

**Title:** Bistable Embrace

**Dimensions:** 1m (H) x 1m (L) x 1.5m (B), 5 total installation units

**Materials:** Silicone Rubber, Aluminium Extrusions/Wood Frame

**Proposal Type:** Interactive Large Scale Installation/Spectacle

**Concept Proposal:**

Bistable Embrace will be an interactive installation measuring 1m by 1m made up of a flexible multistable metasheet arrayed with evenly spaced domes. This sheet will be cast out of silicone rubber that allows easy inversion of each dome when they are interacted with by audiences. A stand attached in the middle will act a pinned boundary condition allowing easy inversion of each dome. The sheet will be positioned such that the domes will be convex towards the audience encouraging them to be touched and pressed. The mold for each dome will comprise of two parts and either be manufactured through 3D printed in PLA plastic or CNC milled in wood. A pourable or dough like skin safe silicone rubber will then be deposited into each manufactured mold for curing within a 24-hour period. Assembly will then consist of adhering each dome to form the final grid (Figure 2) that will measure 5-by-5 domes, totalling 25 domes per sheet for a total of five dome metasheets. A wooden or aluminium structure will then support the dome sheet vertically, being bottom heavy to ground the structure to the floor. Additions for further securing the overall structure will be considered.

To invert each dome, the viewer will place one of their hands at the edge of a dome or the sheet while the other hand presses down at the pinnacle of the dome. As the domes are inverted one-by-one by audiences, the stress from the inversion will be retained in discrete pockets where the inversions are located. This will gradually case the dome sheet to curve towards the viewer. Depending on the order, and how the domes are pressed, the resulting form will vary from creating in cylindrical wrap-around to an overhead covering over the viewer (Figure 3). As each dome is inverted, they will stay in their inverted state until manually pushed back to their original configuration. When the domes revert back to their original state, the sheet will then also return to its original flat state. In addition to a description that will include the technology used and the concept of the installation accompanying each installation, instructions for interaction such as suggesting the location to stand and encouragement to invert the domes will be placed on the ground to further encourage audience interaction.

Bistable Embrace aims engage students by bringing one of many emerging technologies within engineering research out of the lab environment and into the public space. Through this we hope to introduce novel applications with multistable metastructures through one or more of these interactive installations and break the paradigm of engineering research being purely for pragmatic and functional application. Furthermore, after an extended indeterminate period in which people have not been able to publicly embrace each other due to the pandemic, the creation of the dome wrapping around individuals creates a viewer determined pseudo-private space. Bistable Embrace allow audiences to imbue an inanimate object with a lifelike characteristic in the desire for reciprocal contact.

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**Artist Impression** (Image may not be an accurate representation of final structure):

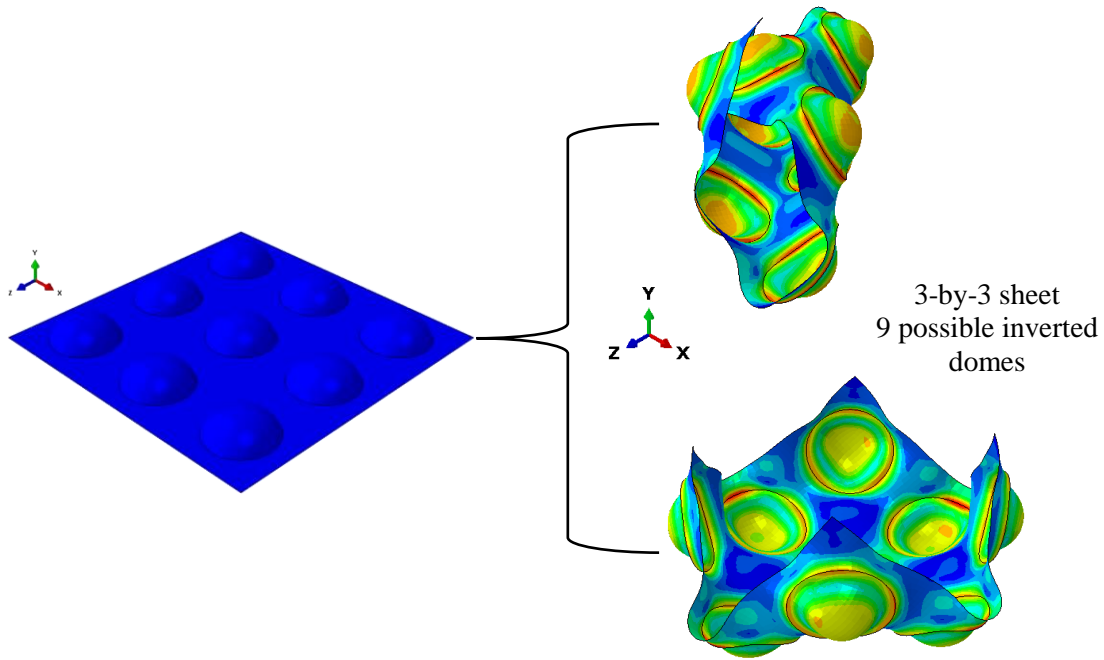


Figure 1 – Simulations of 3-by-3 dome sheet and two possible deformations and shapes of a dome sheet. Similar outcomes are observed for larger dome metasheets.



