Field Density by Sand Replacement and Degree of Compaction

Test-hole volume, bulk and dry density of compacted soil from the sand-replacement test, and relative compaction against the lab maximum.

Method: Sand replacement method (IS 2720-28 / ASTM D1556 principle)

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass of sand filling the hole	3.6000	kg
Calibrated sand bulk density	1,500.0	kg/m³
Mass of wet soil excavated	4.6000	kg
Moisture content (dry basis)	12.000	%
Laboratory maximum dry density	1,900.0	kg/m³

Calculated results

Parameter	Value	Unit
Hole volume	2.4000	L
Bulk density	1,916.7	kg/m³
Dry density	1,711.3	kg/m³
Relative compaction	90.069	%

Notes for this case

- The sand mass is that in the hole only (exclude the cone of the pouring cylinder, found by calibration). Specifications often require 95 % of standard or 90 % of modified Proctor maximum dry density.

Formula and method

$$V = \frac{m_s}{\rho_s}, \quad \rho_d = \frac{m_w / V}{1 + w}, \quad RC = \frac{\rho_d}{\rho_{d,max}}$$

Variables

m_s	Mass of sand filling the hole	kg
ρ_s	Calibrated sand bulk density	kg/m³
m_w	Mass of wet soil excavated	kg
w	Moisture content (dry basis)	-
$\rho_{d,max}$	Laboratory maximum dry density	kg/m³
V	Hole volume	m³
ρ	Bulk density	kg/m³
ρ_d	Dry density	kg/m³
RC	Relative compaction	-

Method and standards

Density definitions.

Assumptions and limits

- Representative sample.

References

- Sand replacement method (IS 2720-28 / ASTM D1556 principle)

Report details

Report reference	FCC-R40W-88C1 (the same inputs always give the same reference)
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Release checks	2 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/sand-replacement-density

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.