



Ubiquity and Autonomy

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Janus

A Self-Erecting Colossus

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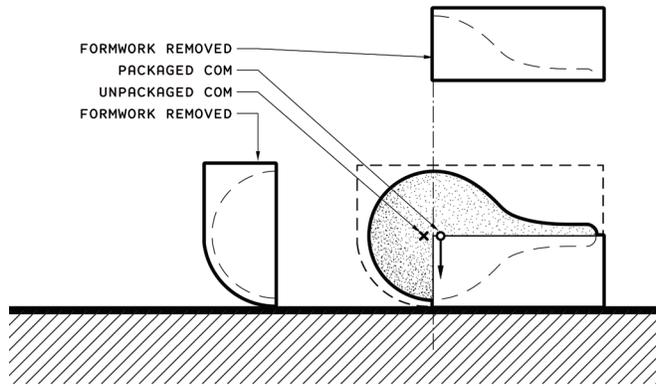
1 Janus being performed at the American Academy in Rome

Megalithic era construction resolved an incredible feat of strength surrounding the transportation and erection of massive stones—fueled by carbohydrates and the limitations of the human body. In order to provide these incredible structures, megalithic civilizations were forced to impart intelligence of these actions into the elements themselves. This is evident in the Egyptian and Roman civilizations, particularly surrounding obelisks, structures that were transported horizontally and stood vertically without the energy consumption of mechanical cranes (Diebner 1991). While much is still uncertain about the ancient Egyptian and Roman methods, archaeologists have proven that the colossal statues of the Moai Rapanui were carved using a highly calibrated relationship between the curvature of the form and the center of mass (COM) of the object, enabling the Moai to march forward when tugged side to side (Hunt 2012). Today, contemporary construction is driven by fossil fuels, resulting in a default approach of dead-lifting heavy elements with cranes and other mechanical equipment. In the face of this reliance upon external devices, contemporary construction could learn a great deal from ancient civilizations about how to more intelligently deploy massive architectural elements with less energy.

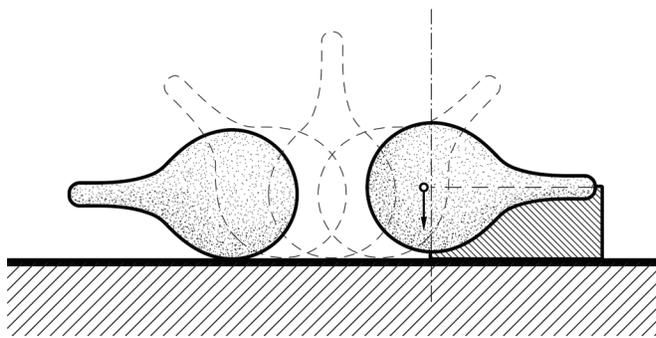
As experiment, this research tackles the ancient problem of transporting and standing heavy elements of architecture. Building upon the knowledge gained in a previous research experiment titled *McKnolly Megalith* (Clifford 2016), *Janus* tests computation methods against problems surrounding solid cast concrete. When engaging the topic of casting instead of carving, questions emerge surrounding how to intelligently demold a

PRODUCTION NOTES

Designer: Matter Design
Industry: CEMEX Global R&D
Size: 2.25m x 1.3m x 1.3m
Mass: 2,000kg
Material: Concrete
Date: 2018



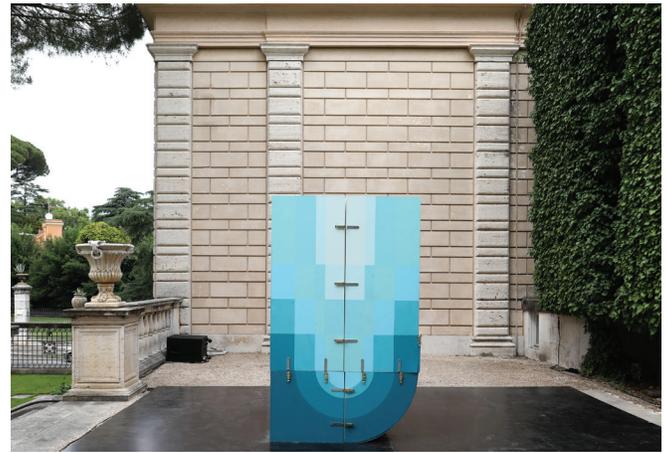
2 Unpacking the formwork to shift the COM to the tipping point



