BIM in Education:

Collaborative Design Studios Integrating Architecture, Engineering, & Construction

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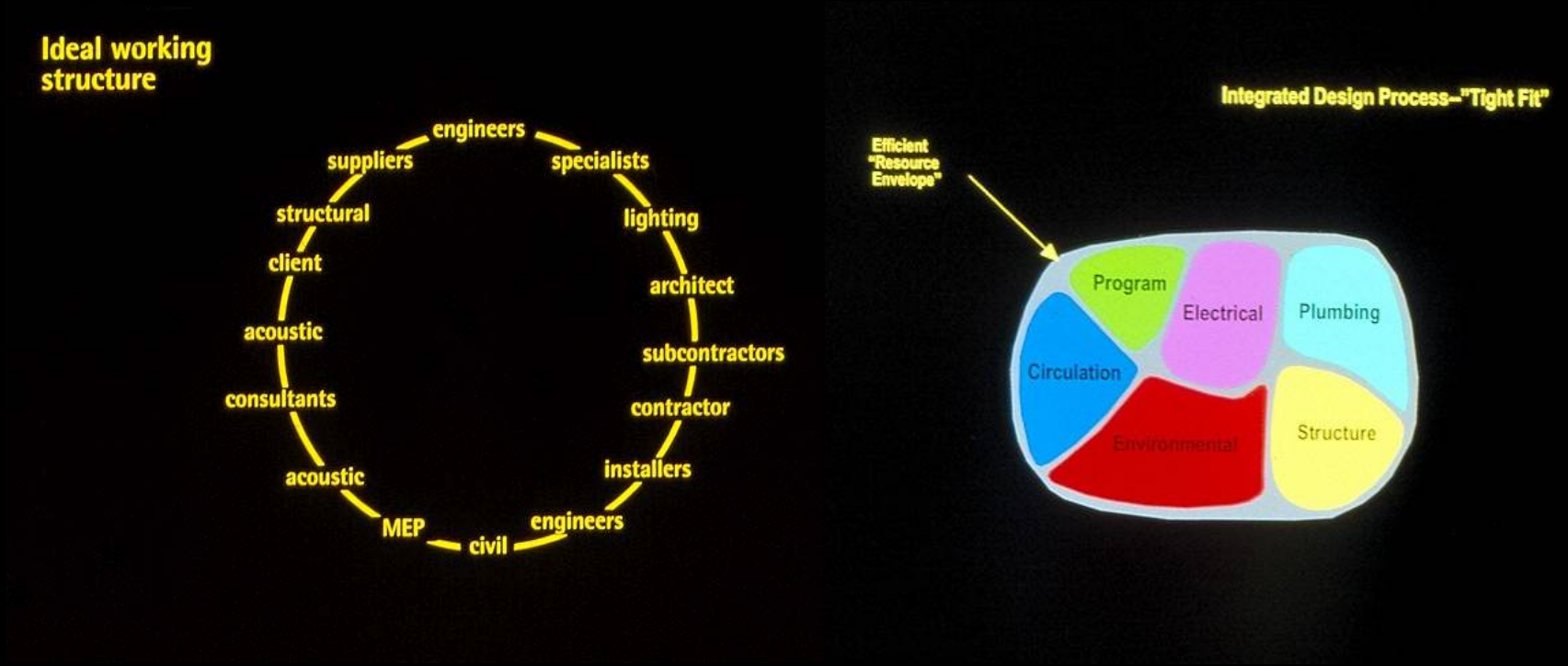
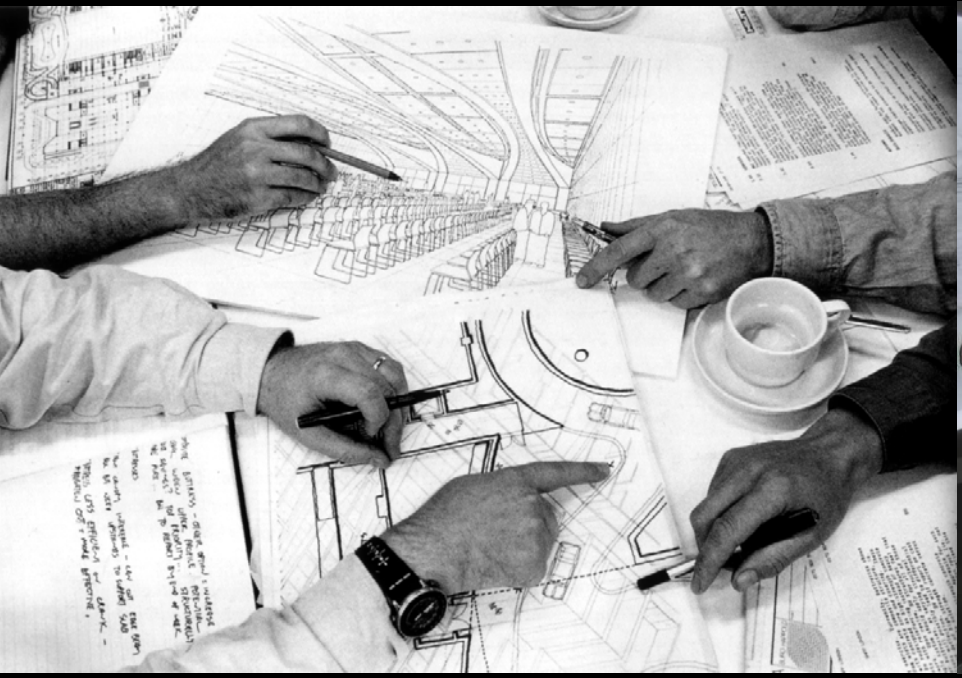
Integrated Design



