Balancing Control and Indeterminacy in Deformation Casting

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Invited Artistic Work

Deformation casting uses the inherent structural intelligence in elastic formwork to create complex organic forms and geometries. When casting in an elastic material,[1] the weight and viscosity of the casting compound are essential elements in the pliable formwork expanding to its projected shape. Similar to how gravity acting on a hanging chain produces a catenary curve, the expansion of an elastic membrane loaded with a casting compound converts the liquid pressure within the volume into surface expansion, resisted through tensile forces (Popovic, 2023, 89-90).[2] This creates an interaction of forces **where load, expansion, and the resulting surface tensile forces are in balance, while the membrane in its expansion maintains a minimal surface to volume ratio.**

When an elastic volume is loaded with liquid casting compound, it expands towards a spherical or drop-like shape in accordance with the laws of energy conservation. During the pour, the loaded formwork can be seen as a system that self-solves the forces acting upon it through the minimal surface deformation necessary for the formwork to reach an equilibrium between internal liquid pressure and external tensile counterforces. The process is similar to how air pressure inflates and gives shape to a balloon with resulting shapes that have much in common with the minimal surfaces produced by soap bubbles. External constrictors and carefully designed formwork patterns are used to upset the elastic volume’s natural expansion

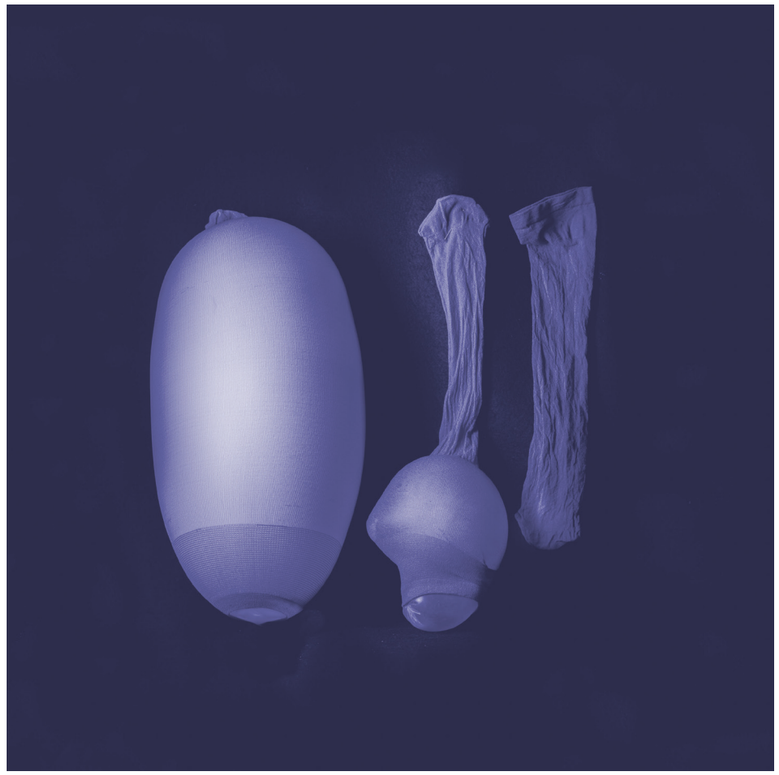

Fig.1 - Inflation test.

Fig.2 - Inflation test.

Fig.3 - Formwork, before pour.

Fig.4 - Cast no. 79, hollow volume.

toward spherical shapes and reveals a formal and plastic plurality that appears organic and evolved in nature.

Where traditional approaches to casting seek to control liquid pressure within the formwork by encasing the casting compound in rigid materials that deny deformation, membrane casting actively embraces and relies on the deformation of the formwork. In this process the practice and purpose of casting is relieved from its association with predictability, tight tolerances, and repeatable outcomes. Instead, deformation casting implicates the practitioner in an intuitive process of tuning the liquid pressure inside the formwork to the resulting tensile forces afforded by the surrounding elastic formwork. Each cast element arrests the pressures and constrictions at play during its creation - and takes a portion of its meaning from the now of its creation.

Casting in flexible formwork made from textile or fabric can be traced back to around 1900 (Veenendal in West, 2016,18) with several independent rediscoveries and reinventions into current day. Relevant to this essay is work by structural thin-shell engineers of the 1950s and onwards, such as Heinz Isler, with their focus on pneumatic formwork (Chilton, 2000, 34-35), as well as a renaissance in the 2000s propelled by the architect Mark West's focus on fabric formwork's capacity to produce building components that combine analogue form finding and organic sculptural form in concrete structural elements.

