BIM in Education:

Collaborative Design Studios
Integrating Architecture, Engineering, & Construction

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San Luis Obispo
Integrated Design

Professional Experience – the transition
Common goals or learning objectives

Analog versus digital or 2D versus 3D
Cal Poly Integrated Design Studio: Learning Objectives

1. Develop verbal, written, graphic and electronic communication skills

2. Work successfully within a small group with diverse values

3. Understand and master the complexities of working nationally/globally

4. Develop design skills in situations with built-in (and often conflicting) constraints

5. Incorporate project management skills, in particular skills associated with day-to-day organization, project documentation, and presentations.

6. Select appropriate design processes and create building systems that integrate architecture, structure, and construction

Analog vs. digital or 2D versus 3D
Getting started – the base model
Getting up to speed

• University seed money to initiate BIM into the curriculum
  • Center for Teaching and Learning

• Office Surveys/visits

• Summer workshop for college faculty

• Software training session in winter

Starting the transition
## Common BIM Software Summary Sheet

<table>
<thead>
<tr>
<th>Software Name</th>
<th>Manufacturer</th>
<th>Information Modeling</th>
<th>Other software owned by manufacturer</th>
<th>Embedded Structural Analysis</th>
<th>Embedded Steel or Concrete Detailing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revit</td>
<td>AutoDesk</td>
<td>X</td>
<td>AutoCAD, ROBOT Millennium, Buzzsaw, Constructware, FM Desktop</td>
<td></td>
<td></td>
<td>Story Dependant &amp; Mostly Object Based Templates, Most Supported Formats</td>
</tr>
<tr>
<td>Architectural Desktop</td>
<td>AutoDesk</td>
<td>X</td>
<td>AutoCAD, ROBOT Millennium, Buzzsaw, Constructware, FM Desktop</td>
<td></td>
<td></td>
<td>Near Obsolete</td>
</tr>
<tr>
<td>Bentley</td>
<td>Bentley</td>
<td>X</td>
<td>Microstation RAM Steel</td>
<td></td>
<td></td>
<td>Common in UK</td>
</tr>
<tr>
<td>Tekla Structure</td>
<td>Tekla</td>
<td>X</td>
<td>X-Steel, Staad Pro</td>
<td>X</td>
<td>X</td>
<td>No Support for Arch Elements</td>
</tr>
<tr>
<td>ArchiCAD</td>
<td>Graphisoft</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>No Support for Structural Elements</td>
</tr>
<tr>
<td>VectorWorks ARCHITECT</td>
<td>Nemetschek</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATIA Project</td>
<td>Gehry Technologies</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>Very Expensive, free form</td>
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</table>

The 3D BIM models can be delivered to the AEC/FM consultants in the following electronic formats:
- IFC (Industry Foundation Classes)
- IGES (Initial Graphics Exchange Specification)
- STEP (Standard for the Exchange of Product)
- OISV2 (Computer Integrated Manufacturing for Constructions Steelwork)
- VRML (Virtual Reality Modeling Language)

### Getting started – the transition
Launching the “program”

ARCE 257: AutoCAD or Revit – the transition begins
Launching the “program”

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Launching the “program”

ARCE 257: AutoCAD or Revit – the transition begins
Interdisciplinary Courses and Collaborative Design

**Integrated Building Envelopes**

**Course Title:** Integrated Building Envelopes

**Course Number:** X410: Integrated Building Envelopes v2: digital

**Course Description:** The goal is to create a team project led by ARCH, ARCE, and CM students, focusing on the following topics:

- ARCH x410: Integrated Building Envelopes (4 units)
- ARCE x410: Integrated Building Envelopes (4 units)
- CM x410: Integrated Building Envelopes (4 units)

**Prerequisites:** 4th-year standing or consent of instructor

**Time:** Tues & Thurs 2pm-4pm

**Course Instructor:**
- James Cantor (ARCH), guest lecturers from industry

**Placement Criteria:**
- Advanced standing elective for ARCH, ARCE, and CM majors
- Professional-content elective for ARCH and CM majors

**Instructional Methods:**
- The multidisciplinary, studio approach integrates an interdisciplinary team approach to design and construction of sustainable envelopes. Students will learn how to design and construct sustainable envelopes. Additionally, students will learn how to design and construct sustainable envelopes. Students will be organized into teams based on the following disciplines: Architectural, architectural engineering, and construction management.

