/q$	Stress ratio	-

Method and standards

Stress distribution.

Assumptions and limits

- Flexible uniform load; homogeneous elastic half-space.

References

Newmark's integration of Boussinesq's solution

Report details

Report reference	FCC-2J60-3RRE (the same inputs always give the same reference)
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Calculator	Vertical Stress below a Uniformly Loaded Rectangle (Newmark)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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

This calculator online

https://calc.firecad.com/civil/geotechnical/rectangular-load-stress

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.