Fibrous Tectonics

A Rethinking Of Composite Production Through Innovation And Exploration Of Molding Techniques And Methodologies

DAVID COSTANZA
Rice University

The inherent possibilities of composites present an exciting frontier in architecture that has remained largely untapped. In light of the current computational capacities and new digital tools in manufacturing, composites are just beginning to re-situate themselves in the field of architecture. Efficiency and durability coupled with a load bearing capacity make a strong case for the use of composites as a primary building material.

We now possess the computational and digital manufacturing tools that make the development of a composite building viable.On a holistic level, the research has concerned itself with an overarching focus on developing a composite building which minimizes the required costs and labor while simultaneously creating the potential for customized forms. Based on the concepts of mass customization, when the workflow from digital conception to digital production is seamless, a variety of composite structures can be produced at no greater expense. This potential for an efficient "one off" composite architecture empowered by digital manufacturing and computation, is where the research is positioned

At present, the research has been focused on exploring surface composite structures through a reinvention of the 'mold'. This approach has involved using inflated bladders, rather than traditional molds of milled foam or aluminum in order to produce composite structures. In doing so, the benefits of inflatables are all encompassing. Not only do they allow for inexpensive transportation and rapid deployment, but they also lend themselves to the production of large scale structures through the simple use of air and pressure, thus minimizing both material and effort. This lies in stark contrast to traditional composite manufacturing techniques which require molds to be milled out of solid aluminum blocks or high density foam volumes, whereas inflatable molds are easily heat seamed and inflated. When considering issues of scalability, traditional molding techniques demand significantly more labor, material, and with that, overarching costs. Inflatable molds however, require only more air.

Coupled with the rethinking of molding techniques is a consideration in the technological methodologies in order to produce such composite structures. The research looks to the new developments in the composite industry, such as Resin Transfer Molding (RTM) and Vacuum Assisted Resin Transfer Molding (VARTM). These processes greatly simplify the manufacturing of composites and eliminate much of the manual labor traditionally associated with composite structures. By taking advantage of the existing vacuum bag used for compaction while producing composites, the VARTM process pulls resin through the bag under vacuum pressure, thus wetting out the fibers and eliminating typical layup deficiencies while producing a nearly weightless composite structure.