FORMAVOID

Economical Sustainable Drainage Systems

UKAS TESTING

Summary

Investigating the Vertical Deformation and Strength Characteristics of Formavoid Filled with MOT Type 3 Granular Infill by Incremental Loading

Test Date: 17/12/2021

Report Date: February 2022

Produced By: BM

Checked By: JHS

Introduction

Vigorous testing has been commissioned the Formavoid 100mm hybrid void forming unit. This report discusses the structural performance of the Formavoid when filled with an MOT Type 3 granular subbase material.

The testing discussed in this report was witnessed by academic professionals and independently tested with calibrated equipment and UKAS accreditation.

Scope of Testing

The initial testing of Formavoid was conducted at Moss Cottage Farm, Lancashire and independently tested & verified by CELTEST. The independent testing company performed an in-situ plate loading test with a 300mmØ plate. Thhis report shows results and summarises the testing of 200mm of Type 3 subbase installed atop the Formavoid. This scope of this testing was decisive enough to illustrate the fundamental characteristics of the product for correct and safe specification.

Equipment Used

14T Excavator
Hydraulic Press
300mm Ø Loading Plate
MOT Type 3 Granular Sub-base to 200mm Cover
Formavoid 100m Units
Plate Testing Kit with Deflection Sensors
Bomag Vibration Roller

Test Method

A test bed was prepared prior to the arrival of the UKAS accredited independent testing operatives. The test bed was installed directly on a concrete yard in a coordinated position so that specific points of the Formavoid can be located and tested (center, joints etc.). 200mm of MOT Type 3 was installed on top of the Formavoid using traditional installation methods. The aggregate was rolled using a bomag vibration roller, ensuring the subbase was compacted properly. Seven test locations were marked the surface, predetermined by coordinates. The 14T excavator was then positioned directly atop these testing locations, ensuring that the slew ring was directly above the testing locations. CELTEST positioned the test

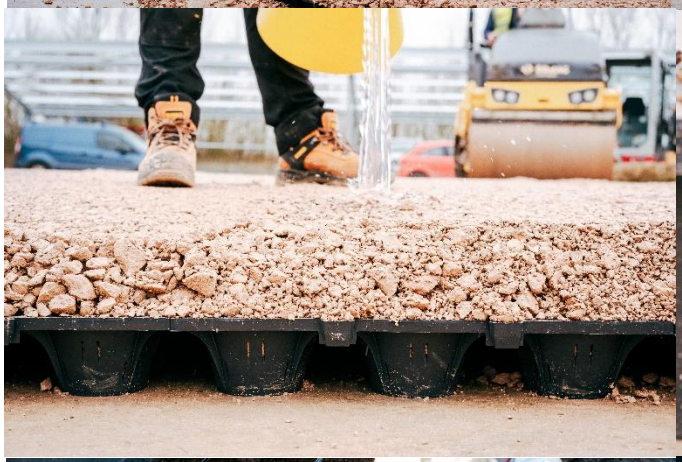
apparatus underneath the 14T excavator and placed the 300mmØ plate on top of the first test location. Deflection sensors were set up and calibrated to zero prior to loading. Loads were applied at various increments and settlement/deflection was recorded for each increment at one minute intervals until movement ceased. The results are presented in tabular and graphical form showing load versus settlement.

