ENGINEERING TOOL

Silo Capacity Calculator Guide

Guide to using the silo capacity calculator: formulas, material density tables, and example calculations for common silo geometries.

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This guide explains how to calculate silo volume and usable capacity for cylindrical steel silos, with worked examples for cone-bottom and flat-bottom configurations. Use it together with the Bulk Material Properties Database (density values) or the online calculator on the Manxing website.

1. Basic Formulas

Cylindrical section: V_c = (pi / 4) x D^2 x H_c

Truncated cone (hopper): V_h = (pi / 12) x H_h x (D^2 + D x d + d^2)

Total geometric volume: V = V_c + V_h

Usable capacity: m = rho x V x f (rho = bulk density, f = fill factor 0.85-0.95)

Symbol	Meaning	Unit
D	Internal silo diameter	m
d	Outlet diameter	m
H_c	Cylindrical wall height	m
H_h	Cone / hopper height	m
rho	Bulk density of material	t/m3
f	Fill factor (headspace, cone dead volume)	0.85-0.95

2. Example 1 - Bolted Cement Silo (Cone Bottom)

Given: D = 4.0 m, H_c = 7.5 m, cone height H_h = 2.5 m, outlet d = 0.3 m, cement density rho = 1.4 t/m3, fill factor f = 0.9.

V_c = (pi/4) x 4.0^2 x 7.5 = 0.7854 x 16.0 x 7.5 = 94.25 m3

V_h = (pi/12) x 2.5 x (16.0 + 4.0 x 0.3 + 0.09) = 0.2618 x 2.5 x 17.29 = 11.31 m3

V = 94.25 + 11.31 = 105.56 m3

m = 1.4 x 105.56 x 0.9 = 133.0 t -> corresponds to an MX-CS-100 class silo

3. Example 2 - Welded Clinker Silo (Flat Bottom)

Given: D = 9.5 m, H_c = 18.0 m, flat bottom with aeration floor, clinker density rho = 1.45 t/m3, fill factor f = 0.85 (flat-bottom dead volume).

V_c = 0.7854 x 9.5^2 x 18.0 = 0.7854 x 90.25 x 18.0 = 1,275.9 m3

V = 1,275.9 m3 (no cone volume)

m = 1.45 x 1,275.9 x 0.85 = 1,571 t -> corresponds to an MX-CS-2000 class silo

4. Example 3 - Sizing from Required Tonnage

Target: store 500 t of cement (rho = 1.4 t/m3) with a 10% safety margin, fill factor f = 0.9.

Required volume V = 500 x 1.10 / (1.4 x 0.9) = 436.5 m3

Choose D = 7.2 m (MX-CS-500 class): cylinder volume per meter of height = 0.7854 x 7.2^2 = 40.72 m3/m

Required cylindrical height H_c = 436.5 / 40.72 = 10.7 m, plus a 2.8 m cone; total wall height approx. 13.5 m.

5. Reference Densities

Material	Design Density (t/m3)	Recommended Fill Factor
Portland cement	1.45	0.90
Fly ash (dry)	0.85	0.85
Clinker	1.55	0.85
Limestone (crushed)	1.65	0.88
Coal (bituminous)	0.85	0.90
Slag (granulated)	1.25	0.88
Sand / aggregate	1.75	0.92

6. Practical Tips

- Always apply a 5-10% safety margin on calculated capacity
- Cement and powders compact slightly during storage; use design (maximum) density
- Flat-bottom silos hold more material but need efficient aeration and sweeping systems
- Cone angles of 45-60 deg guarantee mass flow for most powders
- For high moisture or cohesive materials, reduce fill factor and add aeration/vibration
- Manxing engineers verify every calculation with 3D modeling before release for production

Contact Manxing

For quotations, engineering review and site assessment, please contact the Manxing engineering team. Our engineers will respond within one business day.

Email	info@manxingim.com
Tel / WhatsApp	+86 159 3903 7000
Website	https://www.manxingstorage.com
Address	Zhengzhou City, Henan Province, China

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