Polystorm Uplift / Buoyancy Check - Based on Eurocode 7

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Design factor of safety (FoS)

Ultimate Limit State		Uplift (UPL)	
Permanent actions (G)	- Stabilising, $\gamma_{G,stb}$	0.9	*[Table A.NA.15, NA to BS EN 1997-1:2004]*
	- Destabilising, $\gamma_{G,dst}$	1.1	*[Table A.NA.15, NA to BS EN 1997-1:2004]*
Variable actions (Q)	- Stabilising, $\gamma_{Q,stb}$	0	*[Table A.NA.15, NA to BS EN 1997-1:2004]*
	- Destabilising, $\gamma_{Q,dst}$	1.5	*[Table A.NA.15, NA to BS EN 1997-1:2004]*

Assumed installation parameters

Material density	- granular backfill, γ_{Bk}	20.0 kN/m³	*[Assumed]*
	- water, γ_{Wk}	9.81 kN/m³	*[Assumed]*
	- saturated backfill, γ'_{Bk} (= γ_{Bk} - γ_{Wk})	10.2 kN/m³	
Depths	- GL to structure IL, H	0.900 m	
	- GL to GWL, h_w	0.480 m	

Proposed Polystorm structure

Unit description	Polystorm-R
Product code	PSM1A
Structure depth, h_1	0.400 m
Cover depth, h_c	0.500 m

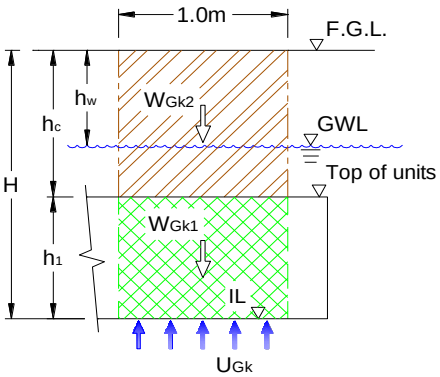

Fig 1) Definitions illustration

Actions

Displaced water volume, Vol_{cell} 0.40 m³/m²

Characteristic destabilising

Water uplift, U_{Gk} *3.92 kN/m²*
(= γ_{wk} x Vol_{cell})

Characteristic stabilising

Self weight of	- Polystorm structure, W_{Gk1}	*0.19 kN/m²*	*[Polypipe technical data]*
	- Backfill, W_{Gk2} (If h_w<h_c = γ_{Bk} x h_w; else = γ_{Bk} x h_c)	*9.60 kN/m²*	
	- Saturated fill, W'_{Gk2} (= γ'_{Bk} x [h_c - h_w])	*0.20 kN/m²*	

Effects of Actions

Destabilising design vertical actions, $V_{d,dst}$ ***4.32 kN/m²***
(= $\gamma_{G,dst}$ x U_{Gk})

Stabilising design vertical actions, $V_{d,stb}$ ***8.99 kN/m²***
(= $\gamma_{G,stb}$ x W_{Gk})

Degree of utilization, Λ_{UPL} *48 %* **< 100%; Passes Check**
(= $V_{d,dst}$ / $V_{d,stb}$)

Traditional Verification of Stability Against Uplift

Traditional lumped FoS, F **2.5**
(= W_{GK} / U_{GK})

Notes

1. Groundwater assumed to act as a permanent destabilising action
2. If uncertainty in the level of ground or free water exists, consideration should be given to the application of a safety margin to the assumed characteristic water level
3. The above assessment assumes that the Polystorm structure is completely flexible and that there is negligible fricitional resistance between the geocellular structure and the native soil. The uplift stability verification has therefore been simplified, based on a m² (plan area) basis.

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