

Attenuation Tank 3 (318 m²) 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;

$$\text{Density of water} = 1000\text{kg/m}^3 \times 9.81 \times 10^{-3} = 9.81\text{kN/m}^3$$

Therefore, characteristic uplift force acting on the tank is:

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

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

Stabilising Actions

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

Self-weight of the tank

$$\text{Modular units} = \text{Approx. } 57 \text{ kg/m}^3$$

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

Self-weight of the soil above tank

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

$$\text{Depth of soil over tank} = 0.80\text{m}$$

$$G_{stb;d; \text{soil}} = 17.6\text{kN/m}^3 \times 0.80\text{m} \times 1\text{m}^2 = 14.08\text{kN}$$

Design Permanent Stabilising Force

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

$$G_{stb;d} = (0.44\text{kN} + 14.08\text{kN}) \times 0.9$$

$$G_{stb;d} = 13.068$$

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

$$8.64\text{kN} \leq 13.068\text{kN} ; \text{OK}$$

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