**Instructional Outlines:**
- The course includes a series of lectures during the first part of the quarter on the topics that pertain to sustainable envelopes. Weekly round table discussions delve into the interdisciplinary impact of each topic. All instructors will attend the round table discussions in order to bring their unique perspectives to each topic. During this time, the instructor will select a building to use as a precedent study for their second three teams to select. These precedent buildings will be selected from completed buildings that display high-level of design, sustainability, a high level of engineering, and a high level of construction coordination.
- The second half of the quarter concentrates on a team project, with each member of the team taking a different discipline. The project is the design, development, procurement, and construction of a sustainable building envelope. The instructor involvement for the second period will be more flexible and will be determined by the individual teams during class time.

**Student Expectations:**
- Student learning is based on three team projects with each team comprised of ARCH, ARCE, and CM instructors.
- Project 1 is an introductory project on building envelopes using digital tools (ARCH, Architecture & Construction Management).
- Project 2 is a precedent-based project where an existing building is investigated to understand design, construction, and procurement issues.
- Project 3 is a design-based project where multi-disciplinary teams design and construct a building envelope for a multi-story building.
Interdisciplinary Courses and Collaborative Design

X410 Integrated Building Envelopes v2: digital project one
Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital project one
Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital project two
Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital two
Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital project three
Integrated Building Envelopes v2: digital project three
Interdisciplinary Courses and Collaborative Design

**Cost Estimate:**

**Frit Patterned Exterior**

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty</th>
<th>Unit</th>
<th>Cost/Unit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured Glazing Pan</td>
<td>100</td>
<td>SF</td>
<td>$37.41</td>
<td>$3,741</td>
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<tr>
<td>Glazing w/ Frit Pattern (no/ Clear Basket Grid)</td>
<td>100</td>
<td>SF</td>
<td>$37.41</td>
<td>$3,741</td>
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<tr>
<td>Bal Arm Support w/ Spider Connection</td>
<td>2</td>
<td>Ea</td>
<td>$91.94</td>
<td>$183.88</td>
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<tr>
<td>Pin arm of Spider Connection</td>
<td>2</td>
<td>Ea</td>
<td>$24.71</td>
<td>$49.42</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>130</td>
<td>SF</td>
<td>$53.19</td>
<td>$6,899.74</td>
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**Green Wall Louver**

<table>
<thead>
<tr>
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<th>Qty</th>
<th>Unit</th>
<th>Cost/Unit</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Painted Material (perl. 4' East)</td>
<td>27.5</td>
<td>SF</td>
<td>$1.75</td>
<td>$48.125</td>
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<td>Fireproof Mesh</td>
<td>97</td>
<td>SF</td>
<td>$121.66</td>
<td>$11,833.66</td>
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<tr>
<td>Irrigation System</td>
<td>1</td>
<td>EA</td>
<td>$567.84</td>
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<tr>
<td>Metal Framed Panel</td>
<td>61</td>
<td>EA</td>
<td>$2.86</td>
<td>$171.86</td>
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<tr>
<td>Main Metal Channels</td>
<td>25</td>
<td>LF</td>
<td>$15.85</td>
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<td>Ext. Arm Support</td>
<td>1</td>
<td>EA</td>
<td>$145.67</td>
<td>$145.67</td>
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<tr>
<td>Noris Metal Channel</td>
<td>8</td>
<td>LF</td>
<td>$16.54</td>
<td>$132.32</td>
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<tr>
<td>Main Panel Rotation System</td>
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<td>EA</td>
<td>$25.99</td>
<td>$25.99</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>37.8</td>
<td>SF</td>
<td>$62.45</td>
<td>$2,393.73</td>
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**Complete Construction Cost**

**SW Envelope**

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty</th>
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<th>Cost/Unit</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Unitized System</td>
<td>1.54</td>
<td>SF</td>
<td>$71.12</td>
<td>$107.76</td>
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<td>Gutters System</td>
<td>4.56</td>
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<td>$333.57</td>
<td>$1,530.83</td>
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<td><strong>TOTAL</strong></td>
<td>6</td>
<td>SF</td>
<td>$122.25</td>
<td>$1,634.18</td>
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**SE Envelope**

<table>
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<tr>
<th>Description</th>
<th>Qty</th>
<th>Unit</th>
<th>Cost/Unit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unitized System</td>
<td>2.79</td>
<td>SF</td>
<td>$26.12</td>
<td>$72.30</td>
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<tr>
<td>Gutters System</td>
<td>9</td>
<td>EA</td>
<td>$3,991.75</td>
<td>$35,925.75</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>11.78</td>
<td>SF</td>
<td>$102.52</td>
<td>$36,657.95</td>
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</table>

Integrated Building Envelopes v2: digital project three
Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital project three
Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital project three
Where do we go from here?

Collaborative Design Studio: ARCE + ARCH + CM
Thank you for your time

Revit v3.1 – 2000