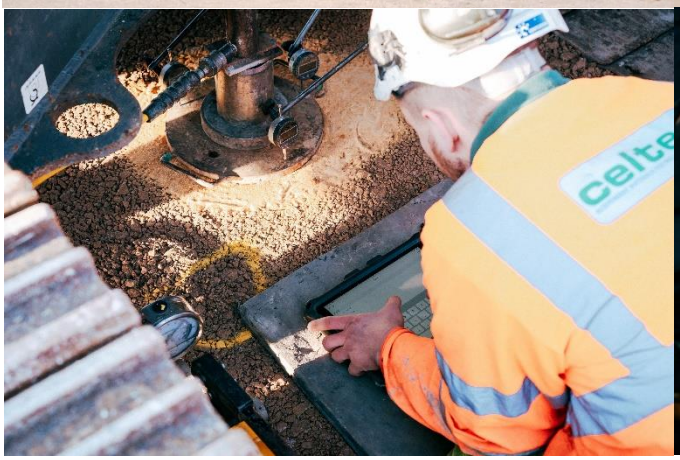
Summary

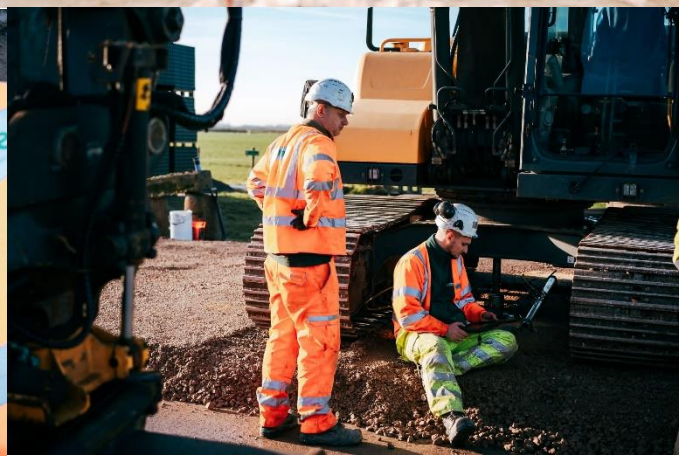
The Formavoid outperformed expectations and presented no indication of failure/yield during this test. A maximum load of 850kN/m² was initially applied to the first test site, however the Formavoid did not yield and it seemed appropriate to increase the maximum load on the subsequent test locations. The maximum applied load was increased to 1275kN/m² which was the capacity of the hydraulic press. Even at 1275kN/m² of applied load, the Formavoid did not yield. Recorded deflections were minimal and in the order of 5mm/6mm, recovering to a permanent deformation of 1.6mm when the load was released. This permanent set can be attributed to small amounts of settlement in the MOT Type 3 aggregate.

Further to the plate test results, various observations were made during the construction of the test bed. During rolling, it was observed that sufficient compaction was achieved after 2-3 passes. It was also observed that the Formavoid provided excellent retention of the granular infill. Following the test, various investigations and discussions with academic and industry professionals concluded that the columns of the Formavoid acted as anchors/plugs, enhancing the inherent interlock of granular material and created excellent retention characteristics.

