

20079 – Floatation Calculations

Cellular Storage 01 (CS01)

Design Information

Existing Ground Level (Worst Case) = 23.29m AOD

Finished Ground Level (Lowest / Worst Case) = 23.05m AOD

Ex. GL – 0.15m (Design groundwater level) = 23.14m AOD

Invert Level of Cellular Storage 01 = 21.10m

Total depth from Groundwater to formation level of Cellular Storage Tank = **2.14m**

- Assumed Ground Water Density = 1000 kg/m³
- Assumed London Clay Density = 1800 kg/m³
- Assumed Concrete Density = 2400 kg/m³

Buoyancy Calculation

1.2m x 200m² = 240m³ (Volume removed from ground within water table)

240m³ x 1000 kg/m³ = **240,000 (Upward Force)**

Design Counter Action Calculation (Using London Clay ONLY)

0.60m x 200m² = 120m³ (Volume of London Clay above cellular storage)

120m³ x 1800 kg/m³ = **216,000 (Downward Force)**

240,000 – 216,000 = ~~24,000~~

Design Counter Action Calculation (Using London Clay with 150mm Thick Concrete Slab)

0.45m x 200m² = 90m³ (Volume of London Clay above cellular storage)

90m³ x 1800 kg/m³ = **162,000 (Downward Force)**

0.15m x 200m² = 30m³ (Volume of Concrete Slab)

30m³ x 2400 kg/m³ = **72,000 (Downward Force)**

240,000 – 162,000 – 72,000 = ~~6,000~~

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Design Counter Action Calculation (Using London Clay with 300mm Thick Concrete Slab)

$$0.30\text{m} \times 200\text{m}^2 = 60\text{m}^3 \quad (\text{Volume of London Clay above cellular storage})$$

$$60\text{m}^3 \times 1800 \text{ kg/m}^3 = \mathbf{108,000 \text{ (Downward Force)}}$$

$$0.30\text{m} \times 200\text{m}^2 = 60\text{m}^3 \quad (\text{Volume of Concrete Slab})$$

$$60\text{m}^3 \times 2400 \text{ kg/m}^3 = \mathbf{144,000 \text{ (Downward Force)}}$$

$$240,000 - 108,000 - 144,000 = -12,000 \text{ (1.05 Factor of Safety)}$$

Design Counter Action Calculation (Using London Clay with 500mm Thick Concrete Slab)

$$0.10\text{m} \times 200\text{m}^2 = 20\text{m}^3 \quad (\text{Volume of London Clay above cellular storage})$$

$$20\text{m}^3 \times 1800 \text{ kg/m}^3 = \mathbf{36,000 \text{ (Downward Force)}}$$

$$0.50\text{m} \times 200\text{m}^2 = 100\text{m}^3 \quad (\text{Volume of Concrete Slab})$$

$$100\text{m}^3 \times 2400 \text{ kg/m}^3 = \mathbf{240,000 \text{ (Downward Force)}}$$

$$240,000 - 240,000 - 36,000 = -36,000 \text{ (1.15 Factor of Safety)}$$

Design Counter Action Calculation (Using London Clay with 600mm Thick Concrete Slab)

$$0.20\text{m} \times 200\text{m}^2 = 40\text{m}^3 \quad (\text{Volume of London Clay above cellular storage})$$

$$40\text{m}^3 \times 1800 \text{ kg/m}^3 = \mathbf{72,000 \text{ (Downward Force)}}$$

$$0.60\text{m} \times 200\text{m}^2 = 120\text{m}^3 \quad (\text{Volume of Concrete Slab})$$

$$120\text{m}^3 \times 2400 \text{ kg/m}^3 = \mathbf{288,000 \text{ (Downward Force)}}$$

$$240,000 - 288,000 - 72,000 = -120,000 \text{ (1.50 Factor of Safety)}$$

CS01 Summary

Minimum of 600mm Thick Concrete Slab & 200mm Thick London Clay above Cellular Storage

Minimum cover level of cellular storage = 23.25m AOD

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Cellular Storage 02 (CS02)

Design Information

Existing Ground Level (Highest / Worst Case) = 25.79m AOD

Finished Ground Level (Lowest / Worst Case) = 24.95m AOD (Formation level @ 24.45m AOD)

Ex. GL – 0.15m (Design groundwater level) = 25.64m AOD

Invert Level of Cellular Storage 02 = 21.45m

Total depth from Groundwater to formation level of Cellular Storage Tank = **4.29m**

- Assumed Ground Water Density = 1000 kg/m³
- Assumed London Clay Density = 1800 kg/m³
- Assumed Concrete Density = 2400 kg/m³

Buoyancy Calculation

$0.8\text{m} \times 54\text{m}^2 = 43.2\text{m}^3$ (Volume removed from ground within water table)

$43.2\text{m}^3 \times 1000 \text{ kg/m}^3 = \mathbf{43,200 \text{ (Upward Force)}}$

Design Counter Action Calculation (Using London Clay ONLY)

$2.20\text{m} \times 54\text{m}^2 = 118.8\text{m}^3$ (Volume of London Clay above cellular storage)

$118.8\text{m}^3 \times 1800 \text{ kg/m}^3 = \mathbf{213,840 \text{ (Downward Force)}}$

$43,000 - 213,840 = \mathbf{24,000}$

$43,000 - 213,840 = \mathbf{-170,840 \text{ (3.95 Factor of Safety)}}$