Building Information Modeling (BIM) and its future in Undergraduate Architectural Science Capstone Projects

Shahnaz Aly, Assistant Professor
Western Kentucky University
Introduction

- The Architectural Science Program in the Department of Architectural and Manufacturing Sciences at Western Kentucky University is a four year program accredited by Association of Technology, Management, and Applied Engineering (ATMAE)
- Department founded in 1920
- Curriculum rewritten in 2008 when the current capstone cycle was introduced
• The capstone sequence comprises two courses over two semesters
• Objective
get students exposed to an applied research experience through which they demonstrate mastery and competence in Architectural Science
AMS 488 - Comprehensive Design
• First course of the capstone experience
• Senior Year Fall Semester
• Course focus
  Identify a project & client
  Develop an architectural proposal
  Generate a program
  Conduct site analysis
  Review applicable building codes and regulations
  Begin schematic design
AMS 490- Senior Project

- Second course of the capstone experience
- Senior Year Spring Semester
- Culmination of the capstone sequence
- Course focus
  - continue to develop schematic design
  - design development
  - presentation drawings
  - construction drawings
  - project presentation to client, faculty and industry professionals
BIM in Architectural Science

- BIM is taught as an elective course in the Architectural Science curriculum
- First introduced in the curriculum in 2009
- Focus was initially on Architectural Science students
- Expression of interest from Construction Management students
2012-2013 Capstone Sequence

- Fifteen students enrolled
- Fourteen successfully completed the course
- Ten students used BIM as the medium to generate the drawings and data for their projects
- Four students used ACAD and Google SketchUp
- The students enrolled in the course had varying levels of knowledge of BIM
Student Perceptions

Tools used for capstone project

- Ten students used BIM tools specifically the REVIT platform
- Four students used non-BIM tools (ACAD, Google SketchUp and other available software)
- Of the students who used BIM
  - four students used BIM tools right from the schematic design stage during AMS 488
  - six students started using BIM tools at the start of the spring semester (AMS 490)
Objectives and motivation in tool selection

- The students who used BIM tools from the start of the project felt it helped them visualize their designs in a more holistic manner.
- Ease of generating two-dimensional drawings from the three-dimensional model.
- The six students, who started using BIM in the spring semester, did so primarily as they had not been exposed to the technology previously and were taking the BIM elective course during the spring semester simultaneously with the capstone.
- Students who used BIM, did so to improve their skills as they felt it would be to their advantage when seeking employment.
Experience with BIM tools

- 9 students had either taken the BIM elective in spring 2012 or were currently enrolled in the BIM elective (spring 2013)
- one of the students was self-taught
- The students felt that taking the course had given them the foundation they required to utilize BIM technology in the capstone (and other courses) and helped them realize the potential of BIM
- Students spent on an average 3-4 hours per week outside class learning how to model the more intricate aspects of their project
- Most of the information and research was gained through resources available on the internet
Recommendations to future student users

• All the students who used BIM tools said they would definitely recommend the use of BIM tools to future seniors for their capstone experience

• Reasons provided for this included the ability to develop a complete project, ability to generate good three-dimensional renderings and the ease of generating two-dimensional drawings from the created model
Future advantages of using BIM tools

• Students felt that using BIM to develop their capstone project gave them an opportunity to utilize their skills and put into practice all that they had learnt about BIM potentially giving them an advantage in the job market
Case Studies

- Three capstone course projects have been discussed
  - the student who was self-taught
  - the student who had taken the BIM elective in spring 2012
  - the student who was simultaneously enrolled in the BIM elective while working on the capstone project
River View at Veterans

- Project Location- River front, Owensboro, KY
- Mixed use facility
- Lower level - retail and restaurant
- Upper floors - one, two and three bedroom condominiums
- The student who worked on this project was self taught
Reasons cited for using BIM

- Easier three-dimensional design visualization as the model was being developed
- Gradual learning curve and shorter rendering time due to the use of the native renderer
- The ease of generating two-dimensional construction drawings
Main problems encountered while creating the BIM model
• Difficulty in editing families and creating custom objects
• The program slowed down due to the large amount of data (model size 110MB)
• The student had started learning BIM in the fall of 2011 and had worked on simple projects in BIM
• The student spent approximately three hours a week outside of class researching and learning the more complicated aspects of the tool
• The lack of formal training also affected in certain situations, the student’s ability to decide between using three-dimensional or two-dimensional objects in the model
Sigma Phi Epsilon Fraternity House

- Project Location - State Street, off Western Kentucky University Campus
- Design included living, recreation spaces, and bedrooms for the chapter members
- Student worked on developing the interiors as well as details for the structure
- Student had taken the BIM elective in Spring 2012
- BIM technology (REVIT) was used from the schematic design stage
Reasons cited for using BIM

- Higher comfort level using BIM software (REVIT) compared to ACAD
- Constant visualization of the three-dimensional model through the development of the project
- Help in improving BIM skills which would be an asset while seeking employment
Main problems encountered while creating the BIM model

- Lack of knowledge of certain aspects of the technology, initially giving the impression that the design was being driven by the software
- Difficulty in modeling roof elements
• Due to prior training in BIM the student had the foundation required to be successful in using BIM for the capstone project
• The student spent about 5 hours a week looking over material available over the internet and books
Owensboro City Center

• Project location- River front. Owensboro, KY
• Mixed use facility
• Lower Level - Retail, restaurant
• Upper Levels - Offices, boutique hotel and condominiums
• The student was enrolled in the BIM elective during spring 2013 while simultaneously working on the capstone
• During the schematic design stage the student worked on the project using ACAD and Google SketchUp
Reasons for switching over to using BIM tools

- Modeling exterior elements of the structure was easier
- Easier rendering using the inbuilt renderer of REVIT
Problems encountered
• Embedding doors into the curved wall surfaces
• Time constraints due to switching over to the BIM platform later in the semester
In developing the capstone project using BIM the student faced the additional challenge of taking the BIM elective while simultaneously working on the capstone.

The student spent about 5-6 hours outside class learning some of the more complicated modeling aspects of the program.
Discussion

The case studies discussed have emphasized the innovative approach of BIM to three-dimensional design and two-dimensional drawing generation

- Taking a course in BIM was not an indicator as to the time spent outside class on BIM related issues
- Time spent researching BIM related aspects of the project depended on project complexity and student comfort level
- Students concentrated on the 3D aspect of the project
- Student who had taken the BIM elective or were currently enrolled in the elective seemed to experiment to a greater extent
• BIM enables students to focus on the core design solution using a tool that manages the huge information complexity that a comprehensive design solution demands.

• When Architectural Science students use BIM tools they not only create a three-dimensional view but are also able to see and understand the nuts and bolts of what goes into the structure (information model)

• Student feedback indicates that a significant driver of interest in BIM was that it is seen as an important requirement of the job market
Conclusion

- A huge facilitator in enhancing future capstone experiences position the elective BIM course prior to the start of the capstone to enable students to take advantage of BIM from schematic design stage rather than have a steep learning curve for BIM during the capstone experience. Augment BIM course content from beyond foundational to addressing similar complex modeling problems encountered by students in the current capstone cycle.
• Future capstone courses should move towards integrating the fourth and fifth dimensional aspects of BIM in creating schedules and estimating
• It is also envisioned that collaboration with the Construction Management Program in the department can lead students to explore the limits to which BIM can be utilized in achieving an ideal architecture solution for the capstone projects
Thank You

shahnaz.aly@wku.edu