

The BIM design paradigm

Karol Mac Gairbheith MCIAT has used Building Information Modelling (BIM) systems for the last ten years. In this article he explains the development and benefits of BIM in architectural practice.

Twenty-first-century construction demands more complex and sustainable buildings than ever before. A paradigm shift in architectural practice is bringing change to the industry's workflow by enabling a previously impossible degree of planning, coordination, and communication. This shift is created by the extensive promotion by government, and the concentrated development of Building Information Modelling (BIM). It is a shift from 'possible to real' to that of 'virtual to actual'. BIM systems and processes are taking us ever nearer to the dream of an integrated practice, via digital fabrication.

The BIM revolution

With the need for better construction management many software manufacturers have developed their own versions of BIM platforms in response to government demands and its target for BIM enabled projects to be mandatory by 2016 on government funded ventures. Autodesk's Revit software, however, remains the most widespread program in use.

Consequently, the implementation of BIM processes within building design and procurement has revolutionised the architectural process. Those processes are the product of parameter-based adaptive models prepared by architectural designers. However, the past five years has seen a surge of use by contractors to feed their cost driven objectives, and to efficiently meet client expectations. Arguably, therefore, the contractor has become the chief protagonist in BIM implementation.

How does it work?

A Building Information Model is a single, intelligent virtual model that satisfies all aspects of the building design process. It is a digital prototype that drives building production rather than a set of drawings; a built-in prototype that acts as a map of the entire computational model by organising all of the live views (plans, sections, elevations, etc), schedules and sheets that have been defined.

It is best practice to use a single BIM model, but some less experienced practices and users split them into sub models to suit limited computation power or varying disciplines within the design team.

The digital management capacity of information models (digital databases) comes into its own when

useful data is extracted for real-time generation of bills of materials, scheduling and construction sequencing. The processes of design development and building realisation are very much interrelated. With automatic coordination and collaboration, one can base the logic of the BIM model on actual construction processes or techniques with ease. This technology requires designers to work in new ways and restructure practice accordingly.

In particular, more insight into how to create the building must be deployed early in the design process as it is best if the building assembly is understood in a concrete way. First, the basic geometry of a building is created. Later, subcontractors execute portions of the building. Based upon their proposed solutions, the model develops. All parameters relating to the building are fed into the BIM model by a collaborative effort from the project team (building owner; designers and constructors), making it an informed 'parametric engine', ultimately enabling it to handle the contradictions posed by project-specific constraints as the scheme evolves.

Focus on design

As a design team progresses with a project the BIM model continues to grow and incorporate changes, becoming more data-rich as the process goes along.

The outcome is a complete set of construction documents with greater coordination than previously possible. With this comes a reduction in RFIs (Requests For Information) and change orders, and this eliminates the time spent tracking intricate details. Hence the designers can focus on designing, as there is no longer a need for them to have to redraw each other's information - as it is already found within a linked or shared model. In fact, the more information that is modelled, the less information is required to be drawn at all.

Architectural draughtsmanship has been part of the designer's presence on site ever since the profession became distinguished from that of the stonemason. Computer Aided Design (CAD) in its nascent form helped eliminate repetitive tasks and increase productivity. That signified a transformation in practice, and a market began to emerge.

Proposals were generally documented as two-dimensional abstractions of a possible building, requiring interpretation from others. With the advent of BIM systems there has been a change from fairly abstract, two-dimensional orthographic projections to three-dimensional parametric models that describe form and drive fabrication. This has enabled an aggressive exploration of new processes and media through experimentation with digital computational tools, architectural prototyping, and most significantly, live building projects.

The BIM system can be used to communicate its results in two ways: visualisations and tabular datasets, which are the product of both 3D components and virtual building systems that promise to retain and resolve every single detail within any design process.

The BIM design paradigm

The opportunities afforded by BIM I refer to as the BIM Design Paradigm. In contrast to the cost

saving and waste minimising aspects that are of particular interest to contractors and surveyors, architectural designers and engineers alike will find the BIM design paradigm most intriguing.

This title emphasises the key ideas of BIM in relation to design, and it nominates a very specific interdisciplinary approach to design that is embedded in technological development and innovation. To successfully engage with BIM requires both software training and thinking that closes the gaps between design, construction operations and management. The development and use of BIM is central to theoretical and experimental design processes, enabling virtual prototyping and pre-adapted designs as opposed to costly retrofitting.

Gathering information during the design process is crucial. The initial setting up of a Building Information Model can take time and affect the initial stages of a design programme, yet having such a refined data set eventually improves project flow.

With more design information acquired earlier in the project, BIM allows us to more efficiently meet deadlines with less work, through fully coordinated output.

Benefits of BIM

The explorations of the last decade laid the foundations for the adoption of BIM in architectural design. The promotion of a more transparent process of checks and balances through information models would seem to be an important value-adding capacity of BIM. Many buildings realised by BIM have reportedly been delivered ahead of schedule and with no change orders during construction.

As BIM allows designers to think through construction and assembly virtually, the relationship of design to fabrication becomes much more comprehensive. Computer Numerically Controlled (CNC) fabrication from digital files enables different parts to be cut from materials as economically as standardised parts were machined in the twentieth century. Building information has been translated into environmental analysis software to study performance criteria. Now buildings can be understood according to how they perform, as opposed to what they look like.

Designers often complain about the rigidity of BIM systems in form generation. It is true to say that models lack fluidity, however they do so with good reason. The models register interference between modelled building systems and components that overlap, intersect, or are duplicated, because mere representation has been superseded by inherent interference-checking tools.

It should be duly noted that BIM systems are only as good as their users. Those who possess advanced skills can deliver projects ahead of schedule and without the need for change orders during construction. Currently we are on the threshold of BIM being used for the life-cycle management of a building well beyond the design and construction process.

The future: a two-speed profession?

Under normal circumstances the kind of fabrication information available in today's Building

Information Models would not emerge until after the project has been designed. BIM can therefore improve collaboration.

The simple change of a parameter in a model during a meeting with a structural engineer has the potential to induce a creative dialogue capable of richly informing the design process. There is a need, however, to monitor the relationships between architecture, structural engineering and construction, and to foresee problems that may arise. This can be achieved by defining disciplinary zones within the BIM system to avoid design clashes ie ductwork clashing with steelwork, etc, ultimately giving volumetric ownership to each discipline.

BIM and parametric design protocols exclude those unfamiliar with their technology and terminology but seem routine to those using them. With fee levels dropping, it is conceivable a two-speed profession will develop, and only those who can use current software will survive financially.

The trick is to learn the system from the bottom up, once it is understood it can be formalised. The challenge now lies with the Architectural Technology professional to take on leadership roles within BIM design paradigm.

About the author

Karol Mac Gairbheith has successfully implemented BIM on live construction projects in the UK and abroad over the past 10 years. Speaking of BIM he says 'It has enabled me to deal with design clashes in advance, iron out irregularities in design as I go along, explore repetitive design processes with ease, apply new construction techniques and deliver innovative designs.'

He has converted actual building systems into virtual 3D components that are adaptable over time to enable evolving project requirements to be incorporated without delay.

As Project BIM Leader at NBBJ London his primary function is to manage the process of virtually constructing a building and documenting the design contract accurately. This entails managing a team of multiple disciplines and owning the construction-documents set. He also leads model management and BIM planning, collaboration and coordination.