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BIM in Practice Demonstration Project #4
DC Riverside Office Building

The Interoperability Story: Vectorworks Architect, Scia Engineering, and DDS-CAD MEP

The intent of this project is to showcase Vectorworks Architect's practical BIM capabilities to users by simulating a project type, size, and workflow that best demonstrates how VW modeling and workflow techniques can be used to fulfill BIM methodologies and technical requirements.

As part of the design and development workflow, this simulation will engage the use of other BIM applications, such as structural modeling/analysis/design, MEP/HVAC modeling/analysis/design, and/or model data validation, to support the design process

In a non-IPD (Integrated Project Delivery) workflow, the architect invests a great deal of time and effort into producing a fairly complete design and set of documents, with the owner's input, before turning the design over to consultants for their input. This process relies on the architect making a great number of assumptions and educated guesses about disciplines that are beyond his/her scope of expertise and responsibility. When the design is turned over for the other consultants to continue working, everyone often anticipates that revisions will be needed to rationalize all the requirements of the other disciplines and coordinate their physical proximity to each other. Changes at this point in the process are very expensive, in terms of time and money, to make and can leave the owner and designer/architect feeling poorly about the management and direction of the project.

Alternatively, the architect may be collaborating with consultants earlier and to a greater extent, but often information is exchanged in an ad-hoc manner. In addition, there is a significant wariness that all the project team members have in collaborating with each other, always suspect of each other's intentions and capabilities to get the project documentation correct, under budget, and in a timely fashion, with competency. These traditional suspicions are often driven from past experiences with negative legal outcomes arising from poor communication, incomplete or incorrect documentation, incompetency, or unresolved expectations from one party or another.

However, by using IPD business models and processes that take advantage of BIM technology, the architect can collaborate more closely with all the other stakeholders in the project - the owner,

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builder, structural engineers, building services engineers, environmental design consultants, etc. - during all phases of the project. By incorporating better technologies with more collaborative processes and relationships, discipline experts don't have to wait until one stakeholder is substantially complete before they can make a contribution, or react, to the input of the others.

The simulation design team will consist of an Owner, Architect, Structural Engineer, Building Services Engineer, and a General Contractor. These members of the design team will be free to use any BIM application of their choice, with the understanding that IFC and PDF will be the primary formats for the exchange of information, requiring IFC competence in their BIM tools.

In this case, we'll focus on the collaboration efforts of the architect, the structural engineer, and the building services (MEP) engineer. The architect will be using **Vectorworks Architect 2010/2011** (www.vectorworks.net) while the structural engineer will be using **Scia Engineering 2010** (www.scia-online.com), and the building services engineer using **DDS-CAD MEP 6.5** (www.dds-cad.net). The architect will be following the design framework of the *AIA E202-2008 Building Information Protocol Exhibit*, where the levels of model detail/development grow in complexity as the design process moves forward in increments. For brevity, we will simulate a simplified iterative process that only requires a couple exchanges of model exchanges in each direction to complete the building design. In a real world project, these exchanges might occur on a more frequent basis in each major design stage (e.g. monthly, weekly, or daily).

The first model, **LOD 100**, is a spatial program, early formal design model, roughly amalgamating the programmatic requirements of the owner in digital blocks from which the interested parties can infer some overall building form in a site context. This model will NOT be shared with the structural or building services engineers, but the site data, and subsequent geotechnical and climatic data, if available, should.

The second model, **LOD 200**, is a early conceptualization, or schematic design, model, which is more formally rigorous with limited detail of walls, floors, fenestrations, roofs, proposals of vertical support and structural bays, and material quality and more detailed spatial/program requirements and form. This model will be shared with the structural and building services engineers to begin structural and building services "competency" models, schematic system designs with many conservative assumptions to test the architectural concept, with little detail, but sizing and placement of important members/objects and systems – including, but not limited to, foundation walls, steel framing (columns, beams, and joists), concrete elements for parking structures and vertical circulation, air supply and exhaust routes, air handling units and power generation/controls systems and equipment. The engineers will receive an IFC data file of the architectural model and then proceed to create a structural and building services geometry and analysis models, as needed. With preliminary analysis and design recommendations complete, the engineers will return IFC files of structural and building services system models to the architect. The architect will import the models directly into Vectorworks Architect and/or use Solibri Model Checker to merge the architectural model, the structural, and the building services geometry models together and compare, or even perform collision checking. The architect will then take this result and revise the design to more closely follow the structural and

building services system recommendations, or return to the engineers with ideas about compromises in the design of the three disciplines to meet overall project goals.

From these results, the architect will produce a **LOD 300** model, where the architectural design intent is given more detail. When this model is substantially complete, a new IFC file will be handed off to the structural and building services engineers to begin the final calculations, analysis, design, modeling, and documentation. When the engineers have models ready with final systems and object sizing, placement, and a moderate amount of detail, they will provide the architect with another set of IFC models to incorporate into the Vectorworks architectural BIM and coordinate final enclosure and finish details around the structural and building services elements.

An optional stage to this stimulation is the production of detailed fabrication models (architectural, structural, and/or building services) of specific features/elements of the building design that require more analysis and design consideration. These models may be part of a larger, comprehensive LOD 400 model, or could be independent models, created by a sub-contractor, or fabricator, for the General Contractor. These models could include trellis/sun shading devices, canopies, photovoltaic installations, or other “green” technology devices/systems/installations. These models may be exchanged via IFC or, depending on the contractor and sub-contractor workflows, as Parasolid (X_T), STL, 3DS, or other relevant file format.

The architect, structural engineer, and building services engineer should assume use of **Solibri Model Checker v6** (www.solibri.com) for validating, merging, and comparing the three IFC models at each stage. **Solibri Model Checker** is an independent platform specifically used for browsing the geometry and data of the IFC model file and validating it against user requirements and IFC specification standards.

All parties should feel free to exchange PDF files documenting their models in more traditional 2D views, to supplement the information exchanges.

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