STORMTANK®
A Brentwood Brand

TECH BULLETIN

Revision 1 **2/6/2017**

StormTank® Urban Root System Bench Scale Load Testing

Background

Brentwood always aims to be the industry leader in product performance. Because of this, we utilize full-scale, installation-based testing, performed by Queen's University. In those tests, the facility installs the system per installation guidelines and installs displacement gauges, as well as strain gauges, to accurately record performance. This test method is important as it integrates the soil structure interaction between the product and the backfill materials. Yet, many other manufacturers continue to test utilizing only bench scale steel press data. To ensure specifiers of the StormTank system have accurate evaluation data to compare against these competitors, Brentwood decided to perform the identical test. Those results are contained within this report.

Test Report

Test Method

1. Maintain an ambient temperature of 72 ± 2°F throughout the test procedure.
2. Assemble the Module using two platens and eight columns.
3. Place the Module, centered, on the bottom platen of the 75-ton press.
4. Apply a pre-load of 2400 lbs. and hold for five minutes.
5. Apply load at a constant speed of 0.2 in/min.
6. Run the test until increasing deflection no longer results in an increasing load.

Test Results

The results of these tests are shown on the right. All test stoppages were due to an incremental decrease in the load required to further deflect the units. Load displacement curves and images of the product are supplied in Figures 1 to 8.

Module Height (in.)	Max Applied Load (lbs.)	Applied Pressure (psi.)	Stroke (in.)
18	70,202	108.34	0.983
24	62,468	96.40	0.974
30	58,994	91.04	0.886
36	44,984	69.42	0.720

18” Module:

Figure 1 - 18" Module at 20,000 lbs., at completion, and after removal from steel press

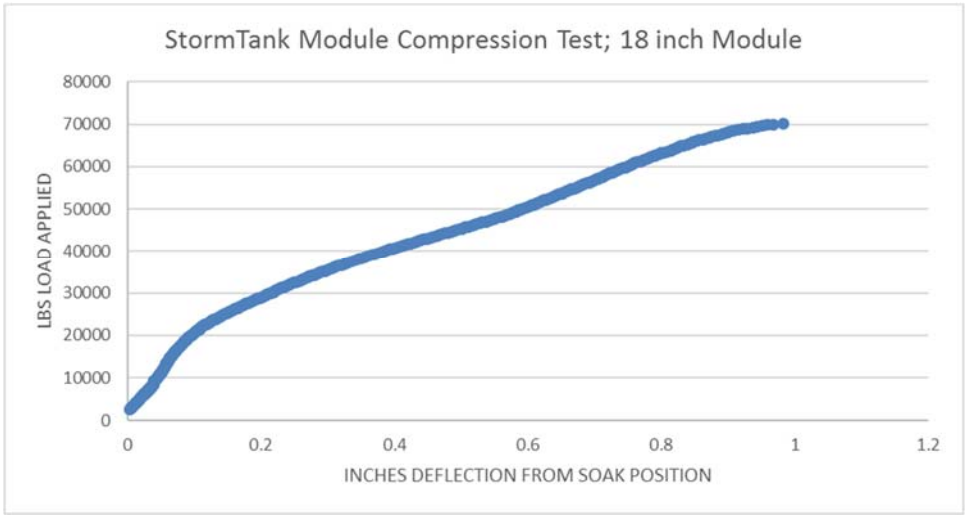

Figure 2 - 18" Module Load v. Displacement Results

24” Module:

Figure 3 - 24" Module at 20,000 lbs., at completion, and after removal from steel press

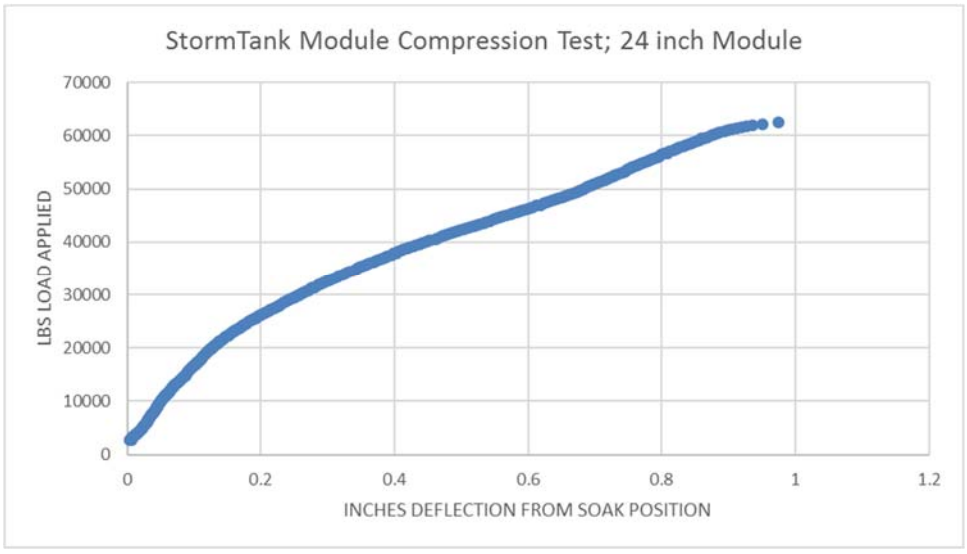

Figure 4 - 24" Module Load v. Displacement Results

30” Module:

