1 Introduction

While usually associated with the back-end of the design process (implementation), building information modeling (BIM) could also redefine the way design ideas are generated by bridging formal creativity with design and technological innovation. This is achieved through a close integration of generative tools with parametric capabilities and intelligent database-enriched digital objects.

Presently, BIM based tools lack significant generative design modules, and thus become peripheral within creative process. This deficiency reflects the difficulty of reconciling the generative—lateral modes of creativity with the didactic—hierarchical problem solving. At the same time, general use, generative design software lacks the database dimension and material-based knowledge associated with its digital models. Architects may be able to develop interesting designs, however, it is impossible to verify if these designs correspond to anything physically constructible, nor they can be associated with a particular scale or material characteristics. This discontinuity in the creative process between generative and implement-ive design stages exemplify significant limitation of digital tool. To bridge this gap, this talk investigates generative qualities of the BIM platform through a relatively narrow but potent set of examples of parametrically controlled constructional details.

2 Approach

Specifically, this talk discusses the integration of building sciences with everyday architectural professional practice. It proposes a design methodology that starts with a construction detail, and pursues designs that naturally emerge out of the assembly of discussed components. While this is a long-practiced approach, this study broadens this method by considering a broader set of design solutions resulting from parametric alterations and alternations of original components. The final design project emerges through a series of explorations with fragments informing the entirety of the architectural design solution: fragments that are representative of the overall design. It is conceptually and metaphorically analogous to a fractal relationship, where a component implies an overall structure.

For appropriate precedent, we investigated contemporary designs representing established practices, which naturally translated into parametric and BIM thinking. Projects by Nicholas Grimshaw, Norman Foster, and Santiago Calatrava were just a few of the designs that fit well into the class methodology and were relatively easy to handle using digital tools. In selecting projects and particular assembly components or construction details, students were asked to study this precedent, model partial assemblies and test them as a three-dimensional BIM models.

When choosing examples for their explorations, students were asked to consider the open-endedness of their particular designs and an ability to develop meaningful variations. Through these studies students learned about the spatial coordination of various element and system components, their interconnectivity and interdependencies. Students were able to manipulate and experiment with parametric components and to follow interactively through the design alteration. Later, in the second part of the project, students explored the parametric possibilities of BIM models. [figure 1] Three-dimensional, parametrically resolved architectural details served as speculative, idea-generating devices for design. Students were expected to demonstrate the creative possibilities of their BIM models and to document their parametric explorations [figures 2] through images, digital models, and a text narrative (final report).

3 Broader Discussion

With parametric analysis, designers can immediately trace the design changes and see how they impact other components in the assembly. Combining or nesting parametric components not only allow for an ease of modeling and a greater flexibility, but also allows understanding how individual changes impact an overall design. Once a single parameter was changed in an overall, often complex, assembly of individual components, students we able to trace the propagation of changes throughout the database-model and immediately evaluate consequences of this particular change. Also, they could propose new designs through interactive manipulations of parameters and see changes propagated through the entire system assembly. This dual use of parametric digital models—for understanding of a significant architectural precedence (construction knowledge building) and for speculative explorations of possible design propositions—allows for greater integration of final designs. Furthermore, in parametrically defined BIM environments, architects can explore designs that are native to the world of construction—that do not have to be translated or reinvented as a result of the progression from a conceptual idea to a real product.

Figure 1. Parametric variations of the roof/deck structure

Figure 2. Analyzing parametrically-driven behaviors of element assemblies. Fully detailed truss at roof condition with parametric control of truss members and slab thickness. Remaining geometry follows spatial transformations of the truss and slab.