Compaction: Dry Density, Zero-Air-Voids Line and Relative Compaction

Dry density from a field or Proctor test, the zero-air-voids dry density at the same water content, and relative compaction against the maximum dry density.

Method: Dry density and zero-air-voids relation (ASTM D698 / IS 2720 Part 7 calculations)

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass of wet soil in the mould or hole	1.9200	kg
Volume of the mould or hole	944.00	mL
Water content	14.000	%
Specific gravity of the solids	2.7000	
Maximum dry density from the Proctor test	1,900.0	kg/m³

Calculated results

Parameter	Value	Unit
Bulk density	2,033.9	kg/m³
Dry density	1,784.1	kg/m³
Zero-air-voids dry density at this water content	1,959.4	kg/m³
Relative compaction ρ_d/ρ_{d,max}	93.901	%
Air voids	8.9437	%

Formula and method

$$\rho_d = \frac{m/V}{1+w}, \quad \rho_{d,zav} = \frac{G_s \rho_w}{1+wG_s}, \quad RC = \frac{\rho_d}{\rho_{d,max}}$$

Variables

m	Mass of wet soil in the mould or hole	kg
V	Volume of the mould or hole	m³
w	Water content	-
G_s	Specific gravity of the solids	-
$\rho_{d,max}$	Maximum dry density from the Proctor test	kg/m³
ρ	Bulk density	kg/m³
ρ_d	Dry density	kg/m³
$\rho_{d,zav}$	Zero-air-voids dry density at this water content	kg/m³
RC	Relative compaction ρ_d/ρ_{d,max}	-
a_c	Air voids	-

Method and standards

Phase relations.

Assumptions and limits

- Water density 1000 kg/m³.
- A dry density above the zero-air-voids value (negative air voids) is flagged as a test or input error.

References

- Dry density and zero-air-voids relation (ASTM D698 / IS 2720 Part 7 calculations)

Report details

Report reference	FCC-4D2D-330E (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/dry-density-compaction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.