by Ben Wallbank

Embracing five dimensional design

John Robertson Architects (JRA) is a 50-strong London-based practice that has been committed to using Building Information Modeling (BIM) for the last 11 years. Using BIM, JRA creates 3D virtual models of buildings that are based on parametric elements: these understand what they are – wall, floor, window, etc - and how they relate to each other.

With BIM, a central database ensures that changes applied to the 3D model, or any 2D output, are fully coordinated automatically in all views and documentation (such as plans, sections and elevations). BIM allows the architect to conduct environmental analysis during the early stages of design, share work on designs with external consultants, and to ensure design integrity through clash detection.

Going to 5D

JRA is one of only a small number of practices in the UK currently using BIM on all its projects. However, it wanted to take the next step, moving beyond model-based architecture towards full building lifecycle management, where design, construction and facilities management utilise the same, continually evolving, building model. Technology advances have made extending 3D design into 5D construction a practical reality and with a visionary developer client in TEAM Ltd, JRA has now started to work in a 5D environment. This may sound unlikely but the fourth and fifth dimensions on a building project are real, and show the cost and time to build. Put simply, imagine a 3D animation simulating what will be the on site construction process for this building. This simulation also includes a timeline to show precisely the state of construction at any point and also a cost accumulator that registers the corresponding cash requirements at any point. Using TEAM's Parmiter Street development as a pilot project, JRA created a 3D virtual model of the extensive £25 million residential/commercial development that includes 105 three-, four- and five-bed homes, as well as accommodation for 55 students in medium rise blocks around two courtyards.

JRA built the 3D model using ArchiCAD® – Graphisoft's BIM software – which also provides the foundation for the unique Virtual Construction™ products from Vico Software. By being able to flow the design model into Virtual Construction, it is now possible to prepare very accurate cost schedules, which can be quickly revised if required, combined with highly visual and flexible on-site planning and control. The on-site planning and control uses a technique especially designed for construction projects – Line of Balance – which has been proved to be far more effective than traditional Gantt charts. Virtual Construction is entirely dependent upon an initial design being prepared using BIM and JRA's experience in model-based architecture was pivotal to the 5D pilot project being successful.

How 5D works

Virtual Construction makes what the architect produces useable to everyone, from structural and building services engineers to the project manager, cost consultants, the client, and ultimately the building operator. The virtual models are viewed as 3D designs but any 2D representation can be easily created; clash detection saves large amounts of time checking the accuracy and correct alignment of details; constructability models identify the sequence of construction; precise costing assists the quantity surveyor; and, the software's planning and scheduling capabilities are indispensable to the project management team. The software does this by utilising the intelligence in the BIM database and extending this with how materials, labour and plant are applied to the construction of this particular design – from initial ground works to final fit-out.

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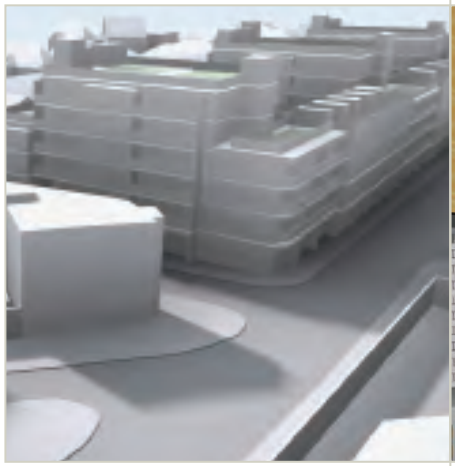
Ben Wallbank – Director at John Robertson Architects



This construction information, or 'recipe', is added to the BIM database as each new build process is planned. Then, as Virtual Construction is used on subsequent projects, the recipes can be re-used and adjustments can be made, for instance to provide more precise costs or construction times and so the information refinement goes on. The 3D design becomes quicker to manage into a 5D environment with every recipe refinement and this enables the 5D software to produce extremely accurate costing and highly effective project planning and management.

Virtual Construction enables everyone to work in the same virtual environment. By providing a platform in which all disciplines can operate it brings a level of transparency to the construction process not previously seen. Designs can be checked and changed in the model, rather than as laborious paper shuffling exercises; potential problems with materials or resources can be highlighted and attended to before work has started on site; and cost implications are apparent long before it is too late to make amendments.

The advantages

JRA Director, Ben Wallbank, says: "Three and now five dimensional modeling is bringing about a change in the working methodology of the architect. We have to move away from 2D design and become proficient in these new techniques because clients and main contractors want to use them. They see that these advances can make the construction process more efficient and if architects don't grasp this opportunity to control the design process someone else will."

JRA's Parmiter Street project has received planning permission and now the model will be developed further to produce a detailed design for construction. The 'recipes' have been applied to the design model and these will be re-used as JRA implements

Ben Wallbank is an Architect who trained at the Bartlett (UCL). He ran his own practice for 14 years and is now a Director at John Robertson Architects, a 50 strong practice. They have offices in London and Dubai. The practice is currently working on several large office projects in the City of London and Copenhagen and a variety of large housing schemes in London and SE England. The practice models all projects and they are now working on their first "5D" fully BIM projects where all consultants are modelling.

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TEAM's newest project, a regeneration scheme in the East End of London. This mixed use development with over 600 residential units uses many of the lessons learned and data input from the previous project. Wallbank says: "Initially there was quite a lot of work to input the recipe data at the start of the Parmiter Street project but that has now fed through for use on this next development. Work that took one and a half months for the Parmiter Street project is instantaneous on the new scheme because the software has remembered what we need and can apply it straight away."

For the architect, 5D design represents a real chance to claw back some of the control lost to design and build contracts, panelized system manufacturers, and even Ikea with its flat-pack homes. Virtual Construction gives the surety of cost and quality that these less design-friendly solutions offer, while allowing architects the freedom to design inspiring buildings. It also automates some of the time consuming elements of the design process, such as cross checking consultants' drawings, bringing more speed and efficiency to the architect's work.

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TEAM will also benefit from the use of 5D design in multiple ways. Its design and construction team is able to keep constant track of project costs and programme implications. Problems are being designed out before work starts on site and the whole pre-construction process is running more smoothly and more efficiently. In the long run, TEAM also plans to use the BIM model as a facilities management tool, to check and update the environmental operation of the building.

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Moving Forward

Currently, there is a serious shortage of architects in the UK who can design properly with BIM. This can be seen as a disadvantage. However, with short supply comes high demand, and, as more forward-thinking clients and project managers look to 5D design as the solution to their construction headaches, those architects in the know will be at the forefront of architectural design in the UK and beyond.

Extending BIM today into Virtual Construction adds unprecedented integration of the design, construction and management processes. It moves the construction site into the realms of economy and efficiency that are already achieved as a matter of course in manufacturing. This is good news for the client but it is good news for the architect too because those who embrace it will offer added value and remain pivotal to the construction process.

Ben Wallbank is a Director at John Robertson Architects. www.jra.co.uk

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