Innovative Sports Technologies, Inc.

Strength of a Sports Surface Underlayment Panel

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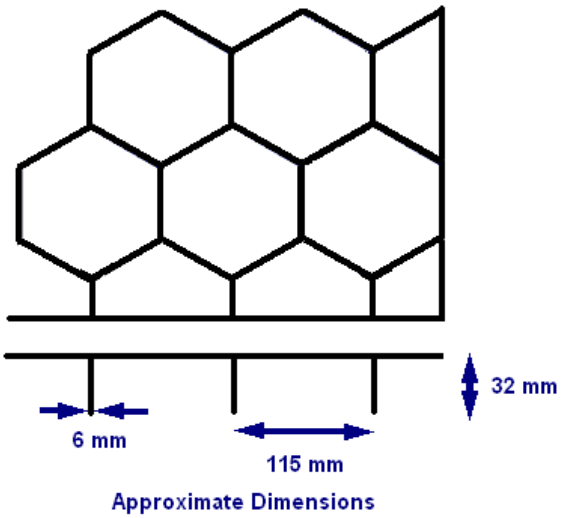
Summary

This report concerns the breaking strength of a molded surface panel. The panel is a semi rigid structure comprised of a flat surface plate and a substructure of vertical walls forming hexagon cells. A sketch of the structure and its approximate dimensions are shown at right.



Approximate Dimensions

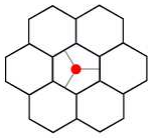
For the purposes of strength testing, the structure is heterogeneous and non-linear – its responses to load depend strongly on how the structure is loaded and how loads are distributed.

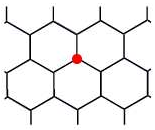
Compressive force-displacement tests were performed at two locations on sample sections of the panel – in the center of a hexagon (nominally the weakest part of the structure) and at the point where three hexagon walls abut to form a "post" (nominally the strongest part of the structure.)

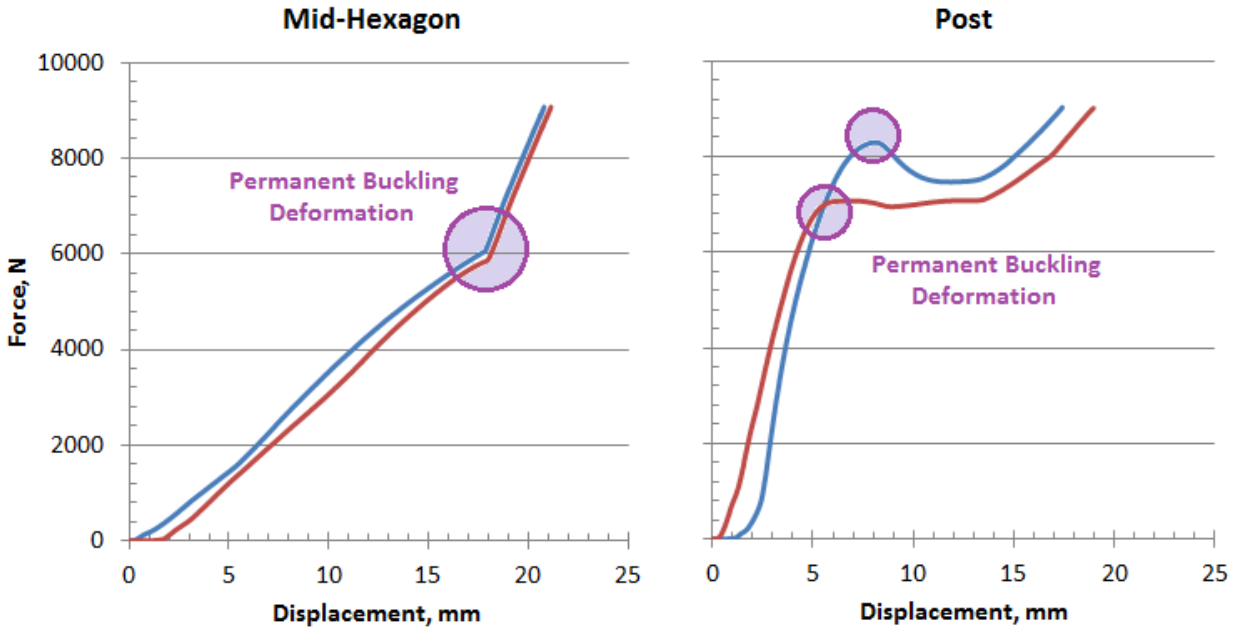
Tests were performed using a Tinius Olsen H 10K UTM with a 50 mm diameter elliptically faced tup (15 mm contact radius) a compression rate of 1 mm s^{-1} and to a maximal load of 9000 N (18 MPa) (~ 2000 lb or 2600 psi) Two examples of each location were tested.

