Education Issues

discussion of core requirements and continuing education issues

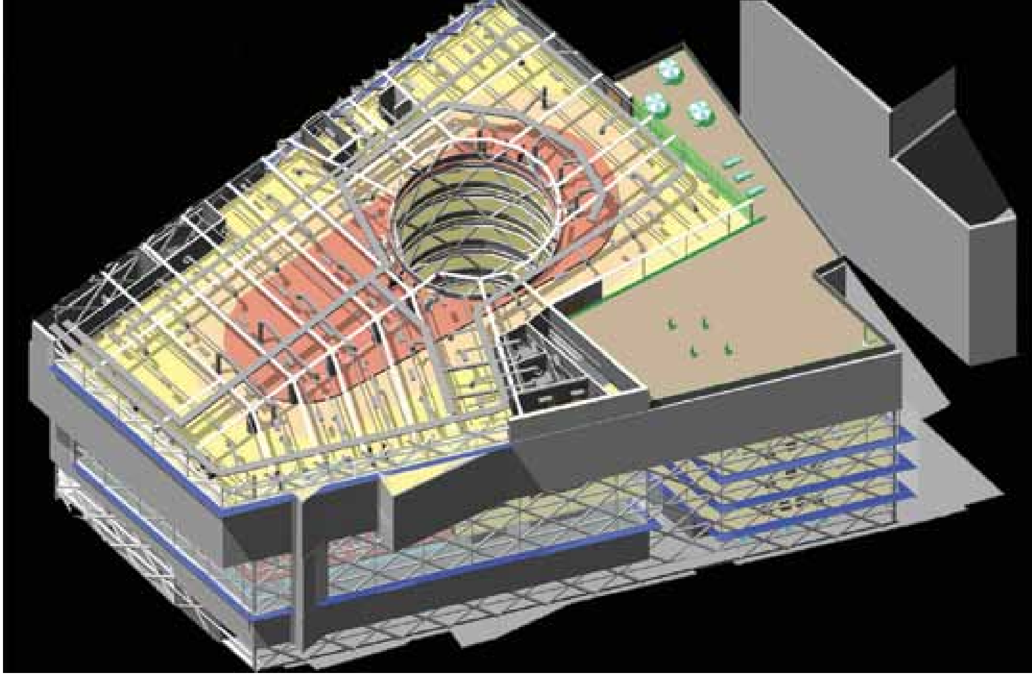

Figure 1: Building Systems Integration (students: Cowan and Krug).

BIM in Education

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Building Information Modeling (BIM) is one of the most promising advances in the Architecture, Engineering and Construction (AEC) industries. Presently the AEC industry is generally embracing BIM through encouraging its association members, stakeholders, etc. However, at the core of all this BIM evolution is education. This article focuses on the experiences gained in introducing BIM in the comprehensive design studio at two institutions of higher learning; Kent State University (KSU) and University of Florida (UF). Using BIM as a framework for an evidence-based design approach, BIM was implemented as the primary vehicle through which architecture seniors were introduced to integrative design practices. This was accomplished in the capstone project at the College of Architecture and Environmental Design at KSU. The students were required to develop an integrative package that includes architectural, structural, mechanical, electrical and plumbing design solutions for their studio's projects.

BIM was introduced at a graduate level architectural-structures course at the UF School of Architecture to develop an integrated view and better understanding of the building and its components, and of the design and construction process. Students were asked to develop their final project using BIM capabilities to support the integration of design and construction activities.

The main objective of this studio is to provide students with means through which integrative pedagogical objectives are achieved through BIM. The interoperable devices were used to enhance students' understanding and provide rubrics to continuously assess successful integration of the building elements. Enhanced in the process is a deep understanding of the complex relationships between its components, and the construction processes through which students' ideas could be realized. This process included documenting and evaluating students' ability to handle cross-disciplinary interests through use of BIM knowledge and other tools into their practical design project.

Case Studies

Kent State University

The comprehensive design studio at Kent State University is a capstone project in which the students demonstrate the knowledge gained throughout their undergraduate experience.

