

Structural Design of Cellular Stormwater Tank



Project details

Site	Church Farm Pagham	Calculations by	PRW
Client	Bourne Leisure	Reference/Date	8707 21/09/2017

Material properties

Unit name	Permavoid	
Design parameters	Vertical	Lateral
Design ultimate compressive strength	715	156 N/mm^2
Short term deflections	126	15 mm per 100mm^2
Max long term vert load	143	20% of max N/mm^2 to long term creep parameter
Creep deflections	0.0055	
Limiting deflection		
Dead load	5	mm permanent
Live load (traffic)	2	mm elastic
Lateral loads		10
Creep	5	mm creep

Installation details

Cover depth	0.25m
Depth to base	0.56
Height of tank	0.300m
Design life	25 years
Soil unit weight	20 kN/m^3
Soil type	Made Ground
α	31.7 degrees
Depth to groundwater	1m
Settle	0.555
R_{a}	0.296

GWL below base of deepest tank

Partial factors

	Ultimate limit state vertical	Ultimate limit state lateral	Serviceability limit state vertical and lateral
Permanent load	1.40	1.35	1.00
Variable (live) load	1.60	1.50	1.00
Material factor	2.75	2.75	1.5

Favourable

Unfavourable

Uplift
Dynamic: breaking and turning factor

Favourable	Unfavourable
0.35	1.50
	1.25

Loads

Variable (live) loads

Designated load	10 N/m^2	16,000kg Vehicles
Concentrated load	50kN	DN 1072 16/16
Width of load contact area	0.2m	HGV min surface contact dimension
Length of load contact area	0.4m	HGV min surface contact dimension
Load spread angle	33.7°	1 in 1 = 4° 2 in 1 = 28.6° 1.5 in 1 = 30.2°

Calculations

Lateral loads

Ultimate lateral load (factored)	6.60 N/mm^2	
Lateral load (serviceability)	4.64 N/mm^2	
Ultimate limit state resistance from units (factored)	56.75 N/mm^2	Pass, units are strong enough
Horizontal deflections	0.46 mm	Pass, deflections acceptable

Uplift or flotation

Water displaced depth	0.44 m	
Uplift force (factored)	-6.60 kN/m2	
Dead weight (factored)	4.94 kN/m2	Pass

Vertical loads

Distributed

Ultimate vertical load on units (factored)	23.28 N/mm^2	
Vertical load (unfactored)	15.2 N/mm^2	
Ultimate limit state resistance from units (factored)	260.00 N/mm^2	Pass, units are strong enough
Deflections (elastic)	0.13 mm	Acceptable
Deflections (creep)	0.07 mm	Acceptable
Over	25	years

Concentrated

Ultimate vertical load on units (factored) includes dead weight	252.17 N/mm^2	Dead to ensure strength of units is not exceeded
Vertical load (unfactored) excludes dead weight	153.06 N/mm^2	Used to calculate elastic deflections due to traffic
Ultimate limit state resistance from units (factored)	260.00 N/mm^2	Pass, units are strong enough
Deformations (plastic)	1.80 mm	Acceptable

