Automation of Construction Documents and Details

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There is no shortage of articles that make claims about how our work can and will be automated in the future. With the recent surge of development happening on the topic of Machine Learning, these claims continue to grow. The reality is, our industry is in a constant state of evolution.

When we look 20 years in the past, the early introduction of computers into the AEC space created a significant disruption that brought a level of efficiency by augmenting the traditional document delivery process. Analysis applications helped streamline laborious and time-consuming calculations engineers had been doing manually for decades, while CAD applications significantly increased the efficiency in creating and revising the 2-D documents that our industry heavily relies on.

The introduction of the computer did not eliminate architecture or engineering as a profession but rather played an active role in its evolution, allowing us to design more beautiful and seemingly gravity-defying buildings.

Digital processes have become widely adopted by the AEC industry and are currently the lifeblood of almost every firm. As the computer automated certain processes of the past, it created new opportunities ripe for exploration.

Much automation is developed by home-grown solutions within forward-thinking firms, which focus on the development of in-house applications to assist in streamlining projects, allowing the firm to be more innovative in their engineering solutions. These custom solutions and design workflows help optimize project delivery.

30 Hudson Yards

An example of automation is the work done on the recently completed tower, 30 Hudson Yards. Designed by Kohn Pedersen Fox, this building consists of a 73-story, 1,268-foot glass tower above reclaimed land spanning the west side rail yards of Manhattan.

Thornton Tomasetti (TT) was commissioned for the engineering and detailing of the steel structure. From the early onset, all project stakeholders set an objective to deliver the project using BIM. The project documentation and models were delivered via LOD400 to allow the models to be used for construction and fabrication of the steel structure. At the time, TT's CORE studio developed a common data environment (CDE) called TTX, later rebranded as Konstru, which allowed engineers to move model data between analysis, documentation, and detailing applications seamlessly.

Multiple applications were used to analyze the structural systems, from lateral to gravity; each system required its own method of analysis. The results of these models contained valuable information for the detailing and construction documentation process. Konstru integrated directly into the analysis applications, extracting the necessary data and porting it to the documentation applications natively. The data is serialized into a common format that is application-independent. Eliminating data silos meant the model data can now easily be supportive in other BIM platforms for further development of the project. The project team did not have to maintain many concurrent instances of models across the variety of applications being used on the project, which is an inefficient and time-consuming process, not to mention could be fraught with human error making coordination grueling. The Konstru platform assisted in keeping up with the rapid pace of project development. Member locations were constantly in motion as program spaces were being updated by the design team to maximize leasable area. Trying to make these updates manually would have made the model obsolete by the time all framing members were updated. The single model set, which contained the geometric information, as well as force data, saved countless hours in coordination. The tower model was exchanged weekly with project stakeholders to keep everybody up to date.

One Vanderbilt

On One Vanderbilt, engineers within the firm executed the project using the CDE, while CORE studio played a support role. The objective was to empower project engineers' level of automaton proficiency. This required a bit of a change in office culture, first gaining the trust of engineers to demystify any black-box scenarios and, second, by taking active steps in the evolution of traditional processes for project delivery. This led to the development of an application, AutoConnect. AutoConnect utilizes the Tekla application programming interface (API) and leverages force data embedded in the model elements, coupled with structural code and standards to auto-generate appropriately sized connection details. Traditionally, each connection detail would be modeled individually. AutoConnect reads attribute data built into each member to identify the forces exerted on the member. When this data is coupled with design criteria and rule sets, connections can be automatically generated in the 3-D model. To increase transparency into the process, safeguard measures were implemented to log all the generated connections so they may be reviewed in conjunction with the BIM data in the model. A Connection Manager was developed to look at the connections generated and allows engineers to plot out the different connection types to identify which connections can be standardized for ease of fabrication, reducing overall cost.

What a Future Project May Look Like

The skills within firms are continually evolving. Designers and engineers are becoming more facile with developing bespoke solutions. Automation allows engineers to focus on creating elegant solutions. As an industry, we should aim to go beyond basic BIM and parametric models and aspire to positively impact the evolution of the AEC industry.▪

The online version of this article contains references. Please visit **www.STRUCTUREmag.org**.

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References

Osborne, Michael & Benedikt Frey, Carl. "Automation and the future of work – understanding the numbers" *Oxford Martin School*, University of Oxford, 13 April 2018, **https://bit.ly/33slZFi**

The Skyscraper Center, Council on Tall Buildings and Urban Habitat, "30 Hudson Yards", **https://bit.ly/2Q1KAwS**