Designing and testing various propositions allowed the students to explore regenerative forces shaping the designed structures in order to reduce wind downdrafts, thus reducing interruption of pedestrian level wind. Formal studies exploring daylighting availability and solar exposure allowedstudents to develop complex formal responses that have definite performative characteristics in fulfillment of the Carbon Neutrality mandate of the program. The resulting complex formal solutions required equally complex and yet innovative structural systems.

The product of such an endeavor was a vast improvement over the conventional linear approach to design *(Figure 1)*. Through the integration process, the students were able to achieve a high level of design integration.

University of Florida

In the fall of 2009, building information modeling was introduced in a graduate level architectural structures course. The students attending the class demonstrated varying levels of familiarity and experiences with BIM. Thus, it was decided to introduce BIM in a way that benefits the students regardless of their expertise. The introduction, which took about four contact hours, was composed of three phases *(Figure 2)*. The next two contact hours introduced and discussed the following topics:

- Benefits of Integrated Practice
- Spectrum of BIM Collaboration
- Internal Collaboration
- External Collaboration
- Model specifications
- Modeling standards
- Interoperability
- Standard of Care and Risk

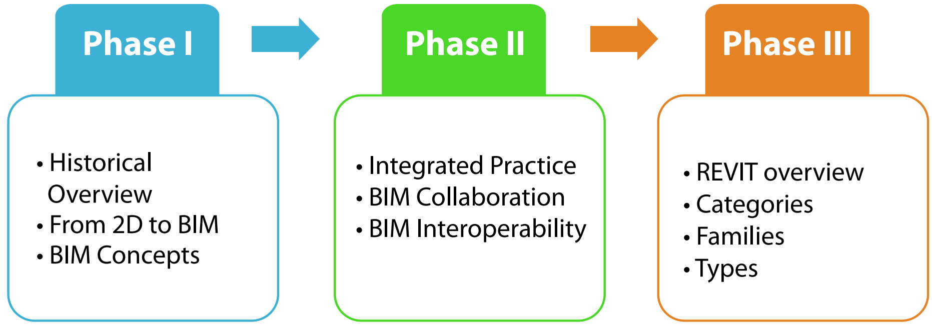

Figure 2: BIM Introduction Blocks.

The last phase of this introduction was an overview of REVIT Structure software emphasizing the comprehensiveness of introduced concepts such as model element, categories, families, types and instances.

In the next phase, students were introduced to structural framing modeling using steel, concrete and wood structural systems. The term project for the course was used as a vehicle to establish the integrated environment. Graduate students of the School of Architecture at UF were asked to design a building using Revit Architecture and Structure software packages. Students applied the acquired knowledge of integrated BIM in theory and practice.

After the completion of the projects students were asked to give feedback on their learning experiences. One of the most important benefits pointed out by students was how easy it is to create "Construction Documents" from a BIM model. The students indicated that BIM significantly expands their design decision metrics. The process of facilitating collaboration among the various disciplines, and identifying conflicts during the design phases of the project, were important discoveries. Incorporating constructability into the building design process has the potential to help students make more informed design decisions, and positively impact overall project efficiency and quality.

Conclusions

This investigation demonstrates our ability to achieve the desired building efficiency and constructability through BIM and integrated project delivery (IPD) transformation in AEC education. To achieve this however, it is essential to implement the following:

- Develop theoretical and pedagogical constructs based on which BIM can be integrated;
- Develop holistic programs that include BIM and IPD as integral part of the life cycle design process;
- Encourage reiteration during the design process to fully benefit from the feedback loops;
- Become proficient at producing 3-D architectural and structural models and 2-D construction documents;
- Be capable of integrating class workflow with that of other disciplines and peers to a much higher degree; and
- Create a culture within the school or College that facilitates and rewards integration.

Experiences in introduction BIM at KSU and UF showed that BIM can deliver an educational environment that integrates design and construction insights in a highly collaborative and interoperable format.▪

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