Figure 5 - 30" Module at 20,000 lbs., at completion, and after removal from steel press

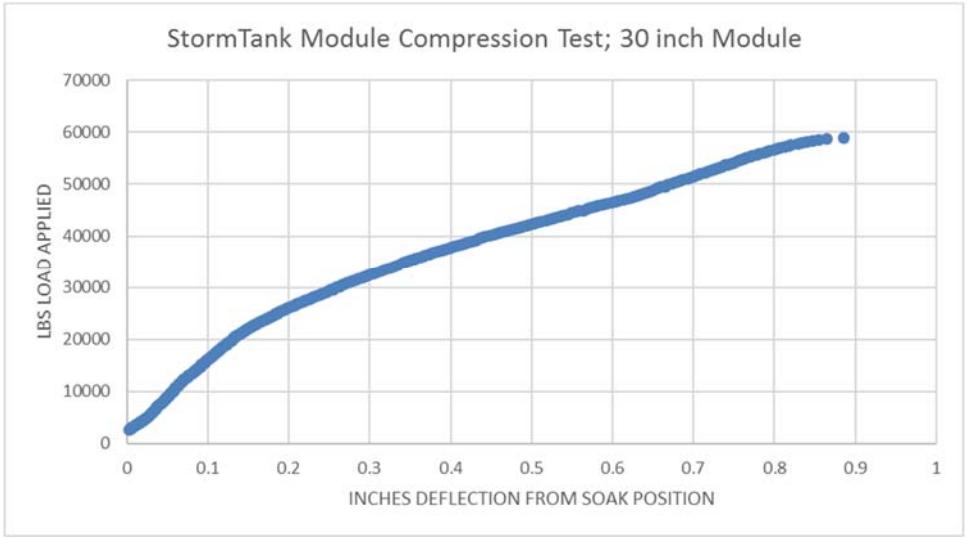

Figure 6 - 30" Module Load v. Displacement Results

36” Module:

Figure 7 - 36" Module at 20,000 lbs., at completion, and after removal from steel press

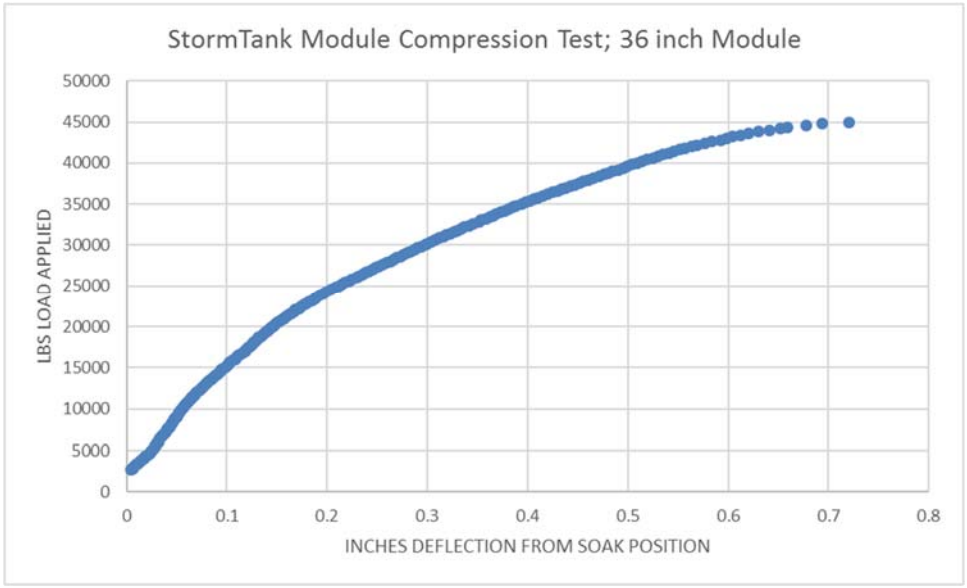

Figure 8 - 36" Module Load v. Displacement Results

Test Observations

1. The first observation is the two distinct Moduli of Elasticity displayed on the graph.

   These two distinct moduli represent the different elements of the StormTank Module functioning during the loading sequence. The initial modulus is that of the columns deflecting under load. The secondary modulus is that of the compression ribs within the sockets of the platen compressing under load. The Module continues to provide loading support through this phase, while additionally preventing a catastrophic rupture or failure.