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

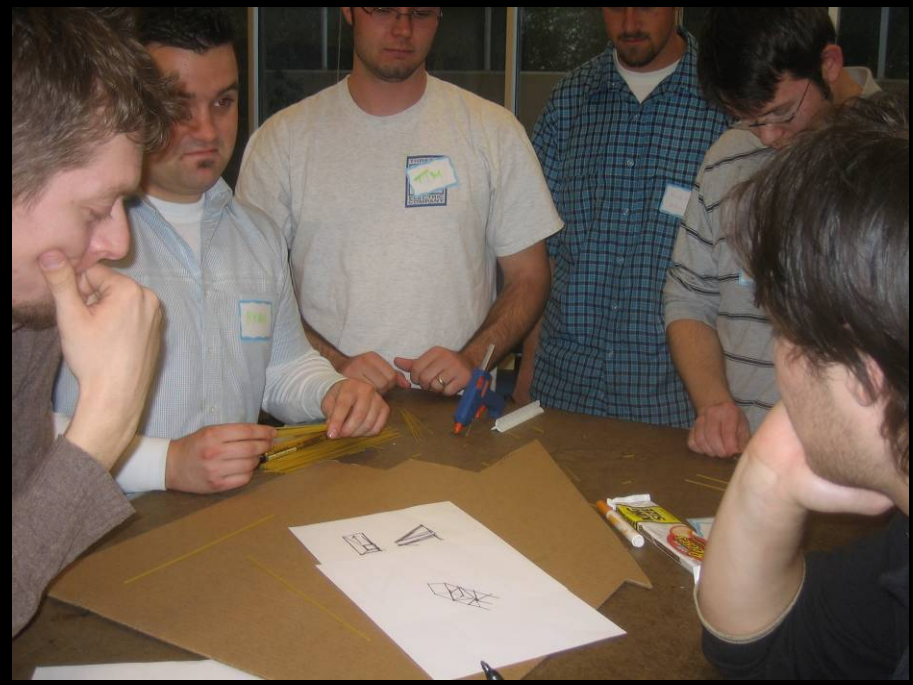
2. Work successfully within a small group with diverse values

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

Cal Poly/ISU Integrated Design Studio - Spring 2005

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

Cal Poly Introduction to BIM

Common BIM Software Summary Sheet

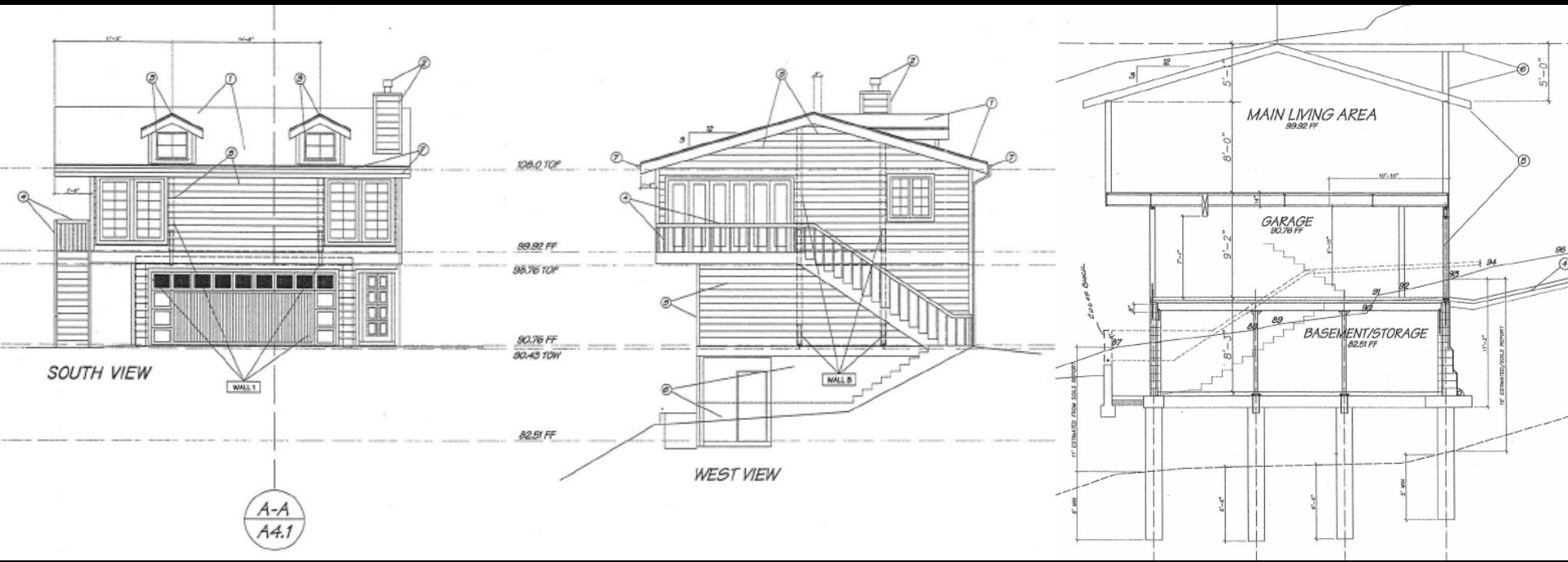
Software Name	Manufacturer	Information Modeling	Other software owned by manufacturer	Embedded Structural Analysis	Embedded Steel or Concrete Detailing	Comments
Revit	AutoDesk	X	AutoCAD, ROBOT Millennium, Buzzsaw, Constructware, FM Desktop			Story Dependant & Mostly Object Based Templates, Most Supported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

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)
- CIS/2 (Computer Integrated Manufacturing for Constructional Steelwork)
- VRML (Virtual Reality Modeling Language)

Getting started – the transition

Launching the “program”



ARCE 257: AutoCAD or Revit – the transition begins

Launching the “program”

