Observations – ceilings

Ceilings are one of the more labour-intensive parts of a building. In some countries, the practice is to produce office buildings as shell and core. Although ceiling tiles, light fixtures and other ceiling fitments (sprinklers, speakers, and smoke detectors) are integrated into modular/standard panel units, the installation of ceilings remains labour intensive for installation. The labour-intensive parts involve the drilling of fixing points on the structure for suspension of the ceiling grid.

With technology, it may be possible in the future to provide for these fixing points on any prefabricated structure and formwork.

Observations – internal walls

Internal walls and partitioning, either as heavy masonry or lightweight, are becoming more prevalent. The off-site, prefabricated walls integrate services reticulation and distribution. Increasingly, the wall modules are prefabricated to a design with simple on-site assembly with minimal cutting and on-site works.

Observations – fixtures and fittings

To some extent fixtures and fittings, commercial kitchens, bar units, and joinery have been substantially prefabricated with minimal on-site reassembly. Increasingly services (wiring and plumbing) are integrated into the prefabricated units.

Conclusion

Buildings are a combination of many elements and trades from structure to finishes and fittings. Technology is impacting on the manufacture of all parts of the building. Increasingly, more of a building is being prefabricated off site.

Computer technology assists the trend – allowing co-ordination of design and fabrication at diverse locations – reducing the extent of on-site works and co-ordination. The internet allows the rapid transmission of digital information in the drawings and specification material.

Steel by its nature is the prefabricated structural form. Thus the trend to wider use of prefabricated building elements could assist increasing use of steel structures in building form. The competitor for steel – concrete – is already seeing wider use of prefabricated building elements both in structure and finishes.

4.5.8 A GLIMPSE TO THE FUTURE – BIM – THE NEW BUILDING INFORMATION MODEL PARADIGM

By John Hainsworth
ARUP for The Warren Centre

Introduction

There is a revolution facing the architectural, engineering construction (AEC) industry. Those aligning themselves now with 3D CAD-based practices, are driving this revolution, and will be best placed to contribute to, and also interrogate, the new Building Information Model paradigm that will emerge.

What follows can only be introduced as a somewhat blinkered peer into the future which will provoke discussion, possibly argument, and only time will tell whether it is valid or not.

What is BIM?

Building Information Modelling (BIM) is a descriptive term for technologically advanced processes contributing to building design, construction, operation and ultimately, decommission. BIM is characterised by the creation and use of geometrically co-ordinated 3D 'objects', which are enhanced by associated computable data. This data is attached to the objects within the model, which can then be manipulated to describe a building project in many, many ways – too many ways, possibly, to be described by one single acronym.

Does BIM mean 3D?

This is a very good question, and the short answer is, no. As a more lengthy explanation of why it is not, we have to think back to the decades when the industry transitioned from manual drafting processes to 2D CAD drawing production. At this time, the industry grappled with the need for, and the methods of, simply producing the same representation of a drawing using electronic lines. On closer interrogation of the lines in these 2D CAD files, we captured little information except for length, display thickness, and the like.

Presently, the industry at large is facing similar disruption in a shift towards 3D CAD. To produce 2D documentation Arup now routinely models in 3D CAD, to streamline the production of our deliverables as 2D drawings from the model. As the drawings are a reflection of the model, they are fully co-coordinated with one another and do not present ambiguous information. Arup has already amassed significant experience in the successful production of co-coordinated documentation sets, interactive virtual construction methods, material scheduling, and the innovative procurement methods that this 3D CAD technology offers.

Closer interrogation of the geometry produced by many 3D CAD applications can yield little more data than their 2D ancestors. Rest assured Arup is pushing the boundaries as to what we can do with the data we can enter, recapture and manipulate, but the trick lies in having this data 'computable'.

This last aspect is where the BIM acronym might become confused with 3D CAD. Within a future BIM environment the interrogation of an object could yield limitless properties – in other words, the 3D view is just a graphical representation of the data it represents, and that data can be manipulated by many disciplines because it is in a format that can be cross linked, i.e. with dependencies on each other – or in other words the data which the object represents is 'computable'.

BIM in the future

As an 'idealised' futuristic example, let us consider that a structural engineer proposes a new beam in a building, and its required depth is seen to have an impact on the ceiling height. Because there is a relationship defined in the model between the 'engineer's beam object' and the 'architect's ceiling object', the architect is prompted to see that a decision is necessary to either accept the proposal of a deeper beam or not.

On accepting the proposal, the architect's model is automatically altered – but then the further impacts, such as the necessary bulkhead relationships, ripple through the model, managed by a controlled 'accept or not' interface. In parallel to this, because the cubic volume of the space bounded by the ceiling is now altered, the cost plan is updated to reflect the change in paint area required to the walls. Furthermore, the 'mechanical engineer's duct object' alters in size in order to service the room, the energy analysis is updated with instantaneous results, and the fabricator's order and erection sequence changes.

Interestingly, on completion of the physical construction, everything that comprises the BIM is then available to be exploited by the building owner through the management of their asset's complete lifecycle and its final demolition.

Just as a spreadsheet is a tool for thinking about numbers, a BIM-enabled project will be a tool for thinking about the *building*. When a change is made in a spreadsheet, its effects are *expected* to update everywhere, and you can choose whether to accept the results or not. Is it not beyond the imagination to see technology advancing to offer a similar approach to the way a team might interact when we plan to build something?

Current BIM within Arup

Back in the real, but information hungry world, it is fair to say 'we always want more' – and so Arup's move from 3D CAD towards the BIM paradigm has already begun. For example, when we add costing information to the 3D objects, the model can now be scheduled to assist with budget comparisons, adding a dimension of cost to the model, and hence the term '4D model'. Similarly, our 5D models are so-called by further adding time, date and sequencing information to the objects, to link them to project management software. Through data translation methods such as the IFC protocol, we already enjoy exploiting the current levels of interoperability between the massive range of software that we use within our own practice, and within the teams we join.

A significant shift in workflows, relationships, liabilities – and opportunities

The industry's challenge is to embrace and accept the BIM-enabled technology on offer now, to produce a more streamlined, right-first-time approach to construction. As with all 'revolutions', external influences aplenty will attempt to quash the adoption of BIM and advancement of a new approach, but Arup is proud, and committed, to be leading the charge.

Forward-thinking clients already tend towards an expectation of 3D CAD-based design. As technology advances these are the clients who will expect the model's object content to be packed with any conceivable aspect of data that can give them a future business advantage. The resulting BIM models will open far-reaching opportunities within the future management and business operations related to the building, and we see Arup contributing to this process as a key part of its multi-disciplinary teams' offerings.

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The University of Sydney

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The Warren Centre for Advanced Engineering is the leading Australian forum for advanced engineering issues, recognised for its inclusive, forward-looking approach and the wide impact of its many achievements.

The Centre is a self-funding, independent, not-for-profit institute operating within the Faculty of Engineering at the University of Sydney, controlled by representatives from industry and elected by the University's Senate.

It has three principal objectives:

- to stimulate the application and further development of new engineering technology.
- to encourage the integration of innovation and engineering technology into the development of Australia's public policy and wealth creation.
- to provide independent comment and advice to government and industry on these and related issues.

The Warren Centre:

- identifies and supports major projects that bring together people at the leading edge in selected fields of engineering technology to develop new technical insights and knowledge in those technologies and accelerate their application in Australian industry.
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- recognises people and projects that make a unique contribution to encouraging excellence and innovation in all fields of advanced engineering.

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