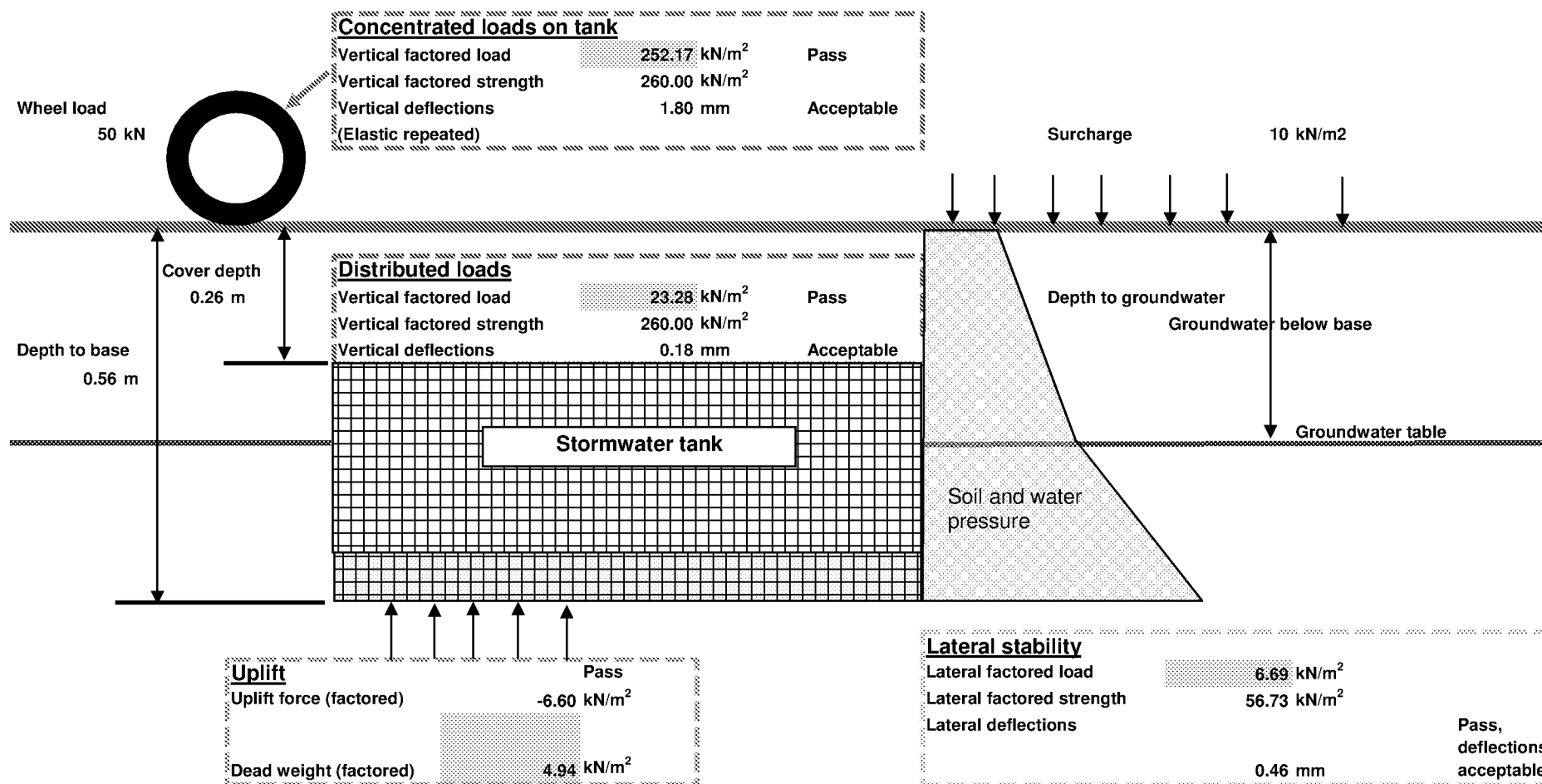
Comments

Based on strength and deformation properties quoted by manufacturer.
Creep load restricted to 20% mobilisation of short term vertical compressive strength over design life.
Lateral pressure based on maximum depth minus 0.25m to allow for load spread at base of unit walls.
Calculations based on British Plastics Federation (BPF), British Board of Agrément (BBA) and CIRIA guidelines.
The client should ensure that all the assumptions made in these calculations are appropriate to the site and that the overlying surfacing is designed to accommodate the predicted movements in the Permavoid. Cranes should also to tolerate the predicted movements. Design assumes foundation below Permavoid has a CBR of at least 5%.

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Summary results (see calculation sheet for full details of input parameters and partial factors of safety)

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Note:

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