Figure 2 – Scale down version of silicone rubber casting of single dome structure. Overall structure will be roughly 20cm in length and breadth with a dome height around 7.5cm. From left to right: Single unit dome in its as-cast state, inverted state after interaction and top view for scale (1 square:1cm)

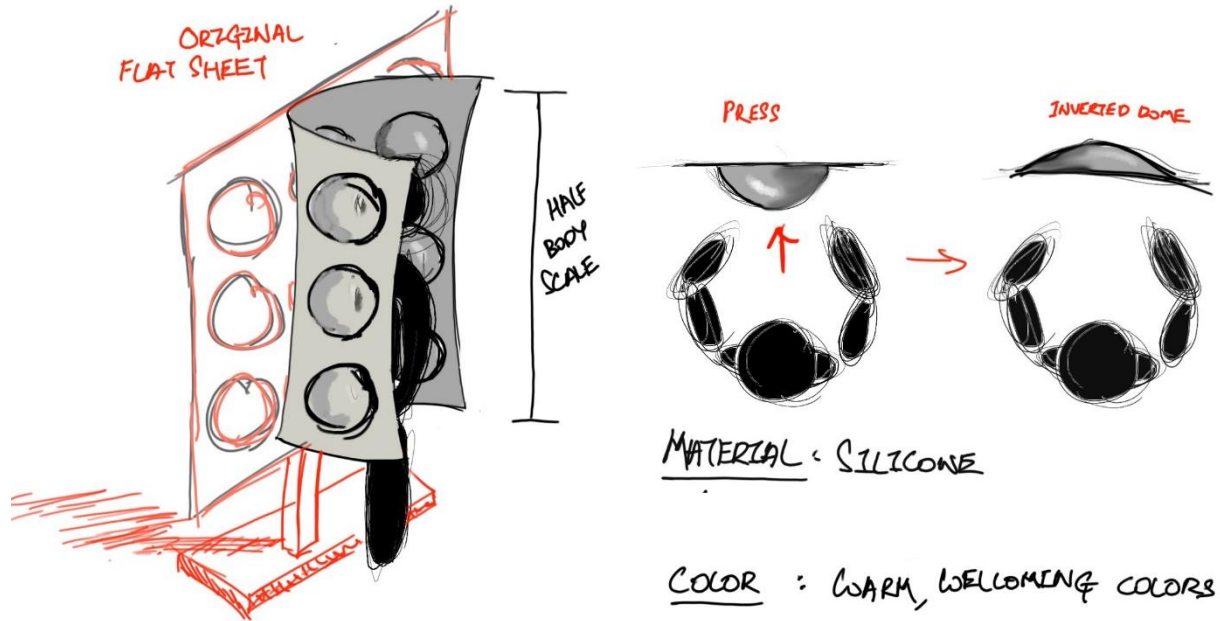


Figure 3 – Artist impression sketch of desired interaction and response of dome sheet for a 3-by-3 layout. Proposed installation is for a 5-by-5 sheet. If greater variations are required when interacted with, more domes can be added to the developed dome metasheet.

**Estimated Budget breakdown (for 5 dome sheets plus stand that the sheet will be attached to. Costs can be adjusted accordingly depending the number of dome sheets):**

<b>Material</b>	<b>Description</b>	<b>Unit Price</b>	<b>Quantity</b>	<b>Total</b>
Silicone Rubber	Silicone rubber for molding and casting either in a viscous caulk or pourable 2-part mix. Material will also be used for assembly of individual domes into full scale sheet. (1 sheet, 5-by-5 domes, requires 1.5 gallons/5.75l or equivalent of silicone rubber)	\$150 (1-gallon tubs, Smooth-On)	8	\$1200
Wood/PLA Filament	Materials for manufacturing of 2-part mold for individual unit cells prior to assemble. Wood – CNC milled, PLA Filament – 3D printed.	\$70 (PLA, Matter Hackers)	10	\$700
Aluminium Extrusions/Wood/Angle Iron	Extrusions/Wood/angle irons for the manufacture display support structure for silicone dome sheet that will stand vertically and anchored in the middle of the sheet. Including the linkages required. Total inclusive of the joints/linkages/nuts and bolts.	\$350 (10 ft aluminium extrusions, McMaster Carr)	5	\$1750
Vaseline/Mold Release Agent	Release agent for the mold. Costs included but may not be necessary.	\$50 (Smooth-on, Home Depot, Menards)	1	\$50
Miscellaneous Tooling	Tooling considerations including, but not limited to: <ul style="list-style-type: none"> <li>• Mixing pots</li> <li>• Screws/nuts/bolts</li> <li>• Tape</li> <li>• Clamps</li> </ul>	\$300 (Amazon, Home Depot, Menards, Purdue Machine Shops)	1	\$300
Man hours	Single individual manufacturing the structure at \$10/hr for a period of 20 hours/week for 1 month	\$10	120 hours	\$1200
			<b>Total</b>	<b>\$5200</b>