Polypipe

Polystorm Uplift / Buoyancy Check - Based on Eurocode 7
Winscott Farm - Tank 1 Buoyancy Check - Min depth of 2m GWL at GL

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}	10.2 kN/m³	
	$(= \gamma_{Bk} - \gamma_{Wk})$		
Depths	- GL to structure IL, H	2.000 m	
	- GL to GWL, h_w	0.000 m	

Proposed Polystorm structure

Unit description	Deep
Product code	PSM5
Structure depth, h_1	0.800 m
Cover depth, h_c	1.200 m

Actions

Displaced water volume, Vol_{cell}   0.80 m³/m²

Characteristic destabilising
Water uplift, U_{Gk}   7.85 kN/m²
$(= \gamma_{wk} \times Vol_{cell})$

Characteristic stabilising

Self weight of	- Polystorm structure, W_{Gk1}	0.43 kN/m²	*[Polypipe technical data]*
	- Backfill, W_{Gk2}	0.00 kN/m²	
	(If $h_w < h_c = \gamma_{Bk} \times h_w$; else $= \gamma_{Bk} \times h_c$)		
	- Saturated fill, W'_{Gk2}	12.23 kN/m²	
	$(= \gamma'_{Bk} \times [h_c - h_w])$		

Fig 1) Definitions illustration

Effects of Actions

Destabilising design vertical actions, $V_{d,dst}$ **8.63 kN/m²**
$(= \gamma_{G,dst} \times U_{Gk})$

Stabilising design vertical actions, $V_{d,stb}$ **11.39 kN/m²**
$(= \gamma_{G,stb} \times W_{Gk})$

Degree of utilization, Λ_{UPL} *76 %*   **< 100%; Passes Check**
$(= V_{d,dst} / V_{d,stb})$

Traditional Verification of Stability Against Uplift

Traditional lumped FoS, F   **1.6**
$(= W_{Gk} / U_{Gk})$

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.
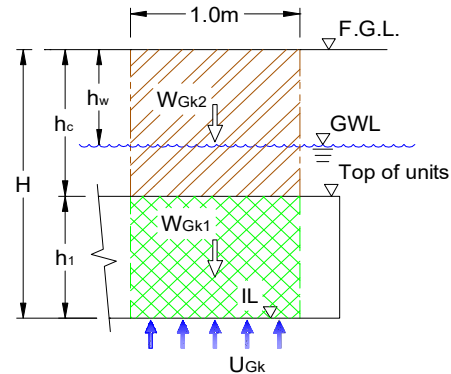
Polystorm Uplift / Buoyancy Check - Based on Eurocode 7

Winscott Farm - Tank 1 Buoyancy Check - Max depth of 2.7m GWL at GL

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}	10.2 kN/m³	
	(= γ_{Bk} - γ_{Wk})		
Depths	- GL to structure IL, H	2.700 m	
	- GL to GWL, h_w	0.000 m	

Proposed Polystorm structure

Unit description	Deep
Product code	PSM5
Structure depth, h_1	0.800 m
Cover depth, h_c	1.900 m

Actions

Displaced water volume, Vol$_{cell}$	0.80 m³/m²

Characteristic destabilising

Water uplift, U_{Gk}	7.85 kN/m²
(= γ_{wk} x Vol$_{cell}$)	

U_{Gk}

Fig 1) Definitions illustration

Characteristic stabilising

Self weight of	- Polystorm structure, W_{Gk1}	*0.43 kN/m²*	*[Polypipe technical data]*
	- Backfill, W_{Gk2}	*0.00 kN/m²*	
	(If h_w<h_c = γ_{Bk} x h_w; else = γ_{Bk} x h_c)		
	- Saturated fill, W'_{Gk2}	*19.36 kN/m²*	
	(= γ'_{Bk} x [h_c - h_w])		

Effects of Actions

Destabilising design vertical actions, $V_{d,dst}$	*8.63 kN/m²*	
(= $\gamma_{G,dst}$ x U_{Gk})		
Stabilising design vertical actions, $V_{d,stb}$	*17.81 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.
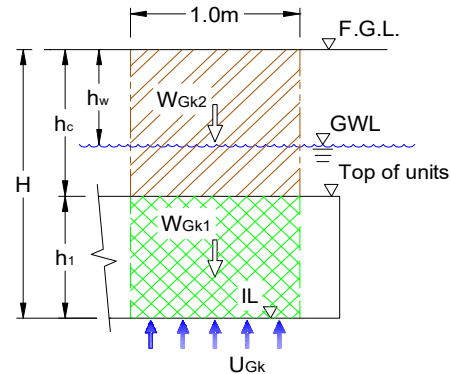
Polystorm Uplift / Buoyancy Check - Based on Eurocode 7

M43012 - Winscott Farm - Floation Check - at 1.8m dp

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}	9.8 kN/m³	*[Assumed]*
	- Saturated backfill, γ'_{Bk}	10.2 kN/m³	
	($= \gamma_{Bk} - \gamma_{Wk}$)		
Depths	- GL to structure IL, H	1.800 m	
	- GL to GWL, h_w	0.400 m	

