INTERDISCIPLINARY COLLABORATIVE BIM STUDIO (ICBIMS)

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(Image: Creative Logic, 2011)
ICBIMS Characteristics

- Interdisciplinary Collaborative Design Teams
- Practitioner / Client Involvement
- Design Benchmarking against real project
Projects

- 2009: Prototype Design Elementary School (100,000 GSF)
- 2010: New Day Care Center (20,000 GSF)
- 2011: New Elementary School (100,000 GSF)
- 2012: Phased Addition to a Recreational Building (120,000 GSF)
- 2013: Philadelphia Energy Hub Classroom Building (25,000 GSF)
COURSE DEVELOPMENT & CURRICULUM INTEGRATION

Tasks

• Architectural Design
• Landscape Architecture Design
• Engineering Design
• Energy Analysis
• Cost Estimating
• Scheduling
• Constructability
• Site Logistics
• Coordination
• Clash Detection
• Benchmarking

(Image: Dos Design Build Team, 2010)
Course Content

- Overview of BIM and Integrated Project Delivery (IPD) and their application to the design and construction process
- Current BIM software
- BIM/IPD Trends in the design professions and construction industry
Deliverables

- BIM Execution Plan
- Schematic Design (~ Conceptual)
- Design Development (~ Schematic)
- Final Design (~ Design Development)
The main objective of this project is to provide a building with integrated building systems that correlate to the integration of the disciplines designing the structure. The goal is to provide a building that is a welcoming point on campus - a gateway - that also serves as a meeting point for students, in both an academic and social approach.

Through a thorough explanation of three key areas, our goal for the Intramural Building was to create an atmosphere to facilitate a link between athletics and academia through transparency, wellness, and socialization. Integrated Inc.'s final design creates a transparent, sustainable, and welcoming fitness hub linking the university's academic and athletic prowess.

Our main goal was to combine fitness and social space, thus creating a new fitness hub. Contemporary socialization techniques have shifted to include athletics within the typical student union framework. Through the Intramural Building Renovation and Expansion, our aim is to create a transparent, sustainable, and social-centered fitness hub with an ideal balance of academic and athletic interaction.
Key Area 2: Climbers’ Canyon

STRUCTURAL:
Climber’s Canyon is the backbone of our building that connects and fully integrates the social and athletic aspects of our new additions. We removed everything from the foundation and re-designed the space from scratch. The structural system is pretty linear compared to the 10-20 foot mechanical elements that took up close to half of the roof area in this section. Snowwill not be a problem during the cold months, and the roof frame was designed to accept forklift access. The existing columns in the perimeter of the floor plate are square and are W14s that vary in size. These beams branch off of the existing structure and then new ties-in were analyzed for the existing loading that was removed and replaced by our square ties. We designed the floor system to handle the seismic forces that were determined through various analysis. These elements influenced the reseating mechanical systems for the space.

A VRF (variable refrigerant flow) system is utilized for our energy and comfort, which is distributed and balanced across the various areas. This was developed and fabricated by the means of four different in the architectural courts run parallel and feed to the VRF in the encroachment.

LIGHTING:
Adding brightness to the space and focus our vision on the path ahead towards the gym, we decided to implement linear lighting. Ledges or ledges were added by the means of beams to the main area to provide a base for the lighting. Arranged that way, the designs of both the lighting and the space are harmonious to the design elements.

CONSTRUCTION:
Our approach was to incorporate the mechanical and structural models in Climber’s Canyon. Additionally, having the same structural walls and columns to attain the seismic structure is a critical concern during phase two construction.

Key Area 1: Lobby + Fitness

LIGHTING:
We decided to play the brick on the front facade with up-light to create the entrance and continue the contrast of lights to light the front steps and walkway. We also highlighted the edges of the columns to emphasize the main entrance. Inside, we used the same approach to add a subtle led accent on the columns. The main feature is a horizontal light fixture with the lamps to illuminate the corridor for the lobby. The red brick work hang lower over the portionated area to create intimate spaces. To help show the integration of academic space, some lighting strategies were used to highlight the lobby and fitness areas.

MECHANICAL:
Both the lobby and the fitness area will be supplied using air-cooled chillers in the core and mechanical system. Some of the features of the lobby is a large glass wall on the north-east elevation that extends from the lobby into the fitness area. To reduce solar gain, we decided to use a double façade system. This will allow for ventilation, temperature changes, and preventing the heat from entering the building. The double façade system consists of an outer glazed glass wall and a single fixed outer pane of tempered glass with a ventilated air space between which controls the ventilation inside. These-protected façade will allow for natural ventilation to enter the space. NATURAL VENTILATION.

For the structure, W14s were used as open beams between the columns that are exterior façade. These will connect to and support the double façade system. The columns frame into the concrete walls that extend the massing as a precast panel system and serve as the main bearing support for the frame. While it’s not visible to support the corridor from above, this also serves the same purpose.

CONSTRUCTION:
While we were developing phase one, our structural and mechanical designers provided input for the depth of the floor for the phase two. The logistics of adding the new supply ducts while maintaining the interior ceiling height was a decision for a finished ceiling appearance.
The concept of replicating multidisciplinary project teams engaged in a re-interpretation of a real project’s design and construction program is simply brilliant. I particularly enjoyed watching the students “walk in the shoes” of their respective disciplines and struggle with competing agenda, goals and egos. This is great training for the real world.