ARCE 257: AutoCAD or Revit – the transition begins

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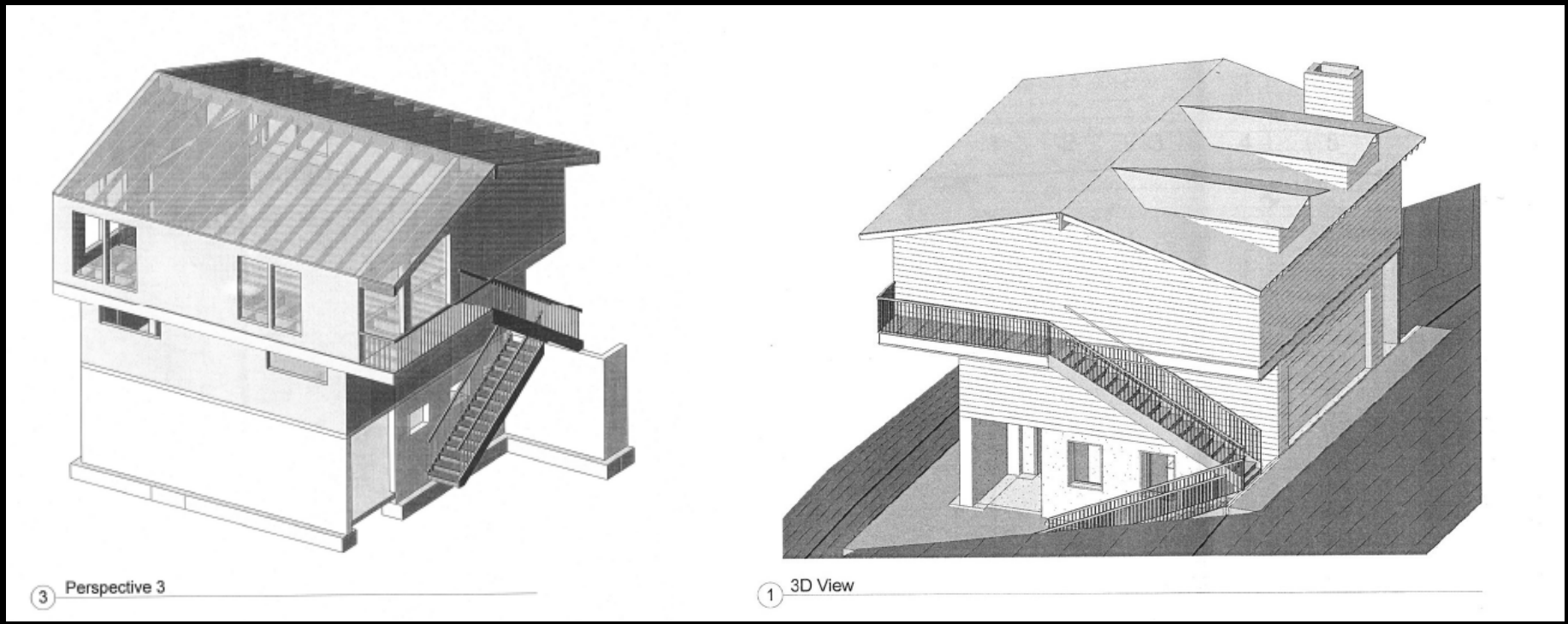
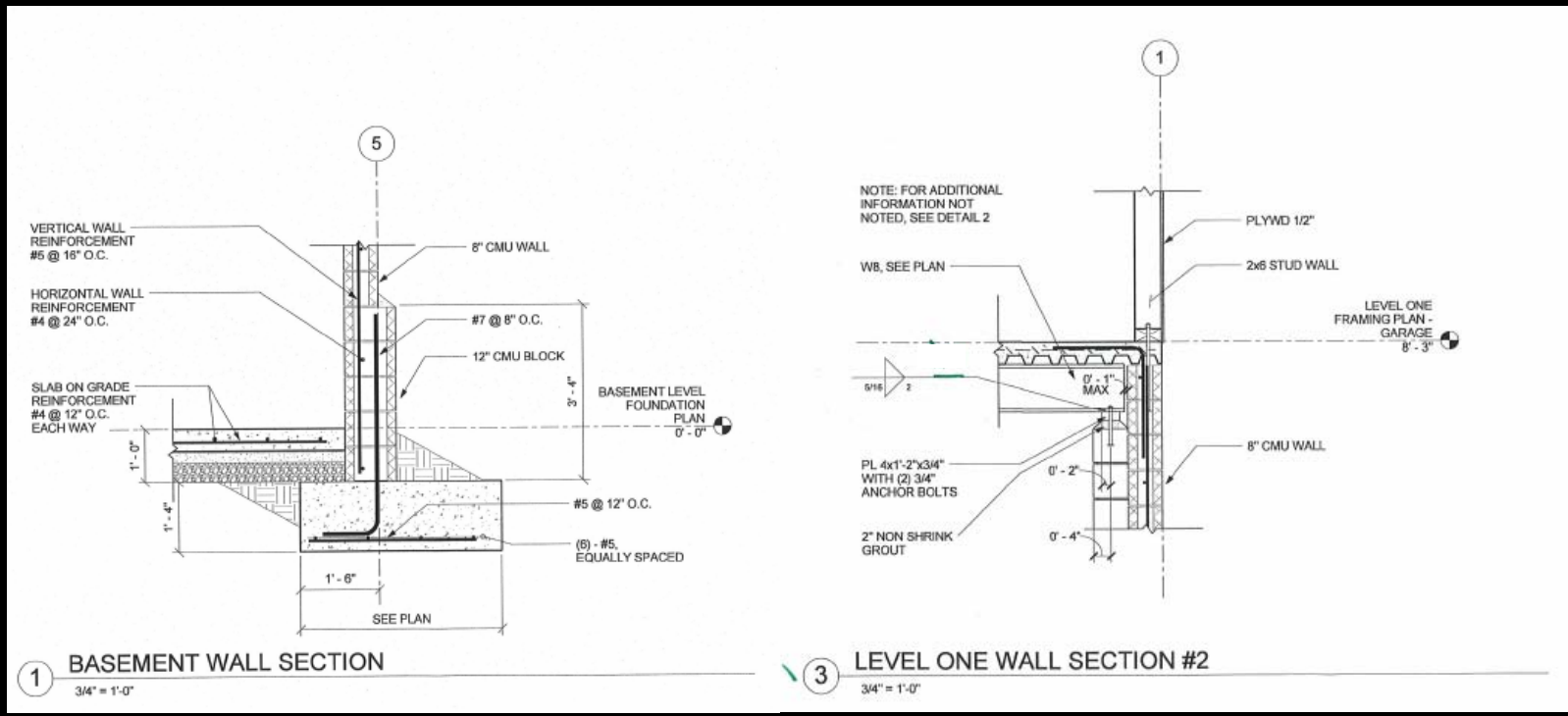