FORMAVOID







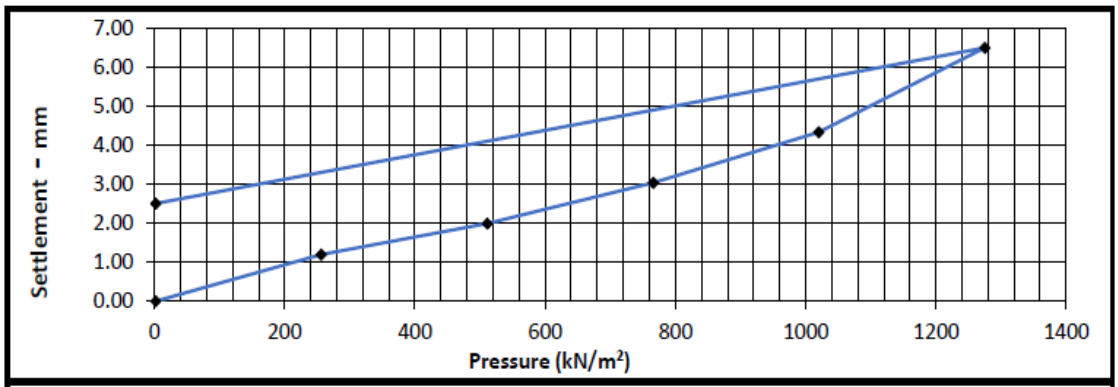
Results/Data

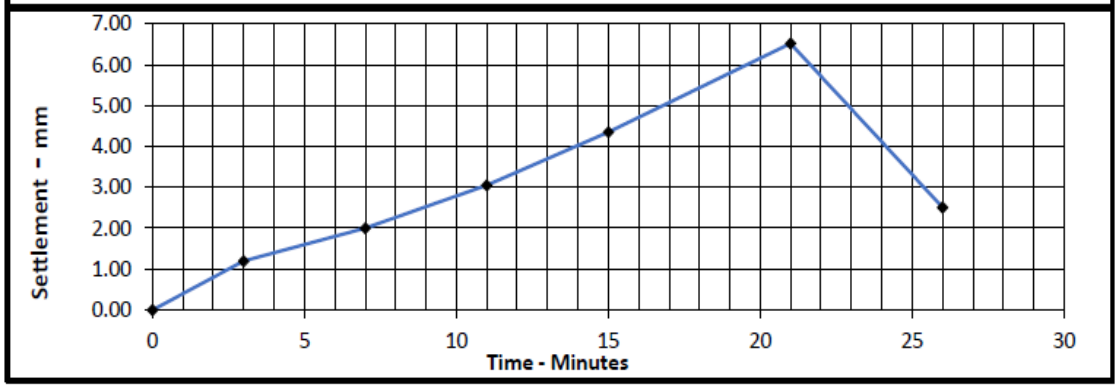
3.2 Test 2

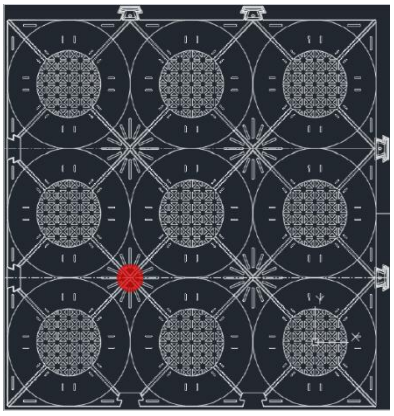
Test Location:	B			**Plate Size:**	300 mm ⌀
Material:	Sub Base			**Initial Temp:**	5 °C
Reaction Load:	14t Excavator			**Final Temp:**	5 °C
Maximum Load:	90kn	**Maximum Applied Pressure:**	1275 kN/m²	**Tested By:**	Iestyn Pritchard
Depth of Test level from Ground Level:			n/a		
Distance Between Edge of Loaded Plate and Excavation Wall:			n/a		

Results

Load (Tonne)	Load (kN)	Pressure (kN/m2)	Cumulative Settlement (mm)	Time Taken To Achieve Settlement	
				Incremental (min)	Cumulative (min)
0.0	0.1	2	0.00	0	0
1.8	18.1	256	1.20	3	3
3.7	36.1	511	2.00	4	7
5.5	54.1	766	3.05	4	11
7.4	72.1	1020	4.35	4	15
9.2	90.1	1275	6.52	6	21
0.0	0.1	2	2.51	5	26





