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Building Information Modeling Curriculum at Virginia Tech

Kihong Ku, Doctor of Design
Assistant Professor of Building Construction

Slide 1

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Structure of Presentation

- Department of Building Construction & School of Construction
- BIM in the Undergraduate Curriculum
- BIM in the Graduate Curriculum
- Pedagogy for tomorrow's Construction Professionals

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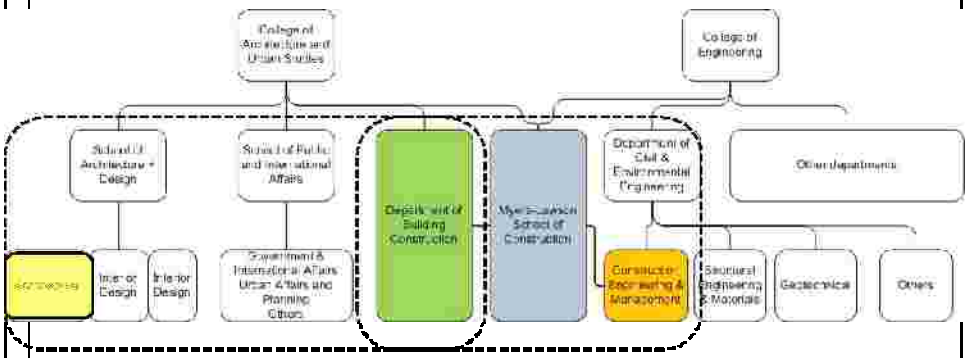
Dept. of Building Construction
School of Construction



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Building Construction Undergraduate

- 4 year program, ACCE accredited
- Technical and managerial
- Construction and Design track
- Development, Real Estate, and Construction track
- Vertically integrated lab (2nd, 3rd, 4th year)
- Integration with architecture

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Construction Engineering & Management Undergraduate

- 4 year program, ABET accredited (in progress)
- Engineering, construction theory and business management
- Integrated lab with BC

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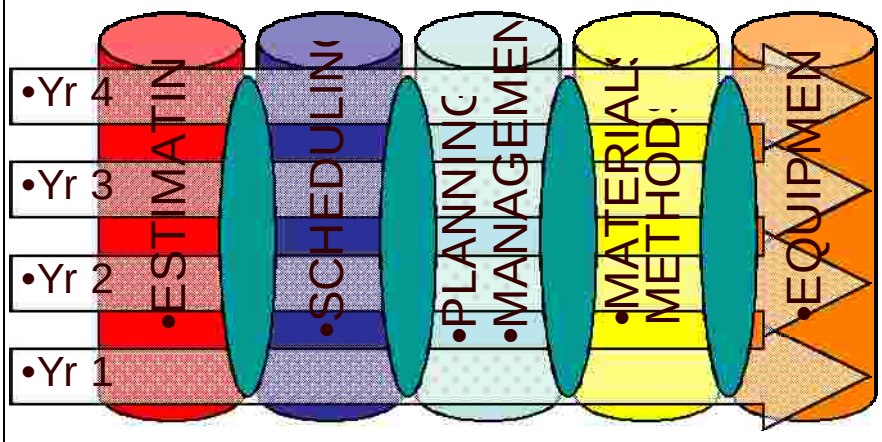
Traditional vs. VT Construction Education



