

Attenuation Tank 1 (60m²) Buoyancy Calculations – 99 Unit Scheme

Buoyancy check – Uplift (UPL) limit state design

$$G_{dst;d} + Q_{dst;d} \leq G_{stb;d} + R_d$$

Design Destabilising Actions $\leq$ Design Stabilising Actions

Destabilising Actions

*Assumed water table is above tank through saturated ground conditions

Thus, Volume of water displaced by tank = 1m x 1m x 0.8m deep = 0.8m³;

Density of water = 1000 kg/m³ x 9.81 x 10⁻³ = 9.81 kN/m³

Therefore, characteristic uplift force acting on the tank is:

$$Q_{dst;k} = 0.8\text{m}^3 \times 9.81 \text{ kN/m}^3 = 7.85 \text{ kN}$$

Design Uplift force, $Q_{dst;k} \times \gamma_{Q_{dst;d}} = 7.85 \text{ kN} \times 1.1 = 8.64 \text{ kN}$

Stabilising Actions

* Shear resistance of tank assumed to be negligible; $R_d = 0$

Self-weight of the tank

Modular units = Approx. 57 kg/m³

$$G_{stb;d}; \text{ Modular Units} = 57 \text{ kg/m}^3 \times 9.81 \times 10^{-3} \times 1\text{m}^2 \times 0.8\text{m} = 0.44 \text{ kN}$$

Self-weight of the soil above tank

Density of soil, $P_{soil} = 17.6\text{kN/m}^3$;

Depth of soil over tank = 1.1m

$$G_{stb;d}; \text{ soil} = 17.6\text{kN/m}^3 \times (1.1\text{m} \times 1\text{m}^2) = 19.36\text{kN}$$

Design Permanent Stabilising Force

$$(G_{stb;d}; \text{ Modular Units} + G_{stb;d}; \text{ soil}) \times \gamma_{G_{dst;d}}$$

$$G_{stb;d} = (0.44 \text{ kN} + 19.36\text{kN}) \times 0.9$$

$$G_{stb;d} = 17.820\text{kN}$$

The design inequality for UPL can now be ascertained, thus:

$$8.64 \text{ kN} \leq 17.820\text{kN}; \text{ OK}$$

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MJA CONSULTING

Civil & Structural Engineers

Monarch House • Abingdon Science Park
Barton Lane • Abingdon • Oxon • OX14 3NB