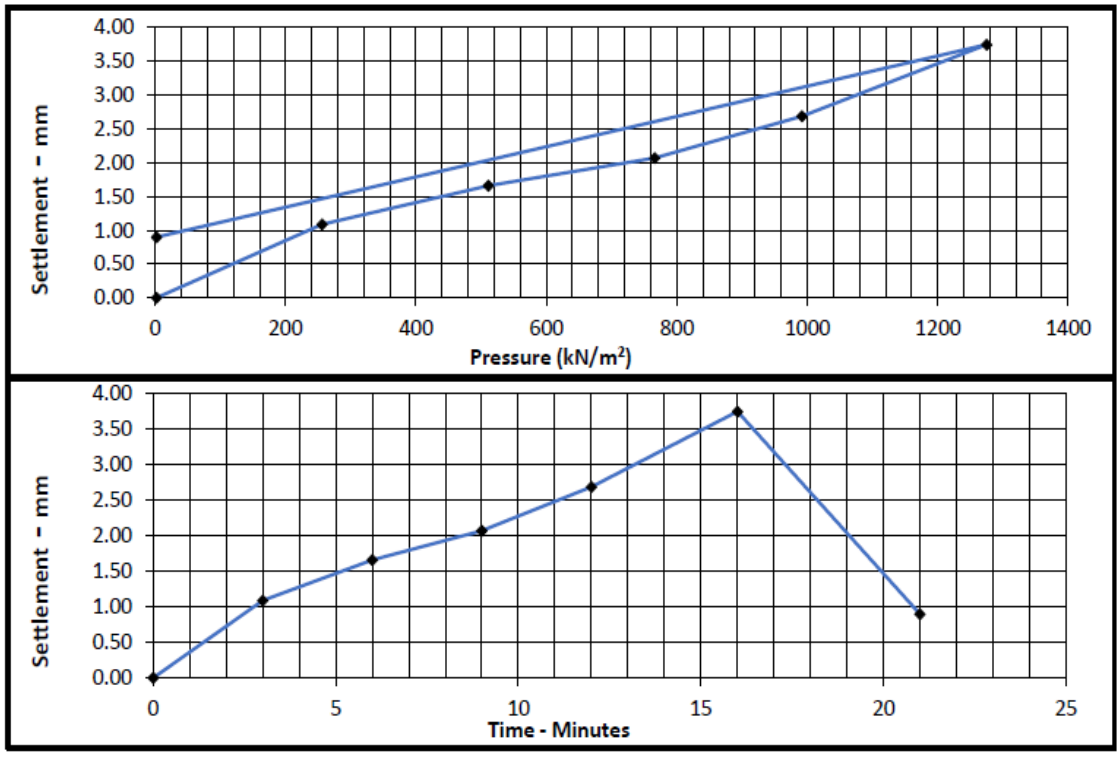


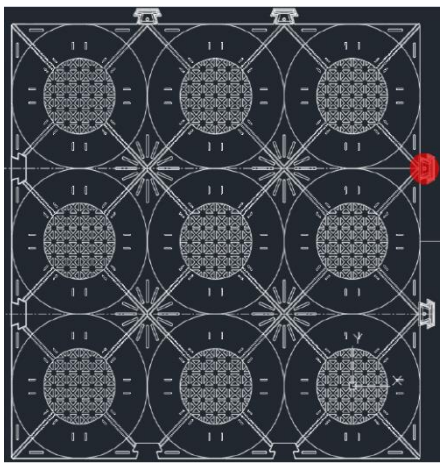
3.3 Test 3

Test Location:	C			**Plate Size:**	300 mm ⌀
Material:	Sub Base			**Initial Temp:**	5 °C
Reaction Load:	14t Excavator			**Final Temp:**	5 °C
Maximum Load:	90kn	**Maximum Applied Pressure:**	1275 kN/m²	**Tested By:**	Iestyn Pritchard
Depth of Test level from Ground Level:			N/A		
Distance Between Edge of Loaded Plate and Excavation Wall:			N/A		

Results

Load (Tonne)	Load (kN)	Pressure (kN/m2)	Cumulative Settlement (mm)	Time Taken To Achieve Settlement	
				Incremental (min)	Cumulative (min)
0.0	0.1	2	0.00	0	0
1.8	18.1	256	1.09	3	3
3.7	36.1	511	1.66	3	6
5.5	54.1	766	2.07	3	9
7.2	70.1	992	2.69	3	12
9.2	90.1	1275	3.75	4	16
0.0	0.1	2	0.90	5	21