Modified from Annie Pearce 2006

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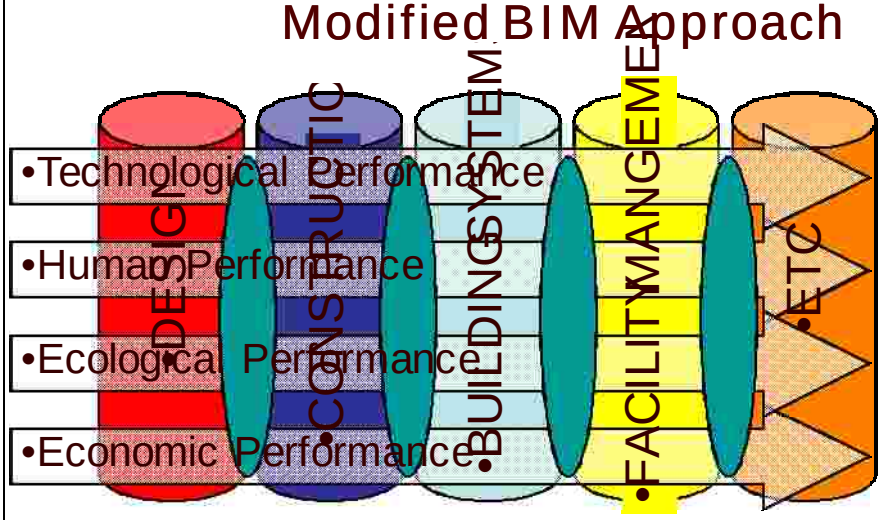
Previous Approach vs. Modified BIM Approach



Modified from Annie Pearce 2006

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BC BIM Curriculum (Undergraduate)

- Start in 2006 as online tutorial/workshop at 1st year: construction, structural components, quantification, pricing, scheduling
- 4th year: modeling from existing project documents, structure, mechanical
  clash detection, 4D scheduling
- Goal to comprehension and operational fluency in manipulations of the data, including inputs/exports during procurement/performance area
- Software: Revit, Navisworks (Commonpoint)

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CEM BIM Curriculum (Undergraduate)

- Intro at 2nd year focus on CAD, schedule impact analysis
- 4th year: modeling from existing project documents, structure, mechanical clash detection, 4D scheduling
- Goal to comprehension and operational fluency in manipulations of the data, including inputs/exports during procurement/performance area

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Student Project Example

Crane Coordination

•(S team Crane Location Illustration)

- Location
  - From S team
- Integrated Schedule
  - Input Crane location into overall schedule

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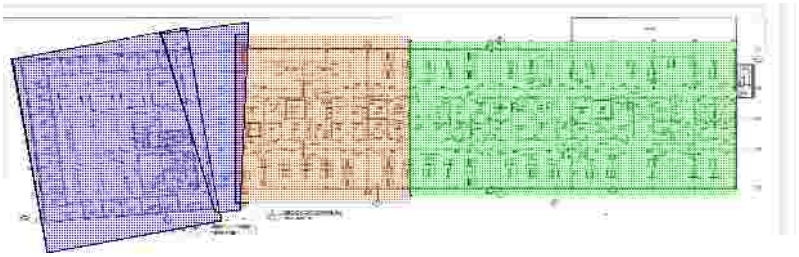
Student Project Example

Structural Schedule

- 3 Phases
  - Col Line 17-9
  - Col Line 9-5
  - Col Line 5-1

n Logic
- Columns
- Beams
- Metal Deck
- Concrete



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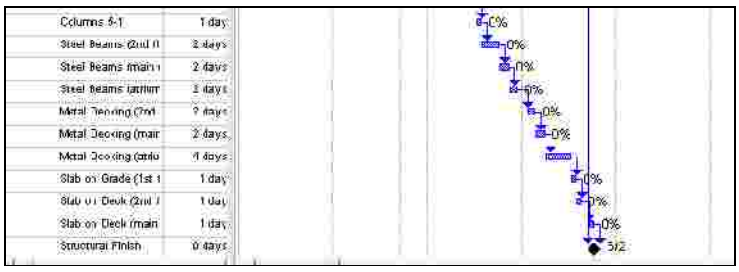
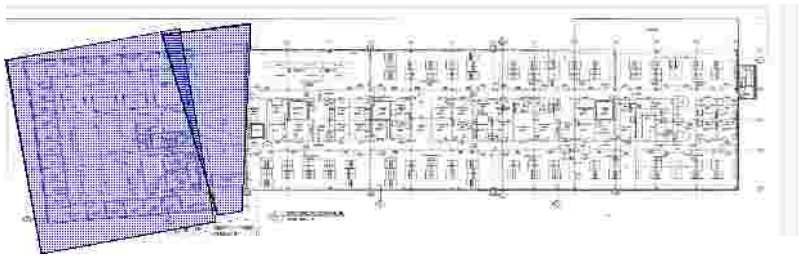
Student Project Example