ARCE 257: AutoCAD or Revit – the transition begins

Launching the “program”



ARCE 257: AutoCAD or Revit – the transition begins

Interdisciplinary Courses and Collaborative Design

Fall 2006

Integrated Building Envelopes

Course Title:
- Integrated Building Envelopes

Course Number:
- The class is a four-unit lecture class team taught by ARCE, ARCH, and CM and is cross listed under the following prefixes;
  - ARCE x410 Integrated Building Envelopes (4 units)
  - ARCH x410 Integrated Building Envelopes (4 units)
  - CM x410 Integrated Building Envelopes (4 units)

Prerequisites:
- 4th year standing or consent of instructor

Time:
- Tues & Thur 2pm-4pm

Course Instructors:
- Kevin Dong (ARCE), James Doerfler (ARCH), guest lectures (from industry)

Flow Chart Criteria:
- Advanced Structural Elective for ARCE majors
- Professional Elective for ARCH and CM majors

Description:
- This multidisciplinary elective explores an integrated project team approach to the design and construction of sophisticated external building envelopes. Additionally, participants will learn how building information modelling (BIM) can be used to collaborate and coordinate continuously through the design and construction process for building envelopes. The class will be organized and team taught by instructors from each of the following disciplines: architecture, architectural engineering and construction management.

Instruction Outline:
- This course includes a series of lectures during the first half of the quarter on the topics that pertain to each discipline and weekly round table discussions detailing the interdisciplinary impact of each topic. All of the instructors will attend the round table discussions in order to bring their unique perspective on each issue. During this time, the students will select a building to use as a precedent study for their second team based project. These precedent buildings will be selected from completed buildings that exhibit a high level of design sophistication, 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 from a different discipline. The project is the design, development, procurement, and construction of a sophisticated building envelope. The instructor involvement for this second project will be desk crits and short customized seminars with the student teams during class time.

Student Projects:
- Student learning is based on three team projects with each team comprised of ARCE, ARCH, and CM majors:
  - Project 1 is an introductory project to building envelopes using BIM (Revit Architecture & Revit Structure)
  - 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 cost a building envelope for a multi-story building