Proposed Polystorm structure

Layer 1 unit type	Xtra	(PSM3)
Layer 2 unit type	Polystorm-R	(PSM1A)
Layer 1 depth, h_1	0.210 m	
Layer 2 depth, h_2	0.800 m	
Total structure depth	1.010 m	
Cover depth, h_c	0.790 m	

Fig 1) Definitions illustration

Actions

Displaced water volume, Vol_{cell} 1.01 m³/m²

Characteristic destabilising

Water uplift, U_{Gk} 9.91 kN/m²
($= \gamma_{wk} \times Vol_{cell}$)

Characteristic stabilising

Self weight of	- Polystorm layer 1, W_{Gk1}	0.12 kN/m²	*[Polypipe technical data]*
	- Polystorm layer 2, W_{Gk1}	0.38 kN/m²	*[Polypipe technical data]*
	- Backfill, W_{Gk2}	8.00 kN/m²	
	(If $h_w < h_c = \gamma_{Bk} \times h_w$; else $= \gamma_{Bk} \times h_c$)		
	- Saturated fill, W'_{Gk2}	3.97 kN/m²	
	($= \gamma'_{Bk} \times [h_c - h_w]$)		

Effects of Actions

Destabilising design vertical actions, $V_{d,dst}$ **10.90 kN/m²**
($= \gamma_{G,dst} \times U_{Gk}$)

Stabilising design vertical actions, $V_{d,stb}$ **11.22 kN/m²**
($= \gamma_{G,stb} \times W_{Gk}$)

Degree of utilization, Λ_{UPL} *97 %* **< 100%; Passes Check**
($= V_{d,dst} / V_{d,stb}$)

Traditional Verification of Stability Against Uplift

Traditional lumped FoS, F **1.3**
($= W_{GK} / U_{GK}$)

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.
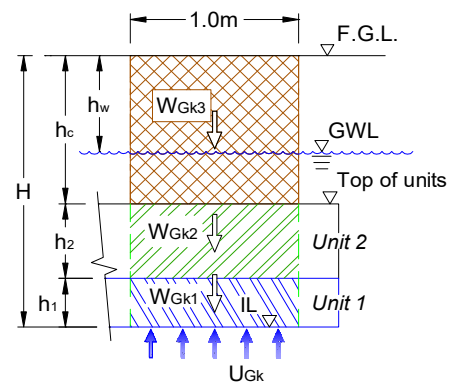
Polystorm Uplift / Buoyancy Check - Based on Eurocode 7

M43012 - Winscott Farm - Floation Check - at 3m dp

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}	9.8 kN/m³	*[Assumed]*
	- Saturated backfill, γ'_{Bk}	10.2 kN/m³	
	(= γ_{Bk} - γ_{Wk})		
Depths	- GL to structure IL, H	3.000 m	
	- GL to GWL, h_w	0.000 m	

Proposed Polystorm structure

Layer 1 unit type	Xtra	(PSM3)
Layer 2 unit type	Polystorm-R	(PSM1A)
Layer 1 depth, h_1	0.210 m	
Layer 2 depth, h_2	0.800 m	
Total structure depth	1.010 m	
Cover depth, h_c	1.990 m	

Fig 1) Definitions illustration

Actions

Displaced water volume, Vol_{cell}   1.01 m³/m²

Characteristic destabilising

Water uplift, U_{Gk} *9.91 kN/m²*

(= γ_{wk} x Vol_{cell})

Characteristic stabilising

Self weight of	- Polystorm layer 1, W_{Gk1}	*0.12 kN/m²*	*[Polypipe technical data]*
	- Polystorm layer 2, W_{Gk1}	*0.38 kN/m²*	*[Polypipe technical data]*
	- Backfill, W_{Gk2}	*0.00 kN/m²*	
	(If h_w<h_c = γ_{Bk} x h_w; else = γ_{Bk} x h_c)		
	- Saturated fill, W'_{Gk2}	*20.28 kN/m²*	
	(= γ'_{Bk} x [h_c - h_w])		

Effects of Actions

Destabilising design vertical actions, $V_{d,dst}$ **10.90 kN/m²**

(= $\gamma_{G,dst}$ x U_{Gk})

Stabilising design vertical actions, $V_{d,stb}$ **18.70 kN/m²**

(= $\gamma_{G,stb}$ x W_{Gk})

Degree of utilization, Λ_{UPL} *58 %*   **< 100%; Passes Check**

(= $V_{d,dst}$ / $V_{d,stb}$)

Traditional Verification of Stability Against Uplift

Traditional lumped FoS, F   **2.1**

(= 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 simp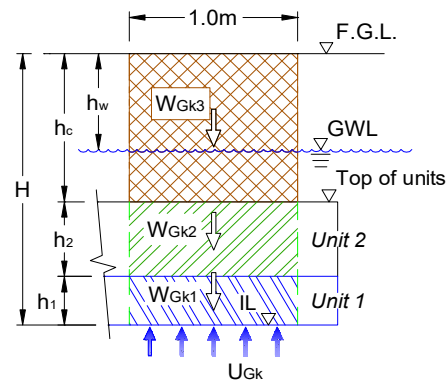lified, based on a m² (plan area) basis.