Structural Phase 3





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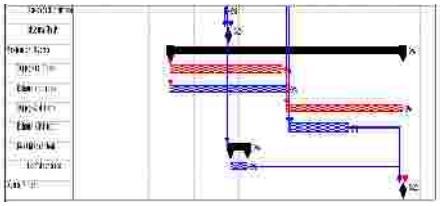
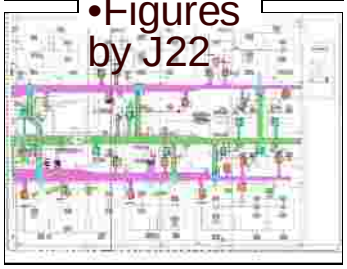
Student Project Example

Mechanical Logic Per Floor

- Floor Logic
  - Ductwork
  - Machines (HX, Hydronic Pipes, etc.)
  - Attenuators, Diffusers
  - Filters, Hoods





•Figures by J22

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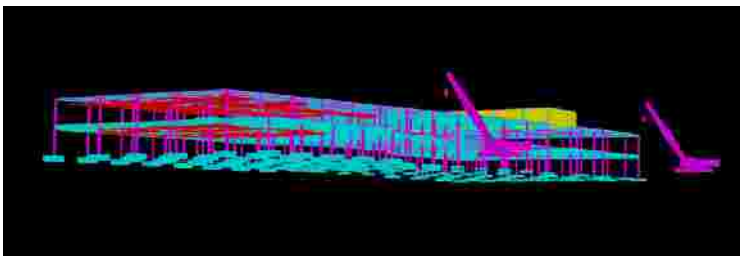
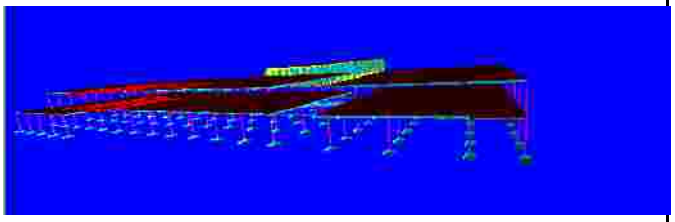
Student Project Example

3 D Model





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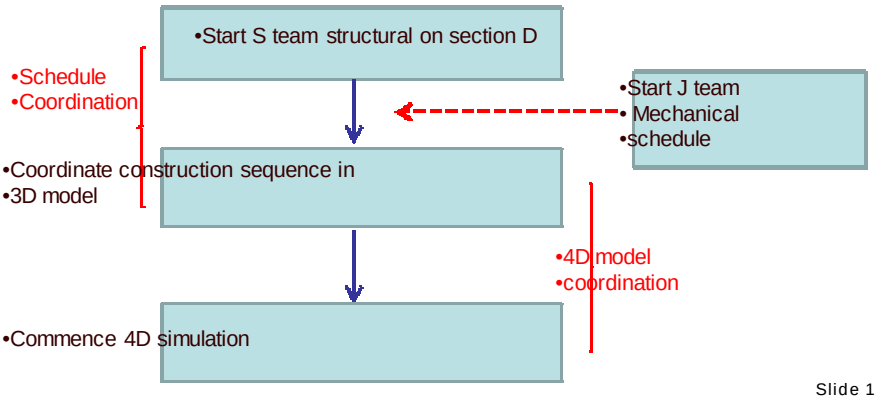
Student Project Example

Overall Coordination Strategy

•Coordination Based on S and J given Schedule:

