Torqueing Spheres

Folly formalism and new material techniques are brought together to produce unusual forms that promote the experience of sculpted space for the collective and the individual: for the public and the secluded. These spaces take advantage of traditional architectural inventions of vaults, arches, and domes in the production of voluminous surfaces for the contemplation of art in the public park and outdoor museum of the Socrates Sculpture Park.

To provide this folly for the Architectural League, straightforward building geometries undergo a transformation to produce unusual and new surfaces. Traditional architectural types of domes, squinches, and pendentives are manipulated to provide a new surface and construction type of Torqueing Spheres. The transfer from this digital practice to material and construction yields innovative and tectonic fabrication techniques. The resulting form is a complex doubly-curved membrane, but made by simple construction techniques that creates a monocoque shell that is self-supporting without a structural frame.
Torqueing Spheres

We are interested in creating a series of intertwining spaces that promote social interaction created from a simple transformation of formal geometries.

New Social Space, Material, Procedure
The resulting folly for the Architectural League is a creative set of outcomes that are gained when stable forms are given unusual rules. Historically, the invention of architectural form have been dictated from geometric rules that are bound by tectonics, structure, material, and building technology. The evolution of corbelling bricks to squinches to vousoir arches is one example. Arches cut from domes has produced the invention of what we call pendentives - a strange non-shape that is neither square nor circular but allows a sphere to rest over a rectangle. The very invention and strange nature of this pendentive comes from the desire for the resolution between curved and straight lines; A folly-like twisting of elements that produced a completely new structural strategy.

(In)Fidelity: Geometric Digital Space to Physical Construction
For our project Torqueing Spheres, we are taking a simple straight line that bulges in and out into spherical pods. Like pendentives and squinches, the Torquing Spheres are made from very simple, planar geometries that are transformed by adding a curve that meanders in circular arcs. Furthermore, the non-shape geometric transitions that are produced between the straight line and the circles produce a new structural logic – this folly is self-supporting due to these pendentives.

Integrated into the folly of novel, digital geometries is a careful study of construction and fabrication. The curving surfaces of spheres and their pendentives is crafted from flat panels that are then bent. Normally, this technique of bending plywood is generated by thermforming layers of wood pressed into molds. Examples of this would be Lounge Furniture 670 and 671 by the Eames. We have determined a way to do this without the costly process of steam, molds and adhesives.

By taking flat plywood and cutting particular profiles, we have developed a method to bend off-the-shelf plywood into varying degrees of curvature that is easily done by two unskilled builders. The same method is used to curve plastic panels. By cutting out a fold line as well as a hole in the center of the panel, the material edges can be overlapped and mechanically fixed in place by simple bolts. The variables in this method to create any desired curvature are 1. Thickness of material and 2. Size of opening in profile. We have rigorously tested and prototyped various techniques and formal assemblies to develop systems of control and delivery.

Design and Delivery
Given this variable control, the schedule, budget, and means of production are manageable and tightly defined. The final design and software analysis are therefore known and measurable parameters. The material order and purchase are continuously updated and mapped. The off-site fabrication and milling allows for higher tolerance and factory-level finish – each piece is tabulated and catalogued. Flat-packed and loaded, the delivery of the panels on site is a simple procedure. On site, a small group of employees and students can easily bend the lightweight panels into shape and assemble them together. Due to the overall curved form along straight lines, the folly does not require any structural frame. The panels would form a monocoque, or self-supporting surface. Any foundations or ground work would therefore be minimal as it would only be to anchor the folly to the ground, and not provide structural support. Furthermore, the plywood and polyethylene panels are stained and finished to withstand the heat and rain of the summer months. Both materials are easily recycled – we have a partnership with a recycling artist in residency program that provides access to any amount of construction waste, elevated and assembled into a folly, and then returned to the recycling process.

Public Space, Public Sculpture: The Gathered and Secluded
The Torqueing Spheres folly on the site of the Socrates Sculpture Park is then ready for human interaction for the summer of 2015. Unlike a pavilion, the spaces of this folly are suggested by deep chambers but no enclosure is provided. The folly invites groups of people to enter its larger interior but it also accommodates small groups of two or three to gather inside the deep spherical recesses that fluctuate along its exterior. The overall effect creates a spectacle of inhabited pods that allow for respite, seclusion, and the feeling of one-amongst-the-many that many successful public spaces produce.

The rhythm of smooth polymer surfaces to tactile wood not only provides overlapping for structural continuity, but it provides a sense of interiority and exteriority dependent on which side of the folly is occupied. The polymer surfaces are also slightly translucent to give passage to sunlight and also soft shadows of those on the other side. Unlike the original squinches, arches, and pendentives, these spaces are not vertical and suggestive of hierarchic social strata. The Torqueing Spheres folly is organized horizontally to reinforce an equality of experience in a park that promotes arts and culture. Because of this structural inversion, the once elevated dome is now a space of exploration, while the pendentives remain structural non-shapes to provide a ribboning or sinuous membrane.
TORQUEING SPHERES

exterior view of the Folly from the bank of the East River
Curved plywood and polymer panels overlap into a stable monocoque
TORQUEING SPHERES

Axonometric and diagrams of the final organization
Spheres undulate along a straight path, creating structural stability
TORQUEING SPHERES
Site plan with general dimensions, left.
Original square with unfolded final configuration, right.
TORQUEING SPHERES

Initial square concept with torqued spheres with new pendentive surface construction.

dimensional studies of curvature, material, and profile cuts

full-scale proof of concept
The Minister of Culture

Section variations

Supporting Project 2
IMAGE DESCRIPTIONS

1. ARCHITECTURE PLANETARY CAPSULE
   A prototype for a deployable shelter or pavilion. A curved plywood monocoque of lightweight, material that may be assembled by two people. -for Kehilla Residential Programme, Toronto, 2014.

2. THE MINISTER OF FOREIGN AFFAIRS
   Large format cubes, spheres, prisms and other primitive architectural forms are examined in new materials and new meanings -with the Dufala Brothers, supported by RAIR, Revolution Recovery, and presented at the ICA, 2013-14.

3. MECHANICAL GARDEN
   Reconfigurable, operable, interactive living rooms for the courtyards of PS1 and their summer Warm-Up events. A full-scale prototype -for the MoMA Young Architects Program at the PS1, 2012.

4. The D.C. LOCI: civic reorder and democratic access.

5. CONICS CANOPY
   An open pavilion made of paired curves developed from conical intersections. Each pair is networked to produce a strong, stable low-profile shell. -Lexington, Massachusetts, 2010

REFERENCES

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