In all cases, the structure failed with permanent plastic deformation at less than the maximal load. Average failure loads for the "mid-hexagon" loading case were 6077 N / 9.2 MPa (1363 lb / 1335 psi). For the "post" load case, average failure loads were ~ 7577 N / 11.5 MPa (1699 lb / 1664 psi).

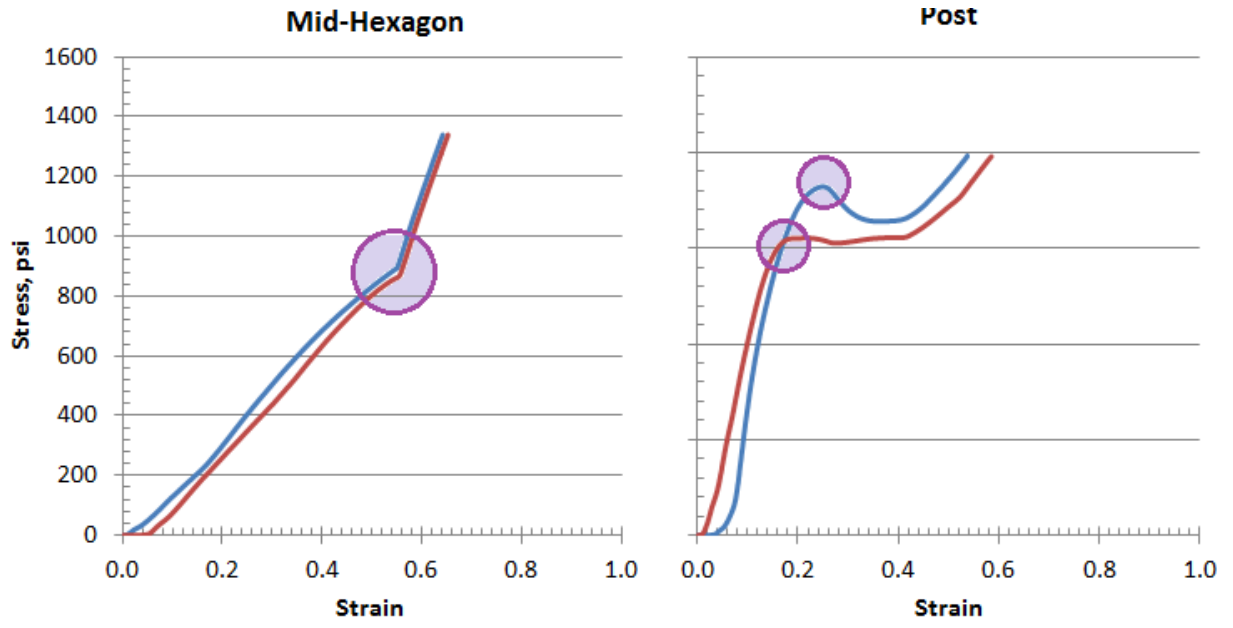
Force-Displacement Curves



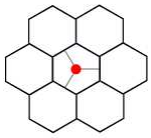


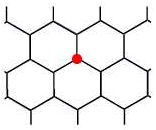


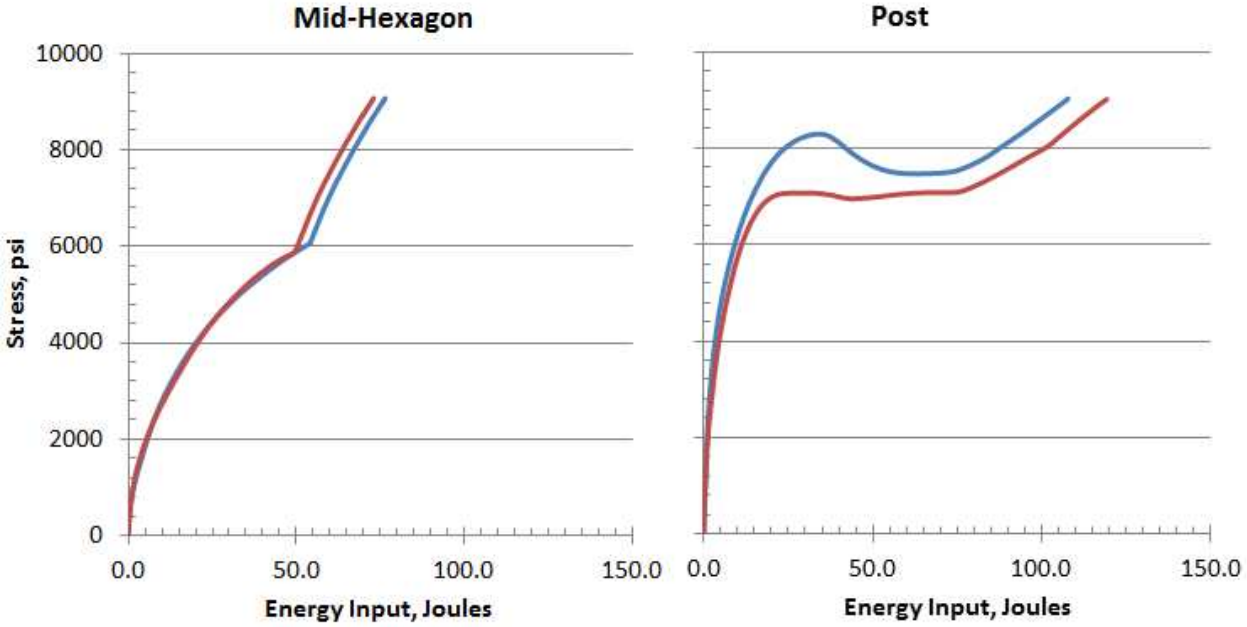
Stress-Strain Curves



Energy Input & Force

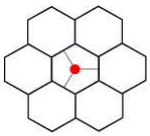


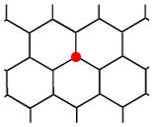




Buckling Loads

Test Site	Trial	Test #	Displacement mm	Displacement in	Force N	Force lb	Strain	Stress MPa	Stress psi	Energy Input Joules	Energy Input ft lb
Mid-Hex	1	6576	18.1	0.70	6293	1411	0.56	9.5	1382	55.4	40.9
	2	6579	18.0	0.60	5860	1314	0.55	8.9	1287	49.2	36.3
	Mean		**18.1**	**0.65**	**6077**	**1363**	**0.56**	**9.2**	**1335**	**52.3**	**38.6**
Post	1	6577	7.4	0.20	8207	1840	0.23	12.4	1803	28.7	21.2
	2	6578	5.4	0.20	6948	1558	0.17	10.5	1526	19.3	14.2
	Mean		**6.4**	**0.20**	**7578**	**1699**	**0.20**	**11.5**	**1664**	**24.0**	**17.7**





In all cases, the structure failed with permanent plastic deformation at less than the maximal load. Average failure loads for the “mid-hexagon” loading case were 6077 N / 3.9 MPa (1363 lb / 559 psi). For the “post” load case, average failure loads were ~ 7578 N / 3.86 MPa (1699 lb / 559 psi).