1. Structural sequence
2. Mechanical sequence
3. Matching schedule
4. Items being brought on site



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Student Project Example

Original Schedules

A) Schedule Coordination

Schedule Coordination of G21 will be based on selected J and S team's structural and mechanical report

B) AON Analysis

Part of creating a uniform G team schedule for the 4D model is through the analysis of J and S teams' AON

C) Total Derived Duration

Steel Duration: 70 days
HVAC Duration: 109 days

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Student Project Example

G21's Schedule

A) Schedule Modification

Steel Duration: 98 days
- Added 28 days
- Concrete Curing
- No weekend work

HVAC Duration: 88 days
- -21 day difference
- Non-modeled components/activities

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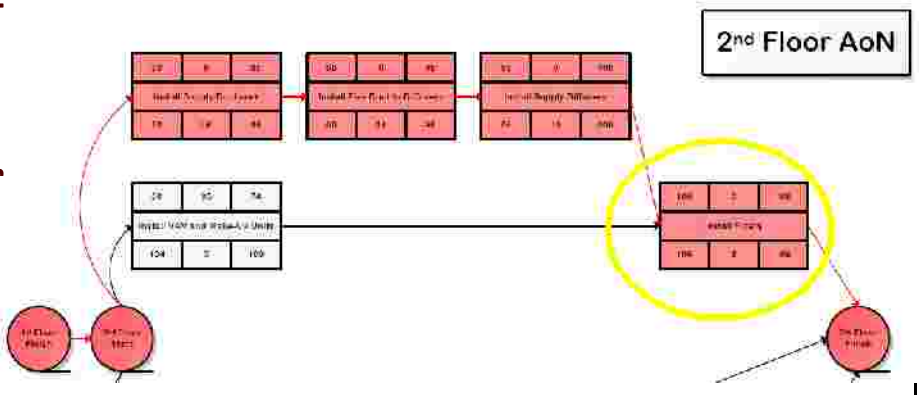
Student Project Example

HVAC Non-modeled Components



- Other Examples
- Heat Exchangers
- Sound Attenuators
- Exhaust Hoods

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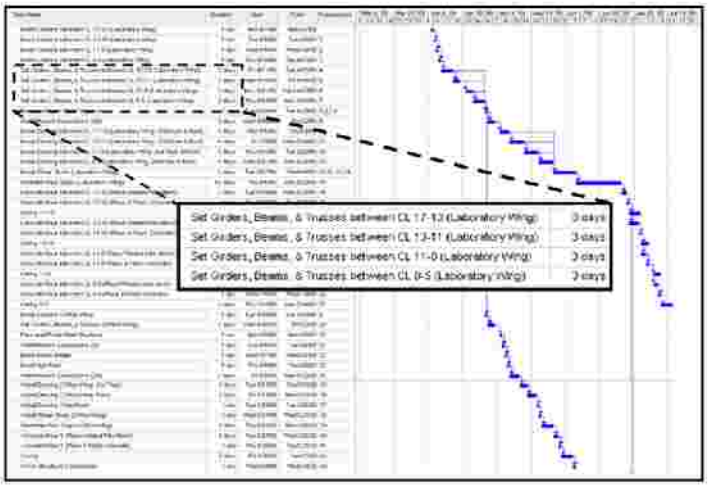
Student Project Example



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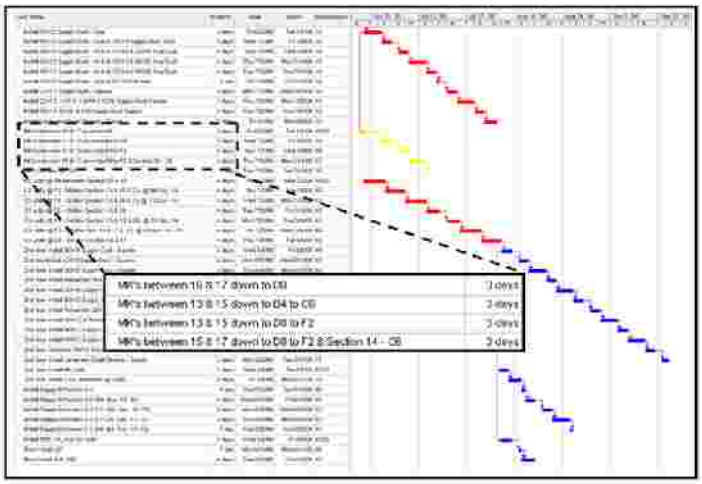
Student Project Example