The work presented here deviates from its predecessors in its use of formwork that is highly elastic. The change from flexible to elastic membranes is not only a change in material properties. The expansion of form-finding capability in elastic membrane casting is accompanied by a surrender of control and diminished predictability of outcome. This positions the practice in a precarious territory, where the work process embraces risk taking and open ended experimentation in pursuit of outcomes that balance between a vague predictability, surprise, and failure in search of discoveries that would not be reached through conscious or analytical approaches (Chard, 2005, 10).

The precision and repeatability traditionally associated with cast elements are replaced by a practice where tolerances vary across the volume and precision remains localised in areas determined in advance of the pour. The elastic membrane simultaneously forms and is formed by the liquid pressure exerted on it, in a process that allows the practitioner to arrest and fix in place the mixture's natural liquid, organic form.[3] The process engages the practitioner in a balancing act between control and indeterminacy. The outcome and integrity of the cast elements are a consequence of the method's algorithmic capacity to self-resolve in a surprisingly constructive way (West, 2020, 40),[4]

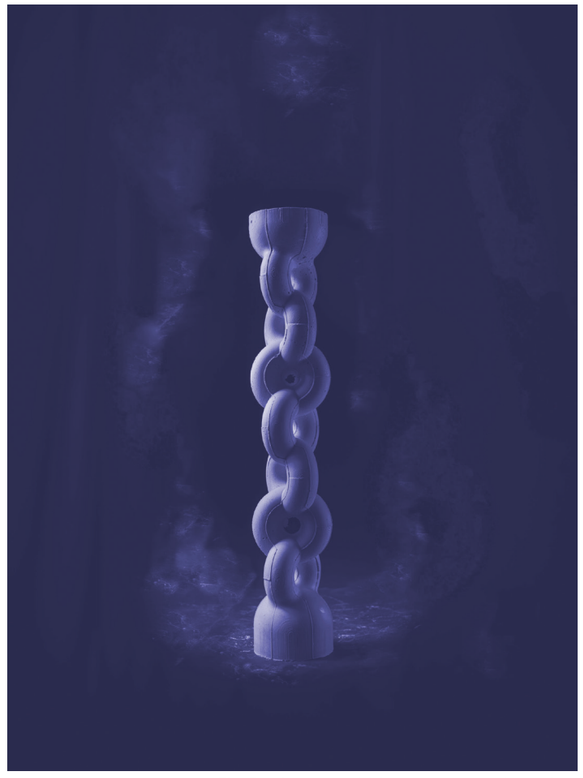

Fig.5 - Cast no. 103, reverse engineering of fundamental torus geometry.

Fig.6 - Cast no. 48

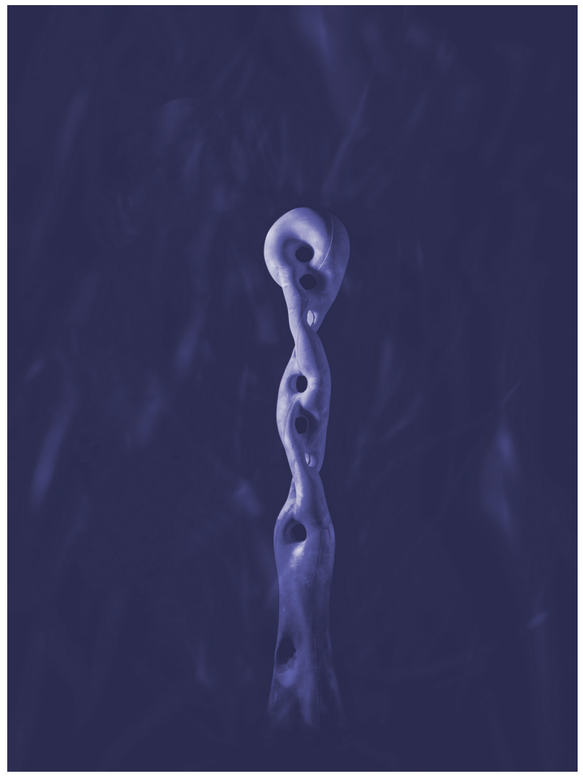

Fig.7 - Cast no. 75.