These students are not just being trained in current best practices of the design and construction industry but they’re actually leading the industry—demonstrating what will become the new standard of care for high performing teams.
Two recent surveys conducted by the National Council of Architectural Registration Boards (NCARB) and the National Architecture Accrediting Board (NAAB) conclude educational gaps exist in preparing students for professional practice and eventual licensure.

(NCARB, 2007)

A CHANGING PROFESSION

Gaps in Education for Practice

• 12 knowledge/skill area gaps in education including BIM and advanced building technology (NCARB, 2007)
• Most significant impact on architecture: BIM/new technology software ranked 1st (29%, NAAB, 2012)
• Greatest affect on architectural education: BIM/IPD technical skills ranked 1\textsuperscript{st} (19%, NAAB, 2012)
REALM A - Critical Thinking/Representation
1. Communication skills
2. Design thinking skills*
3. Visual communication
4. Technical documentation*
5. Investigative skills*
6. Fundamental design skills
7. Use of precedents
8. Ordering systems skills*
9. Historical traditions, global*
10. Applied research

REALM B - Integrated Bldg Pract, Tech Skills, Knowledge
1. Pre-design
2. Accessibility*
3. Sustainability*
4. Site design*
5. Life safety*
6. Comprehensive design
7. Financial considerations
8. Environmental systems*
9. Structural systems*
10. Building envelope systems
11. Building service systems
12. Bldg materials and assemblies

REALM C — Leadership and Practice
1. Collaboration
2. Human behavior
3. Client role in architecture
4. Project management
5. Practice management
6. Leadership
7. Legal responsibilities
8. Ethics and professional judgment
9. Community and social responsibility

A CHANGING PROFESSION

Accreditation – Student Performance Criteria

- BIM alone addresses 1 SPF: Technical Documentation
- BIM with IPD addresses up to 18/32 SPF’s including Realm B (Integrated Building) and Realm C (Leadership and Practice) criteria often difficult to apply in standard courses
- ICBIMS course offers new curricular to meet Comprehensive Design criteria (*11 separate criteria)
Comprehensive Design

- Traditional “thesis” method: individual architecture student “jack of all trades” working to limits of sole knowledge and ability. Breadth with limited depth
- ICBIMS method: each student relies on expertise of team, but knowledgeable about all; Acknowledges reality of contemporary practice
- Result: more breadth in awareness of related disciplines, more depth in fully-designed comprehensive building, impact of “lead / lag”
“The project team is the lifeblood of IPD. In IPD, project participants come together as an integrated team, with the common overriding goal of designing and constructing a successful project.”

(AIA IPD Guide, 2007)

**Team Composition**

- 30 students composed of five teams with one member representing each of the six building design disciplines taught at Penn State
- Class size limited by infrastructure and scheduling
Nearly all survey participants (96%) agree with the statement “Architects must work in collaborative teams with other design, business and construction professionals.”

(NAAB, 2012)
Landscape Architecture Integration / Challenges of BIM Software

- BIM and IPD process is a natural fit
- Architects need to allow Landscape Architects into initial building design process
- BIM tools such as Autodesk Revit are not designed for landscape architectural needs
- Revit landscape library is limited
- Landscape students have utilized other software applications to contribute to the IPD teams including Civil 3D
Responding to Demand

- Increased class sizes from 18 to 30
- More BIM course offerings and software training workshops; IPD/BIM AE capstone project
- Improvements to collaborative workspaces and presentation venues
- Improved hardware and software compatibility for more fluid information sharing across disciplines

Penn State workspaces above, Texas Tech collaboration studio below
Distant Collaboration

• Access to distant project sites and practitioner consultants require new communication and working environments. (2013 Philadelphia Energy Hub)
• Students to be encouraged to work from their preferred space and collaborate using remote access software such as TeamViewer.
• Use of ASUS Slate notebooks (or similar) to facilitate team collaboration.
• Virtual critiques by professional consultants with use of remote access software.
THE FUTURE OF THE ICBIMS COURSE

Research

- ICBIMS provides convenient platform for research at Penn State
- Architecture pedagogy, comprehensive design
- BIM Execution plans
- Creative teams
- Collaborative work, learning spaces
- Virtual studios
2010

Team BIMovation:
Nick Landiak, Neal Diehl, Stephen Pfund, Alex Stough, Josh Winemiller

Team Project Synergy:
Amanda Montemore, Kevin Mokos, Punit Das, Dan McGee, Chris Pozza, Keith McMullen

2011

Team Creative Logic:
Mahzad Tashakori, Laurie Beth Donnachie, Josh Progar, Josh Wentz, Asher Harder, Patrick Laninger

2012

Team esseo:
Rachel Boaziz, Ryan Judge, Andy Penev, Victoria Interval, Michael Palmer, Stephen Blanchard

Team Integrated Inc.:
Jeff Brown, Kaylynn Primerano, Alex Byard, Melanie Fonner, Kyle Houser, Devon Saunders

STUDENT WORK SHOWN
ABOUT THE AUTHORS

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