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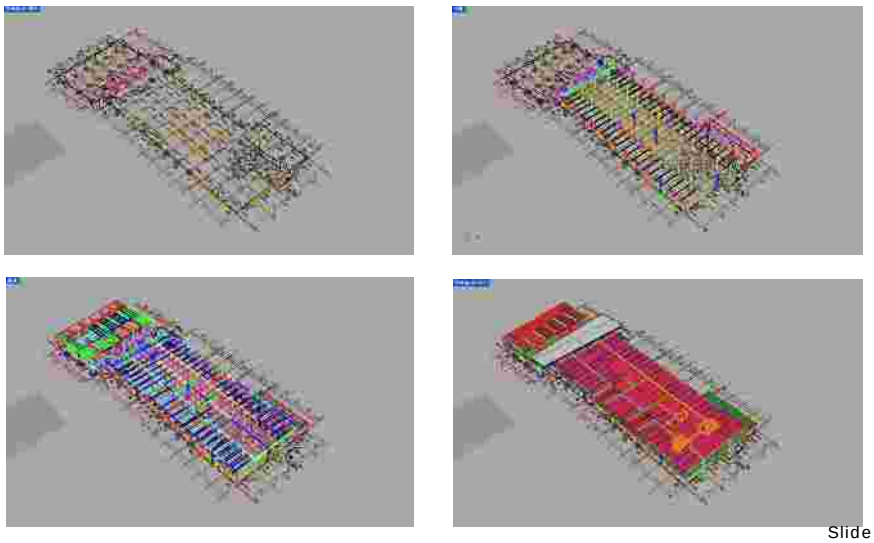
Student Project Example

4D-Sequencing- Phase 1



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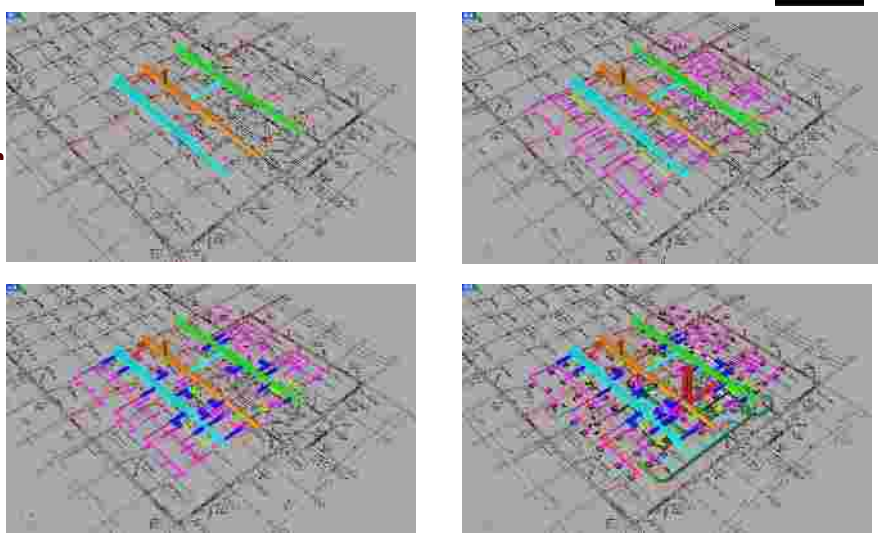
Student Project Example