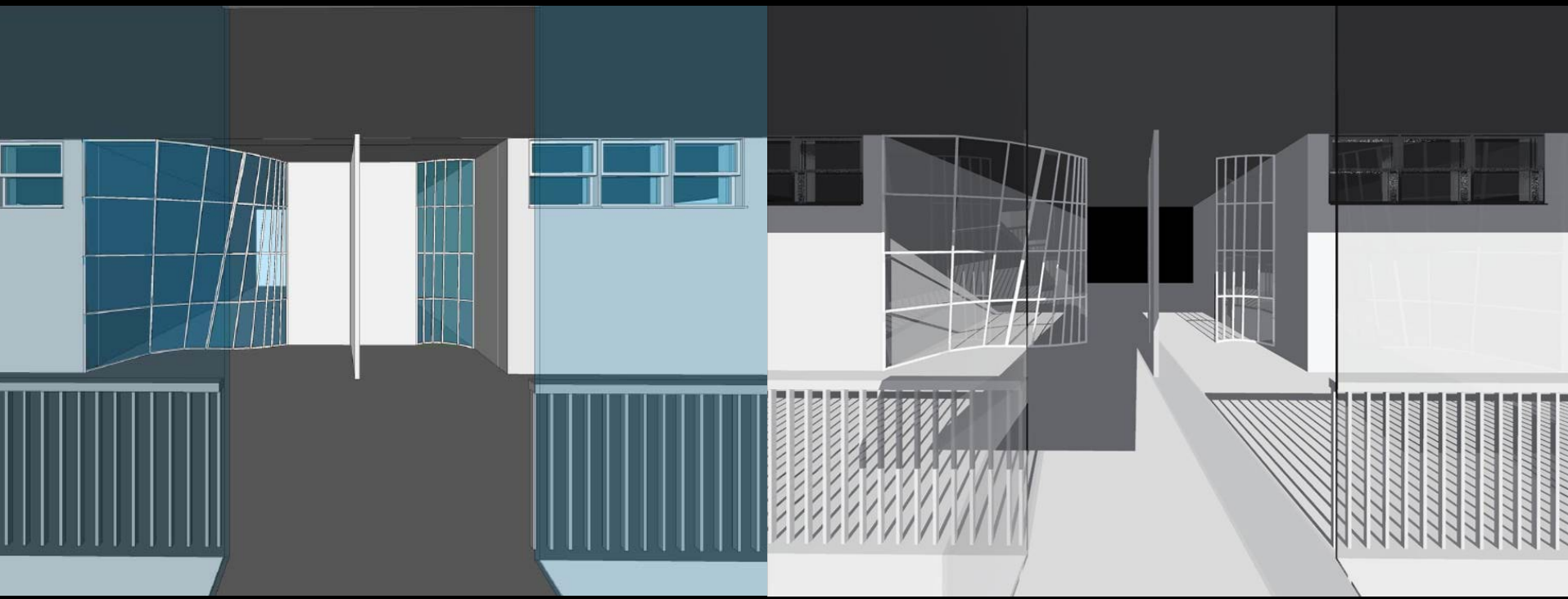
ARCE x410 **ARCH x410** **CM x410**

X410: Integrated Building Envelopes v2: digital

Interdisciplinary Courses and Collaborative Design

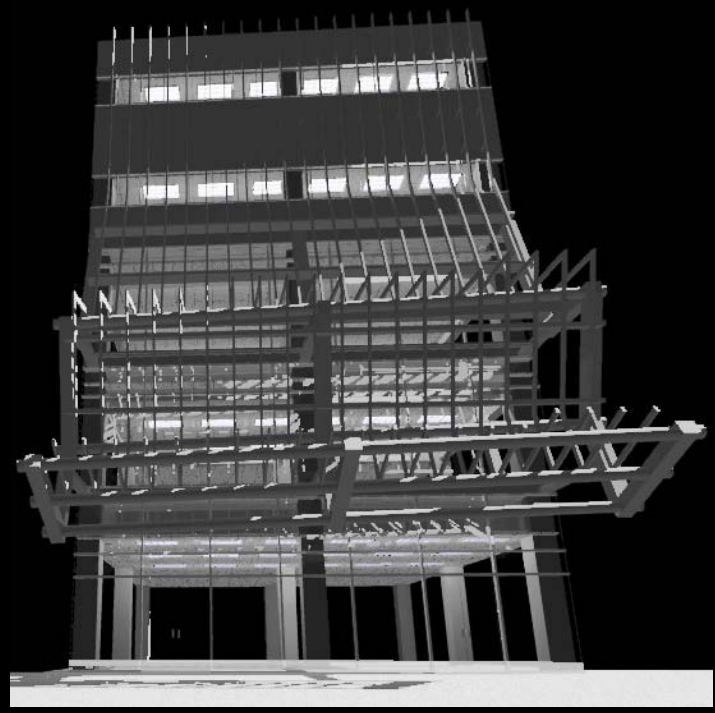
X410 Integrated Building Envelopes v2: digital project one

Interdisciplinary Courses and Collaborative Design



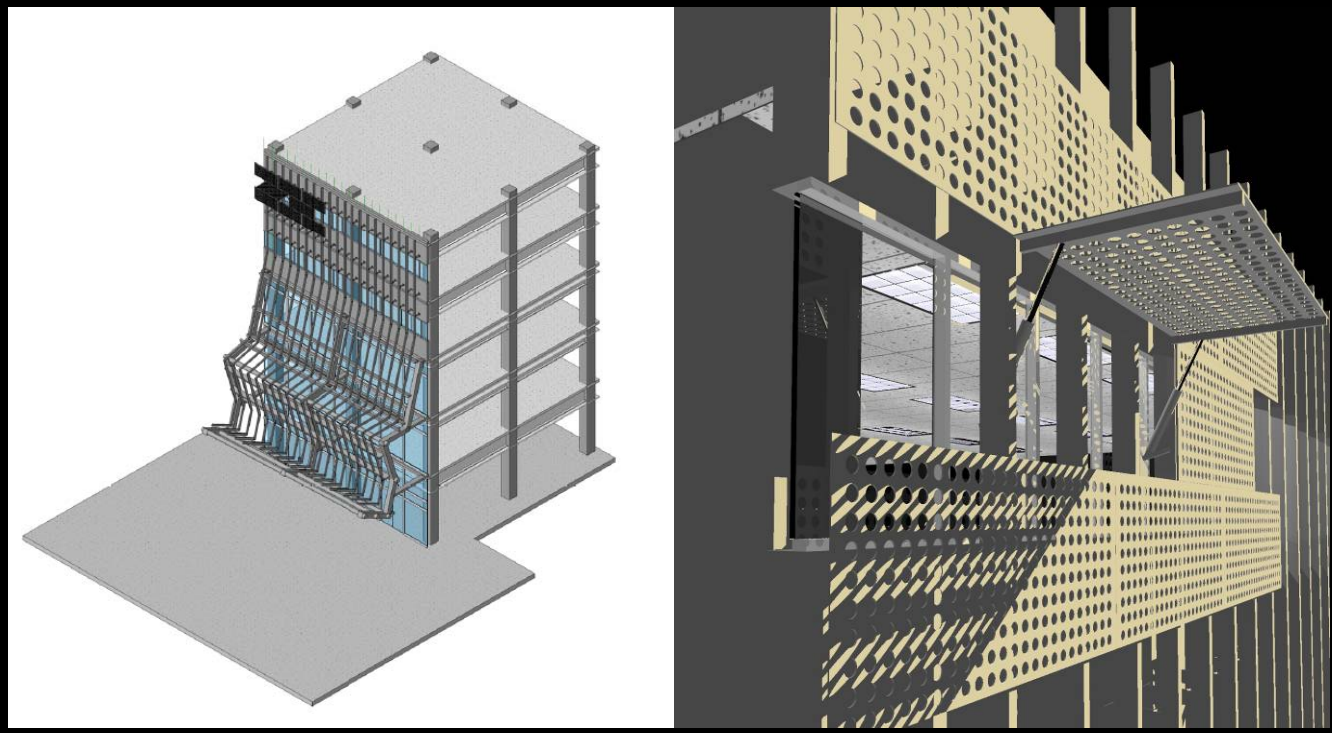
Integrated Building Envelopes v2: digital project one