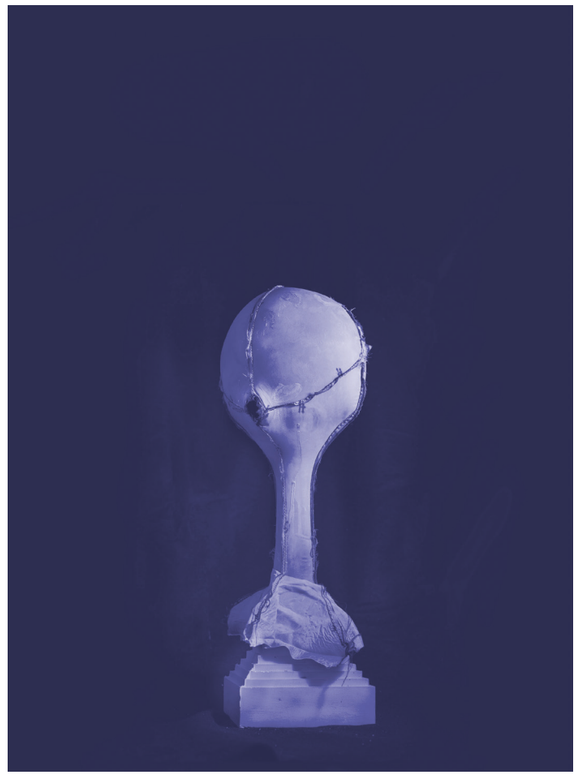

Fig.8 - Cast no. 56, hollow volume.

as well as sculptural and structural considerations motivated by ideas of seeing the elements as anthropomorphic bodies evolved under a novel selective pressure. The technique's capacity to subvert formal expectations are not limited to the sculptural casts: photographs of the formwork in various stages of construction are just as important outcomes of the work as the tangible elements are.

ACKNOWLEDGEMENT

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NOTES

1. The use of formwork made from permeable materials means that the formwork acts as a skin like membrane that gradually secretes water until an optimal water to dry mix ratio is reached. This allows the casting compound to be mixed with a higher water ratio leading to a lower viscosity mixture that flows and deposits easier into crevices of intricate formwork.

2. Popovic writes of engineer Heinz Isler use of wet, draped fabric to define minimal surfaces that are structurally optimised in the same way that a hanging chain defines a funicular curve.

3. "In a flexible mould, concrete is rediscovered as wet, sensual, and responsive material", West 2016, 4.

4. West describes this as inherent structural intelligence.

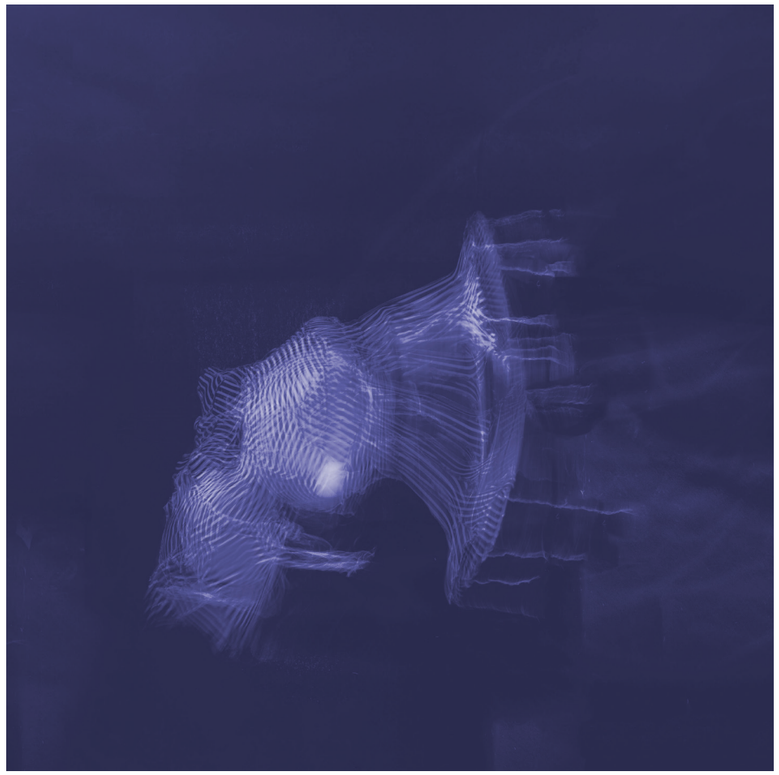

Fig.9 - Hollow volume formwork no. 83, before pour.