4D-Sequencing- Phase 1



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Student Project Example

4D Simulation Issues

- Areas of Concern
  - Software Compatibility
    - Layering of Objects
      - Rhino to Common Point
    - Schedule
      - MS Project to Common Point
  - Visual Restrictions
    - Structural Obstruction of HVAC Installation

Common Point

•Project 4D™

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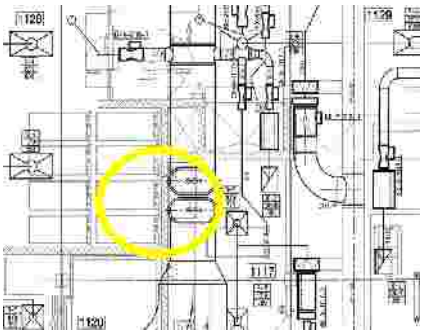
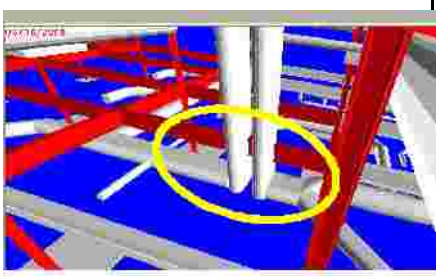
Student Project Example

Collision Detection





•Areas of Concern :

1. 1st floor; page M1.4
2. Clash detection indicated in 4D model.

Slide 26

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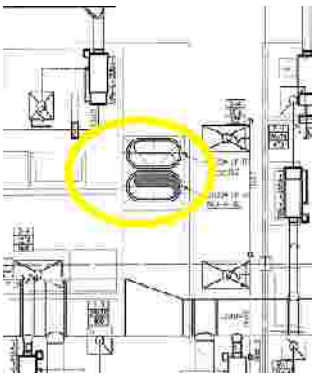
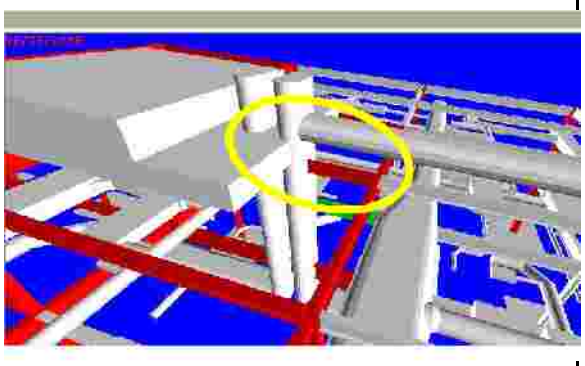
Student Project Example

Collision Detection





•Areas of Concern :

1. 2nd floor; page M1.8
2. Clash detection indicated in 4D model.

Slide 27

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Architecture BIM Curriculum (Undergraduate)

- 5 year program, NAAB accredited
- BIM curriculum by spring 2010
- Modeling/rendering course and Building structures course
- Application at 3rd year for building assemblies, environmental systems analysis
- Digital fabrication & 3D imaging
- Solar Decathlon

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Graduate Courses incorporating BIM

- Construction Integration I, II
- Information technologies in Construction
- Facilities Integration
- Building Systems integration

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Student Project Example

•CYBERTECTURE EGG, MUMBAI, INDIA

•32,000 sq.m. Egg-shaped building
•13 floors of office spaces

•James Law Cybertecture International

•Vision
•Cybertecture Egg will combine "iconic architecture, environmental design, intelligent systems, and new engineering to create a landmark in the city."