Interdisciplinary Courses and Collaborative Design



Integrated Building Envelopes v2: digital project two

Interdisciplinary Courses and Collaborative Design

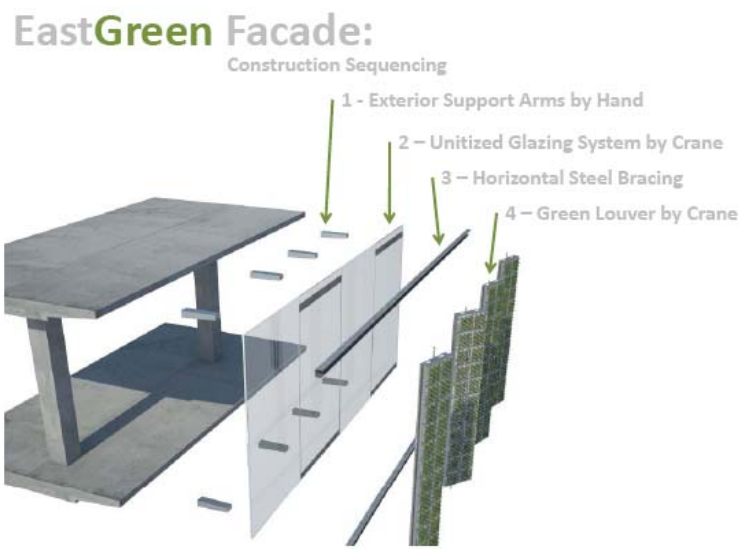


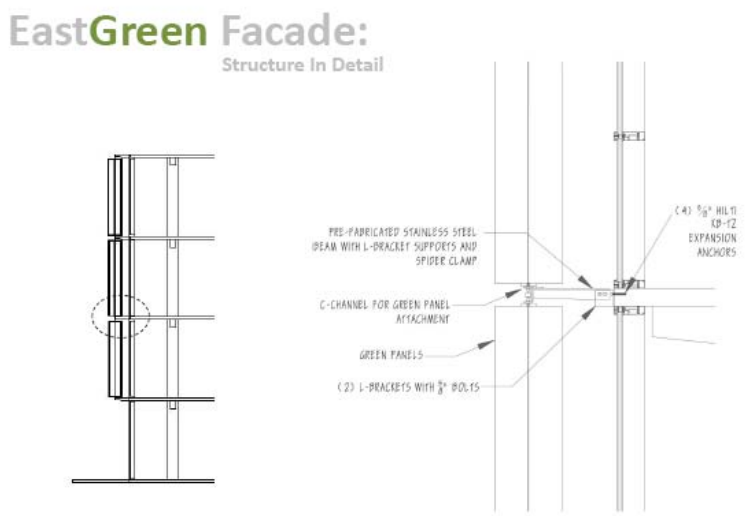
Integrated Building Envelopes v2: digital two

Interdisciplinary Courses and Collaborative Design

Integrated Building Envelopes v2: digital project three

Interdisciplinary Courses and Collaborative Design





Integrated Building Envelopes v2: digital project three

Interdisciplinary Courses and Collaborative Design

CostEstimate:

Frit Patterned Exterior

Description	Qty	Unit	Cost/Unit	Cost
Structural Glazing Fin	15	SF	$42.72	$640.80
Glazing w/ Frit Pattern (incl Clear Gasket Grid)	120	SF	$37.42	$4,490.40
Ext Arm Support w/ Spider Connection	2	Ea	$316.49	$632.98
Fin arm w/ Spider Connection	2	Ea	$246.76	$493.56
TOTAL	120	SF	52.15	$6,257.74

Green Wall Louver

Description	Qty	Unit	Cost/Unit	Cost
Planted Material (incl. 4" Soil)	37.5	SF	$6.78	$254.25
Fireproof Mesh	37.5	SF	$12.48	$468.00
Irragation System	1	Ea	$367.84	$367.84
Metal Framed Panel	24	Ea	$43.58	$1,045.92
Main Metal Chanels	35	LF	$16.54	$578.90
Ext. Arm Support	1	Ea	$185.62	$185.62
Horiz. Metal Channel	8	LF	$16.54	$132.32
Motorized Rotation System	1	Ea	$59.90	$59.90
TOTAL	37.5	SF	82.45	$3,091.75

CostEstimate:

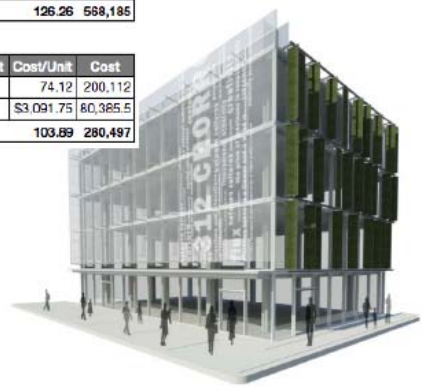
Complete Construction Cost

SW Envelope

Description	Qty	Unit	Cost/Unit	Cost
Unitized System	4,500	SF	74.12	333,519
Ext Frit lazing System	4,500	SF	52.15	234,665
TOTAL	4500	SF	126.26	568,185

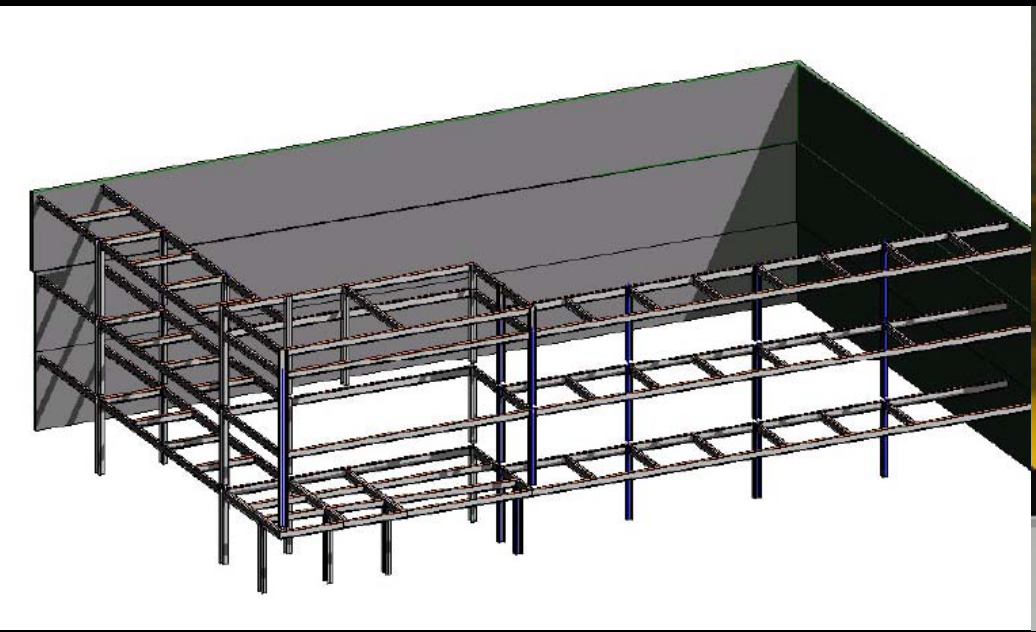
SE Envelope

Description	Qty	Unit	Cost/Unit	Cost
Unitized System	2,700	SF	74.12	200,112
Ext Frit lazing System	26	Ea	$3,091.75	80,385.5
TOTAL	2700	SF	103.89	280,497