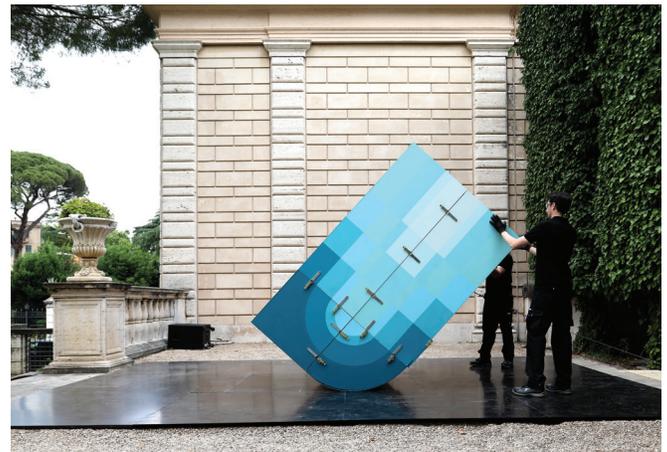
3 Releasing Janus from the formwork

massive concrete object without the reliance on external lifting devices. The challenge involves casting an object in a vertical position that can be repositioned in order to demold. Once demolded, the object should self-emerge from its own formwork and stand in a stable vertical resting position. Figures 2 through 5 demonstrate these various states.

This research incorporates solver computation to determine the location of the desired COM of a concrete object, considering the varying densities of the concrete and of the formwork in its various demolding states. The optimal COM allows the element, while still enclosed in its formwork, to roll onto its back so that the lower portion of the formwork can be demolded. In this horizontal position, enough mass has been removed from the formwork to relocate the center of mass of the element beyond the pivot of the edge of the formwork, enabling the element to stand itself up and emerge from the formwork.



4 Janus in the vertical cast position



5 Janus and formwork being rolled onto its back for demolding

Janus is the Roman god of thresholds, simultaneously looking to the past and the future. The ghost of *Janus* manifests as an animated double concrete sculpture on its original home and the current site of the American Academy in Rome—the Janiculum. *Janus* emerges from its own formwork and performs on stage in front of an audience of spectators. Working with composers, this collaboration merges sonic and physical animation to produce an hour-long living spectacle. During the performance, the audience is enveloped in spatial chatter that transitions from the noise of the crowd to a spirit-like whispering that draws the audience's attention to an apparently gift-wrapped object on stage.

Janus is designed through a series of monstrous contradictions. The graphic box references the Arch of Janus with a uniquely Roman color palette of pinks, oranges, and blues. The box slowly rolls onto its back, exposing itself as merely the lightweight formwork of a massive object inside.



6 Janus in the vertical standing position



7 Front elevation of the mural design



8 Mural continues as Janus rolls onto its back



9 An image of the mural wrap and the side of the formwork enclosure

From this rigid box, a vital concrete object springs to life on its own. *Janus* wobbles on stage, breathing life into a solid sphere and hollowed ring sculpture until the momentum slowly fades and the wrecking ball of an object appears to hover on a single point for the amusement of spectators.

ACKNOWLEDGEMENTS

This research is produced in collaboration between Matter Design and CEMEX Global R&D. The performance is a collaboration with composers Federico Gardella and Simone Conforti. The formwork is provided by Odico Construction Robotics. *Janus* has been performed at the American Academy in Rome and at the Massachusetts Institute of Technology. Terez Lowry performed in the second performance.

IMAGE CREDITS

All drawings and images by the authors.

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10 Janus interacting with performers

Brandon Clifford mines knowledge from the past to design new futures. He is best known for bringing megalithic sculptures to life to perform tasks. Clifford is the director of Matter Design and assistant professor at the Massachusetts Institute of Technology. As a designer and researcher, Clifford has received recognition with prizes such as the American Academy in Rome Prize, a TED Fellowship, the SOM Prize, and the Architectural League Prize for Young Architects & Designers. Clifford is dedicated to re-imagining the role of the architect. His speculative work continues to provoke new directions for the digital era.

Jo Lobdell is a partner at Matter Design where she is driven to bring inspiration and joy to the world through the lens of design. As a designer she uses play as a way to tackle how the body and mind can interact with objects and environments. Her focus is on the way in which color, pattern, and form operate together to express a narrative. Examples of this process can be seen in projects like the award winning Five Fields Play Structure, The Cannibal's Bath for MoMA's Young Architects Program, and The Cannibal's Cookbook that received a PRINT design award.



11 Janus interacting with performers

Tyler Swingle is research lead and project manager at Matter Design and holds a lecturer position at McGill University. In his work, he is committed to exploring the reciprocity between materials and computational methods and frameworks. As a part of Matter Design, this includes both ancient building techniques and new material technologies.

Davide Zampini has over 30 years of experience in the construction materials industry and is best known for pushing the limits of innovation in cement-based products and building solutions. Adopting a design- and industrially-driven innovation approach, Davide leads a multi-disciplinary and culturally diverse team at CEMEX's Center for Innovation and Technology. Through adaptive research and development conceived with versatility in mind, Davide's team at CEMEX in Switzerland develops novel functionalities in cement-based materials that incorporate customer-centered strategies and are designed to create solid emotional ties to a material that for ages has been considered "grey."



12 Janus balanced on a single point at the American Academy in Rome