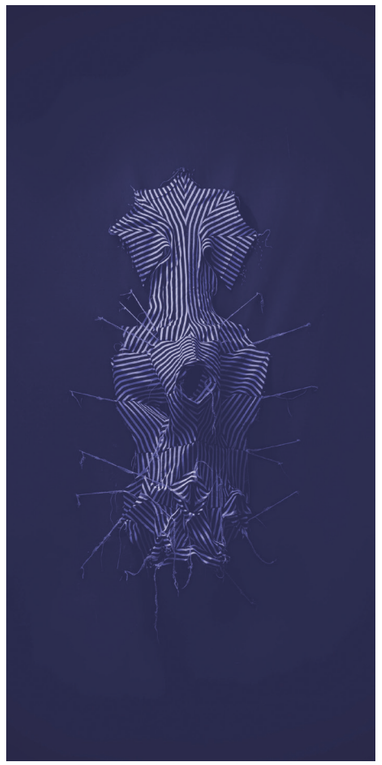

Fig.10 - Hollow volume formwork no. 83, partially assembled.

Fig.11 - Hollow volume formwork no. 86, partially assembled.

Fig.12 - Hollow volume formwork no. 79, before pour.

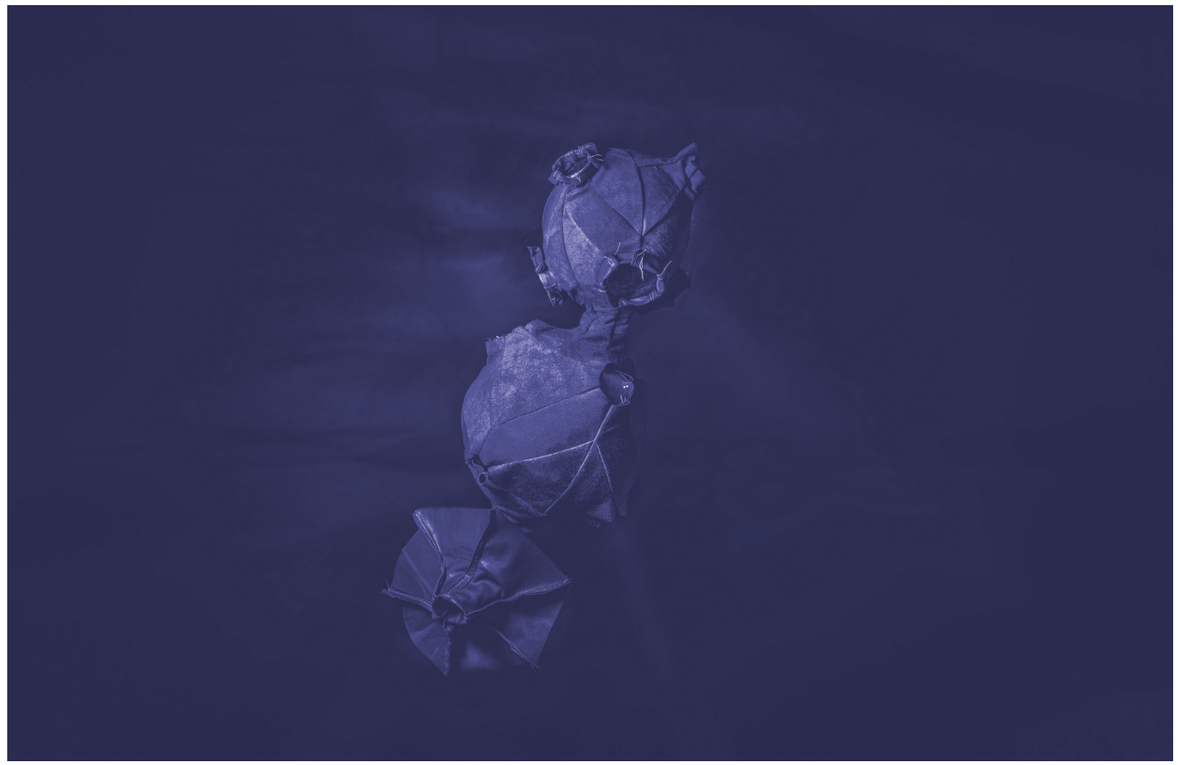

Fig.13 - Hollow volume formwork no. 86, before pour.