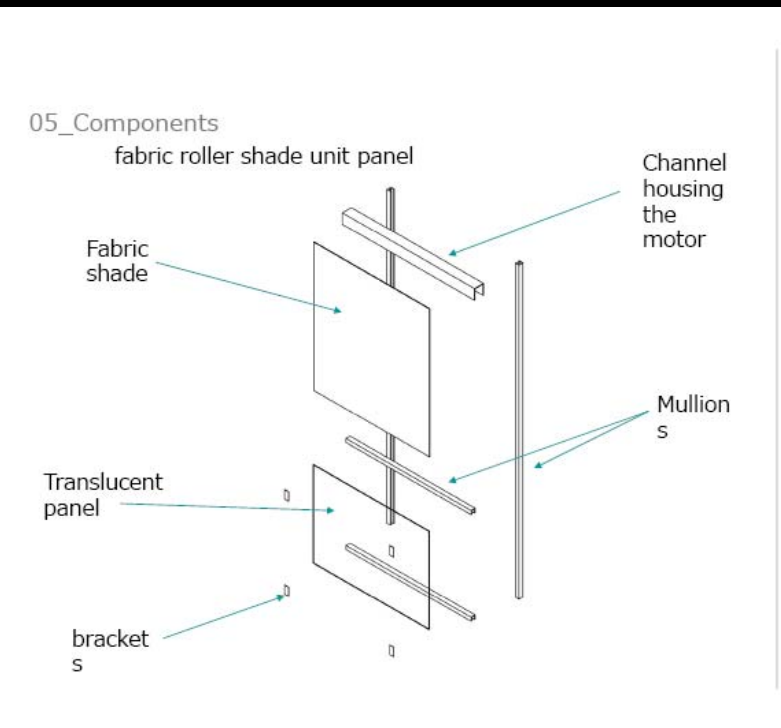
Integrated Building Envelopes v2: digital project three

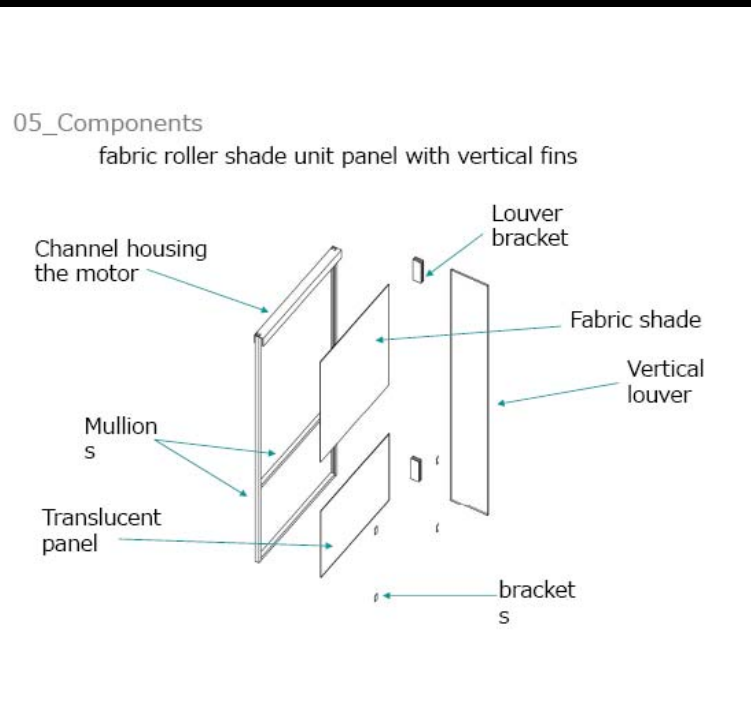
Interdisciplinary Courses and Collaborative Design