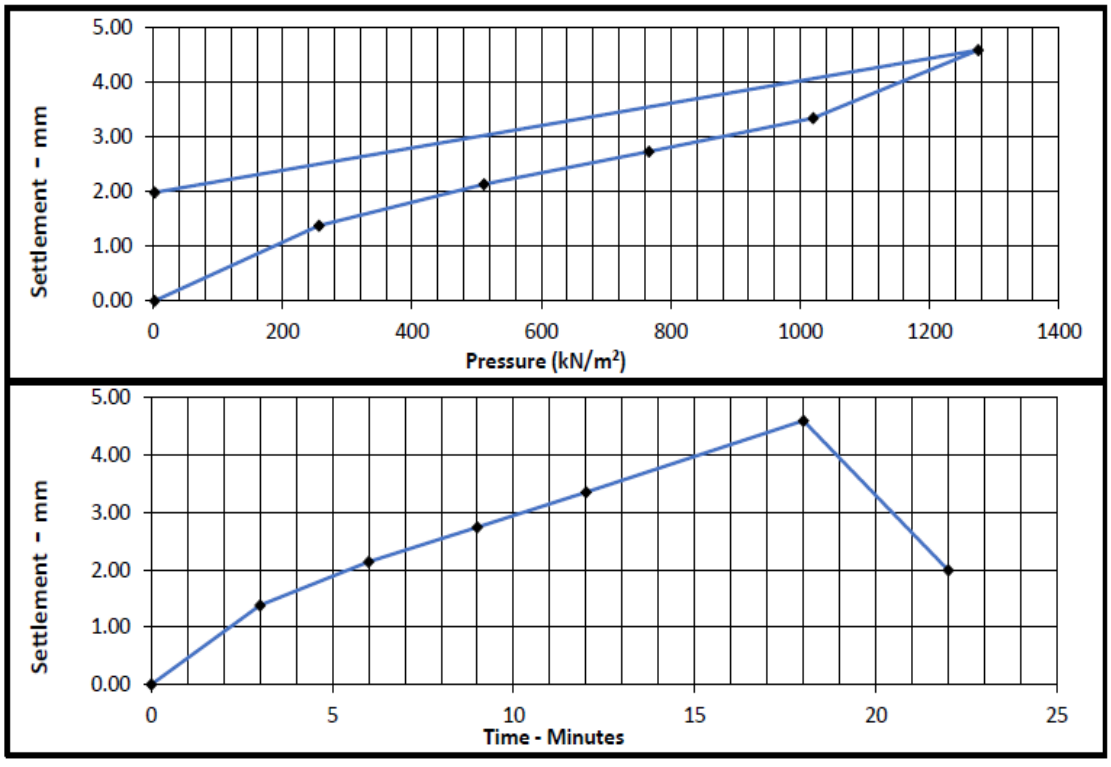


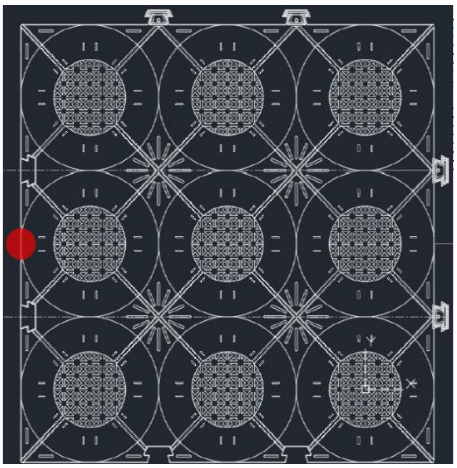
3.4 Test 4

Test Location:	D			**Plate Size:**	300 mm ø
Material:	Sub Base			**Initial Temp:**	5 °C
Reaction Load:	14t excavator			**Final Temp:**	5 °C
Maximum Load:	90kn	**Maximum Applied Pressure:**	1275 kN/m²	**Tested By:**	Iestyn Pritchard
Depth of Test level from Ground Level:			N/A		
Distance Between Edge of Loaded Plate and Excavation Wall:			N/A		

Results

Load (Tonne)	Load (kN)	Pressure (kN/m2)	Cumulative Settlement (mm)	Time Taken To Achieve Settlement	
				Incremental (min)	Cumulative (min)
0.0	0.1	2	0.00	0	0
1.8	18.1	256	1.38	3	3
3.7	36.1	511	2.14	3	6
5.5	54.1	766	2.74	3	9
7.4	72.1	1020	3.35	3	12
9.2	90.1	1275	4.60	6	18
0.0	0.1	2	1.99	4	22



