New perspectives and future directions of BIM workflows: From digital tectonic to digital fabrication and assemblage

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ABSTRACT: “Architects tend to draw what they can build, and build what they can draw”.

William Mitchell, Professor of Architecture and Media Arts and Sciences at MIT

Digital fabrication has expanded the realm of architectural research. Today, many architects are using digital fabrication methods as an alternative to regular construction processes to create custom pieces that can be mass produced, but still meet budget and schedules expectations. Current workflows between parametric/BIM architecture software and CNC are thru CAM software that seeks isolation of 2D elements to be imported for proper toolpathing. Consequently, the entire complex layering of parameters and information gets lost in the process, and it relies on user’s clear understanding of setting up the parts on the 3D modeling for all the bits to be efficiently separated. Parametric software and digital fabrication methods such as 3D printing and computer numerically controlled (CNC) technologies have the capability to inform and influence the design process, as well as the final tectonic expression, and promise testing the future of geometric potentials and materials limits.

Building Information Modeling (BIM) has enabled us to coordinate information across different design disciplines and allow us to provide detailed material specifications and tolerances. The current CNC/laser workflows from a virtual model to digital fabrication are unpractical, interrupted by translators. The unfolding of solid geometry into a 2D shape from BIM is not a direct process. Many problems arise from this file conversion where relationship and layers of information vanish. Within the framework of craftsmanship and digital techniques, the process of unfolding, detailing and assembling a form directly impacts the tectonic and rationality of the form. There is a growing interest within the architecture design profession on the exploration and future developments of a seamless workflow from virtual forms to digital fabrication to smart materials.

As digital literacy strengthens and professionals push to uncover new design inquiries, our expectations towards digital tectonic will not only be descriptive geometry but also will want a dynamic tectonic relationship and material intelligence. The future vision for digital workflows needs to explore digital means that flawlessly support prefabrication strategies and intelligently inform the fabrication and assemblies.' As digital fabrication tools evolve a new design paradigm will arise. We could make a case that these are only early examples of emerging technologies that seek to digitize fabrication. MIT professor Neil Gershenfeld argued that current digital processes are still in analog mode and not yet digital since all the intelligence is external to the system and materials don’t have information. As stated by Gershenfeld, the future is based on computers that don't control tools but computers that are the tool; where the output of a program rearranges atoms as well as bits2. As part of a digital fabrication workshop, we asked architecture students to generate full-scale mock-ups that explored BIM/Parametric architectural skins topologies. This paper examines the current hybrid methods of analog and digital processes to highlights areas for improvement within BIM software as a key link between design to digital fabrication methodology.