Choreographed Construction: The Evolution of Architectural Design

TWENTIETH-CENTURY ARCHITECTURE HAS BEEN DOMINATED BY THE USE OF NEW TECHNOLOGIES, BUILDING TECHNIQUES AND CONSTRUCTION MATERIALS. WHAT COMES NEXT?

Pencil and paper have long been replaced by technology. First came one of the great inventions of the 1980s, AutoCAD, which transformed the design industry. This software opened great possibilities for design creation and interpretation – it also set the standard for what to expect from architects and designers as professionals. Computer Aided Design & Drafting (CADD) was a generational shift as far as engineering documentation is concerned which immensely improved the overall quality of drawings that were made available to the site staff for eventual construction.

But CADD, with all its proven advantages, still has many limitations including its inability to go beyond the geometry or support collaboration that was utterly missing. As the demands of the industry grew, designs became intricate. Rapid developments in construction technologies also resulted in a huge performance gap, a vast disconnect between expectations and capabilities or between demands and deliverables. Design professionals found it increasingly difficult to keep pace with the expectations, not just in terms of speed but quality and efficiency of the services as well. With original project costs becoming less realistic, the whole exercise of building hence became eternally unpredictable.

Then, a wonder-tool was discovered in the 1990s – Building Information Modeling (BIM). BIM is the process of creating and managing a dynamic, three-dimensional, computer-generated model for the design, construction and operation of a building or project. When BIM first emerged, there was a collective thought that the technology would revolutionise the industry.

BIM is an advanced version of Auto CADD, in which a building is designed, visualised and tested in a multi-dimensional and multi-disciplinary environment and where the 2-dimensional documentation – drawings & Bill of Quantities (BOQs) – is just a byproduct.

BIM enables builders construct buildings, and the interiors digitally. It also lets them simulate the performance of its various engineering systems over their entire lifecycle - saving, time, effort, cost and anxiety.

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Not far from now, a fully coordinated federal model will be automating procurement, fabrication and delivery processes of various off-site components. The technology will have the ability to simulate the installation and commissioning sequences of key engineering systems and check the operational efficiencies under different test conditions, far ahead of the actual construction phase.

They will work together to achieve a system efficiency and team productivity like never before. As a result, everything onsite will fall in place just as predicted – the design as intended, quality and performance as benchmarked, timelines as scheduled and costs as estimated.

If appropriately harnessed and exploited, this brilliant tool, in combination with a perfectly coordinated design, predictable construction program, synchronised modern field robotics and onboard machine control applications, will make the complex construction tasks run smooth, swift and seamless, just like a perfectly choreographed construction spectacle.

BIM technology understands the geometry of a design – as is in the case of traditional CADD – but also comprehends a real building with its numerous and distinct components. BIM is far more realistic and utilitarian platform for the construction community.

With information and intelligence nested in each of the objects, the software enables them to be grouped, addressed, attributed, scheduled and quantified. This seemingly simple three-dimensional model has turned out to be a data-rich, inherently smart, functional representation of the building.

The initial efforts were focused on enhancing the efficiency of design and quality of documentation, but in order to reap their real benefits, BIM technologies developed capabilities to improve design deliverables onto construction practices we well. Transferring the true coordinates from the model to the site, is effectively achieved with specialised applications such as Architectural Navigation (for indoor locations) and Robotic Total Station (for outdoor locations) that help map the exact model coordinates physically on the ground. While mega activities such as earthworks, excavation, lifting and shifting of materials or equipment are coordinated through something known as Field-CNC and onboard GPS machine control.

Emerging technologies such as the computerised material delivery systems that work in coordination with a BIM model, help move Radio-frequency Identification (RFID)-tagged building components from the yard to their precise destinations in pre-sequenced multi-directional tracks, all on their own.

Other add-on BIM applications are able to kick in to automate major construction tasks such as building walls, plastering surfaces, fixing roofs, laying floors and pavements to machine-perfection, taking productivity levels of many labourious construction tasks to newer heights.

The next level of BIM-led applications will enable a new generation of construction robotics, digital field devices and personal wearables that work in tandem with the BIM model.

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For those wondering if this is ever going to happen, you should know that most of these technologies are actually available in the world today, while some others are still evolving or being piloted. But, the developments have brought precision, speed and predictability to construction activities and have successfully broken the vicious cycle of errors, surprises and blame games.

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