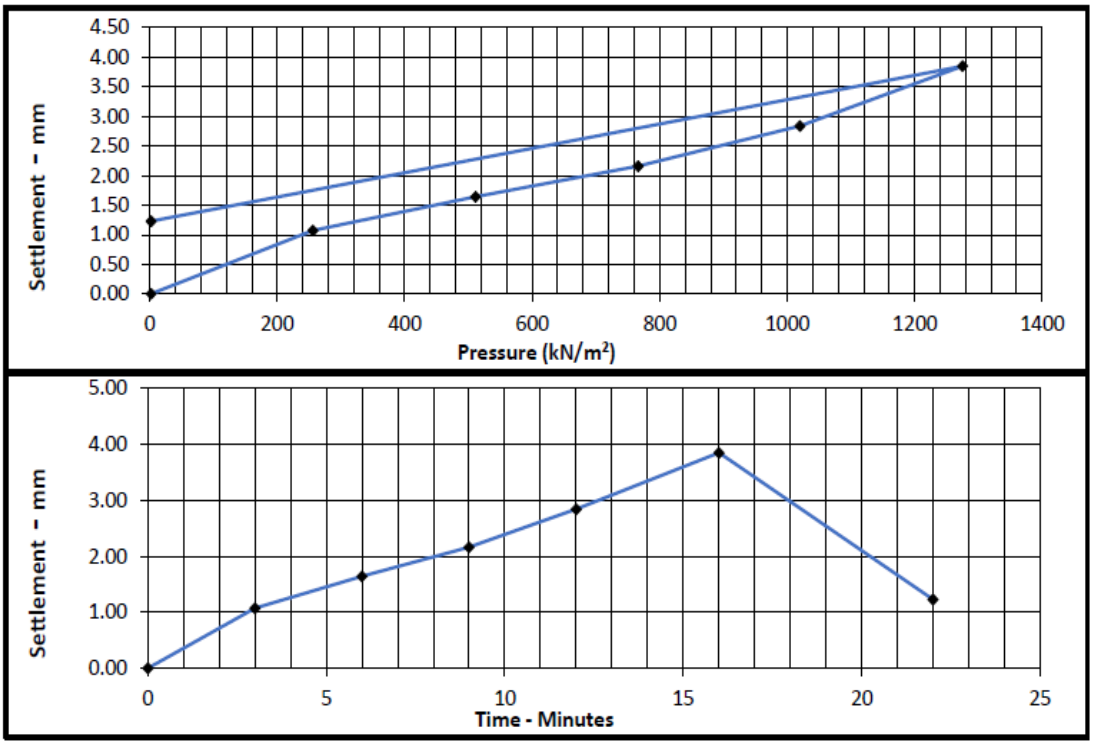


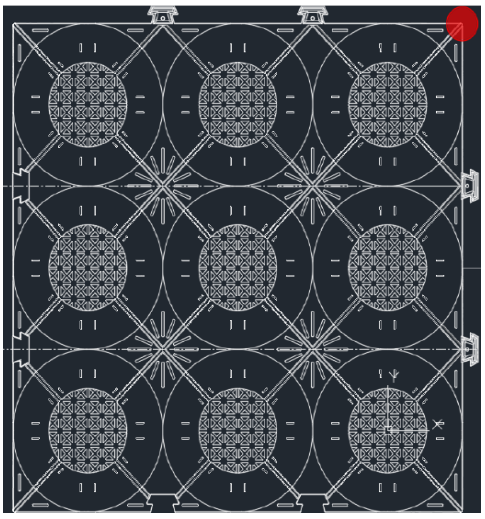
3.5 Test 5

Test Location:	E			**Plate Size:**	300 mm ⌀
Material:	Sub Base			**Initial Temp:**	5 °C
Reaction Load:	14t excavator			**Final Temp:**	5 °C
Maximum Load:	90kn	**Maximum Applied Pressure:**	1275 kN/m²	**Tested By:**	Iestyn Pritchard
Depth of Test level from Ground Level:			N/A		
Distance Between Edge of Loaded Plate and Excavation Wall:			N/A		

Results

Load (Tonne)	Load (kN)	Pressure (kN/m2)	Cumulative Settlement (mm)	Time Taken To Achieve Settlement	
				Incremental (min)	Cumulative (min)
0.0	0.1	2	0.00	0	0
1.8	18.1	256	1.07	3	3
3.7	36.1	511	1.64	3	6
5.5	54.1	766	2.16	3	9
7.4	72.1	1020	2.84	3	12
9.2	90.1	1275	3.85	4	16
0.0	0.1	2	1.23	6	22





3.6 Test 6

Test Location:	F			**Plate Size:**	300 mm ⌀
Material:	Sub Base			**Initial Temp:**	5 °C
Reaction Load:	14t excavator			**Final Temp:**	5 °C
Maximum Load:	90kn	**Maximum Applied Pressure:**	1275 kN/m²	**Tested By:**	Iestyn Pritchard
Depth of Test level from Ground Level:			N/A		
Distance Between Edge of Loaded Plate and Excavation Wall:			N/A		

Results

Load (Tonne)	Load (kN)	Pressure (kN/m2)	Cumulative Settlement (mm)	Time Taken To Achieve Settlement	
				Incremental (min)	Cumulative (min)
0.0	0.1	2	0.00	0	0
1.8	18.1	256	1.04	3	3
3.7	36.1	511	2.42	3	6
5.5	54.1	766	2.56	3	9
7.4	72.1	1020	3.49	5	14
9.2	90.1	1275	5.04	4	18
0.0	0.1	2	1.63	5	23