   As an example, let's look at the 36" unit:

   First, you will notice, when plotted against a test of columns without top and bottom platens, the initial modulus is the same, prior to the engagement of the ribs, which then shifts the curve because the ribs become the limiting factor.

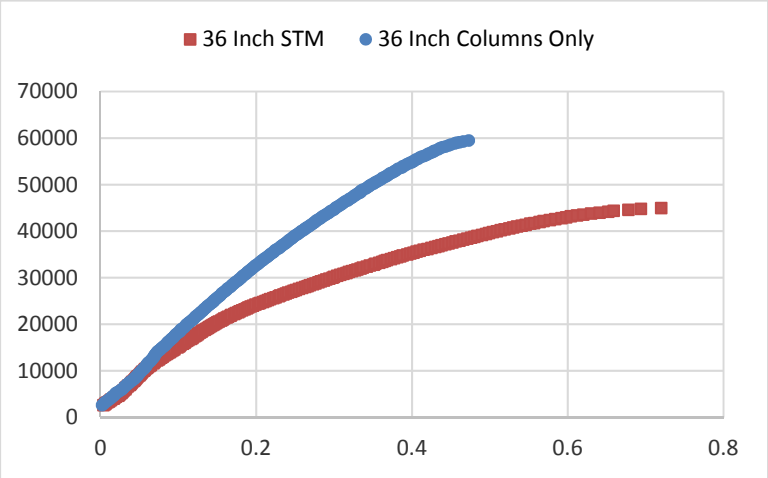

Figure 9 - 36" Compression Testing; Module vs Columns Only

Secondly, the two distant moduli can be calculated as a function of stress over strain. Using Figure 8, you will be able to calculate the initial and secondary moduli:

Initial Modulus:

$$E = \frac{\Delta P/A}{\Delta H/H} = \frac{(11068 - 4853)/54}{(0.063 - 0.024)/36} = \frac{6215/54}{0.039/36} = \frac{115.09}{0.001} = 106{,}239.30\ psi$$

Secondary Modulus:

$$E = \frac{\Delta P/A}{\Delta H/H} = \frac{(37213 - 29418)/54}{(0.443 - 0.287)/36} = \frac{7795/54}{0.156/36} = \frac{144.35}{0.004} = 33{,}311.97\ psi$$

2. No catastrophic failure was observed

   As illustrated by the photographs and data provided, there was no catastrophic or immediate failure during the test. This is because of the integrated compression ribbing and materials utilized in the unit's design. All material removed from the test rig rebounded to a natural state, excluding some markings on the surface of the platens where the ribs within the socket had compressed.

3. When compared to a full-scale installation test, with instrumentation, the bench scale steel pressure results are greater than the full-scale test.

   This difference relates to the full-scale test accounting for soil structure interaction. The bench scale test limits the performance of the product, by utilizing a steel plate against the top and bottom planes of the product. Comparatively, the full-scale test causes the surfaces of the units to interact with the backfill materials, like a real installation. These interactions result in deflections and other factors that impact the total structural capacity.

   Once again, let's look at the 36" unit as an example:

   Full Scale Results:

$$Pressure = \ DL + LL = 120\ pcf * 2' + \frac{53{,}440\ lbs}{12.43\ sf} = 4{,}539.66\ psf = 31.53\ psi$$

   Bench Scale Results:

$$Pressure = \frac{P}{A} = \frac{44{,}984\ lbs}{4.5\ sf} = 9{,}996.44\ psf = 69.42\ psi$$

Structural Soil Cell Comparable Load Performance

To assist in specification and understanding of manufacturer claims, the below table provides comparable results with other Structural Soil Cells on the market.

Manufacturer	Height (in.)	Max. Applied Load (lbs.)	Max. Applied Pressure (psi)
Brentwood	18	70,202	108.34
	24	62,468	96.40
	30	58,994	91.04
	36	44,984	69.42
Silva Cell 2.0	16.7	24,302*	21.10
	30.9	26,597*	23.09
	43.0	22,616*	19.63
StrataVault	16 (30 series)	25,062	43.51*
	16 (60 series)	50,124	87.02*

*Silva Cell 2.0 data from test report prepared by Innova Engineering. StrataVault data from StrataVault specifications.

Conclusion:

Based on the information provided in this document, different tests characterize products differently. It is because of this that it is extremely important to validate the claims of manufacturers and understand the performance criteria before specification. Each system provides unique benefits to shipping, assembly, filling, etc., but reliance on marketing materials is not always the best way to specify a product.