Integrated Building Envelopes v2: digital project three

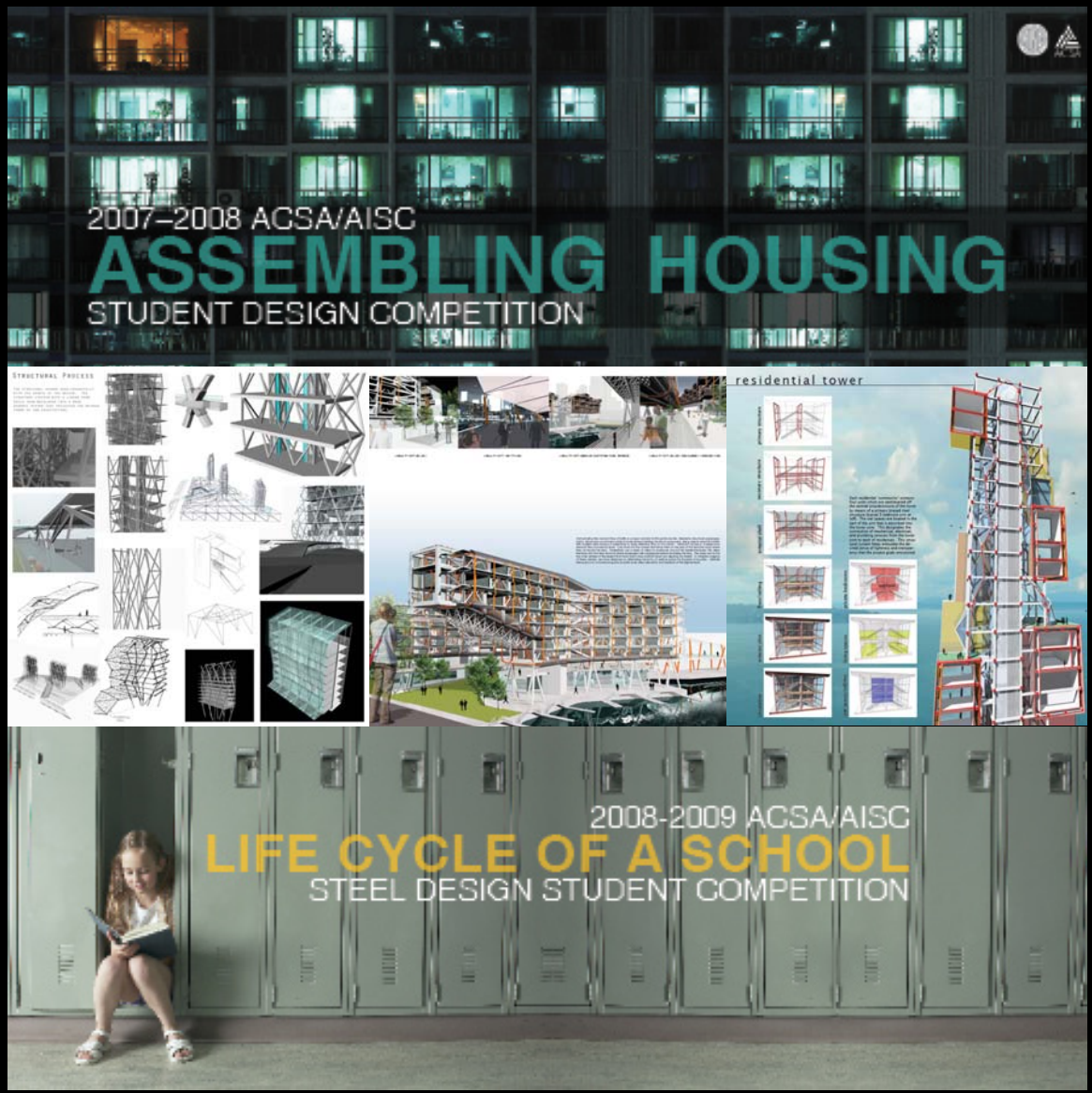
Interdisciplinary Courses and Collaborative Design





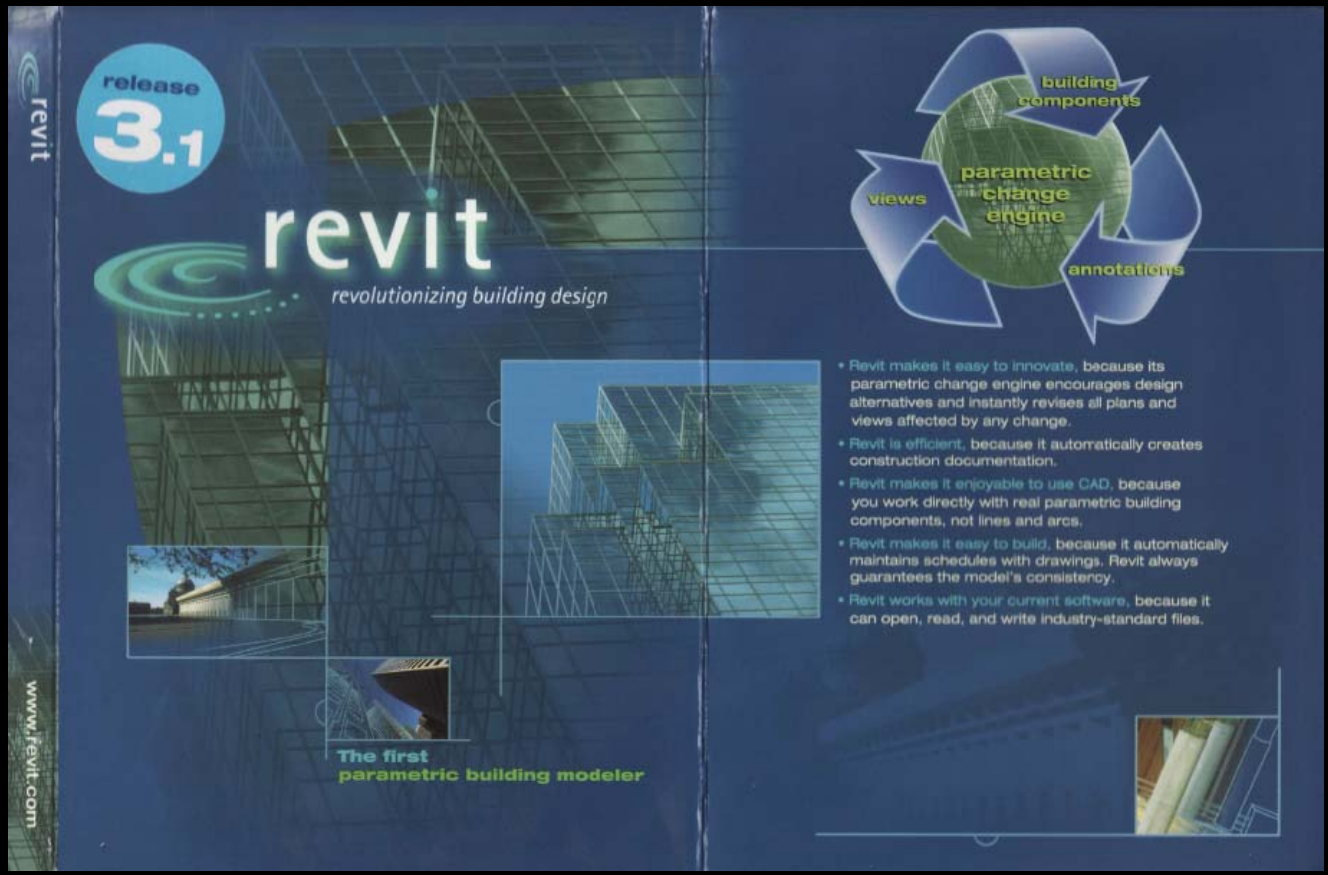
Integrated Building Envelopes v2: digital project three

Where do we go from here?



Collaborative Design Studio: ARCE + ARCH + CM

Thank you for your time



Revit v3.1 – 2000