•The egg is orientated and skewed at an angle to create a strong visual impact

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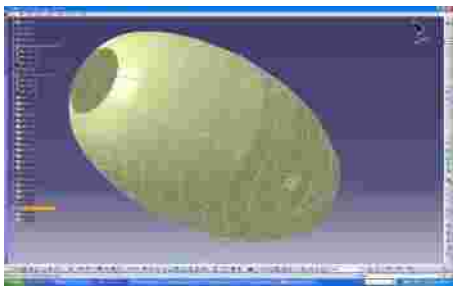
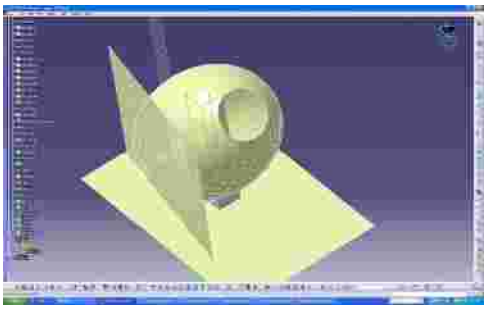
Student Project Example

•MODEL DEVELOPMENT

- •Visualization of the building envelope as a 'cucoon'
- •Array of parametrically increasing circles
- •Formation of a multi-section surface





- •Intersecting surfaces cutting through the multi-section surface
- •Formation of the base surface and the sliced profile

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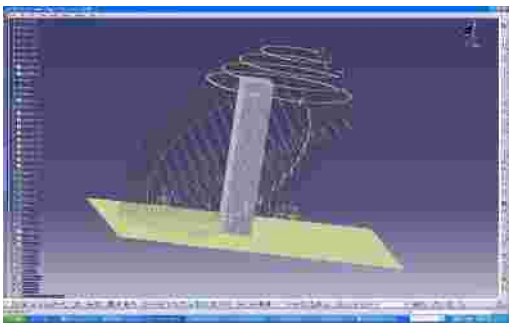
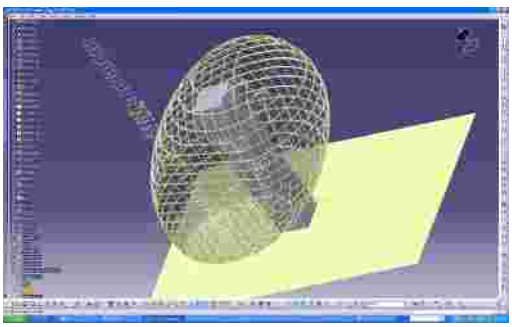
Student Project Example

•STRUCTURAL SYSTEM

- •Initial structural system thought as the circular profiles used to model the surface
- •The shaft as the main support to floors and the glass envelope



- •Primary structural system aligned to the floors of the building
- •Secondary ribs running perpendicular to the horizontal ribs



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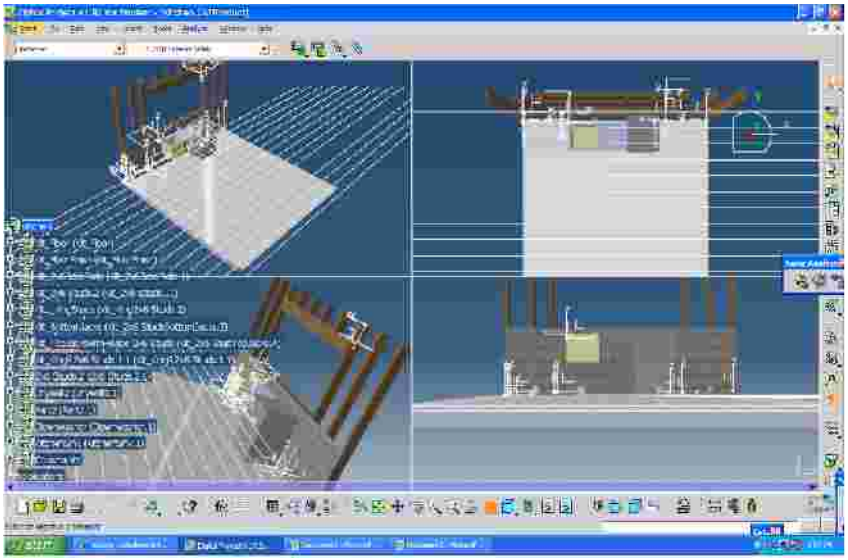
Student Project Example



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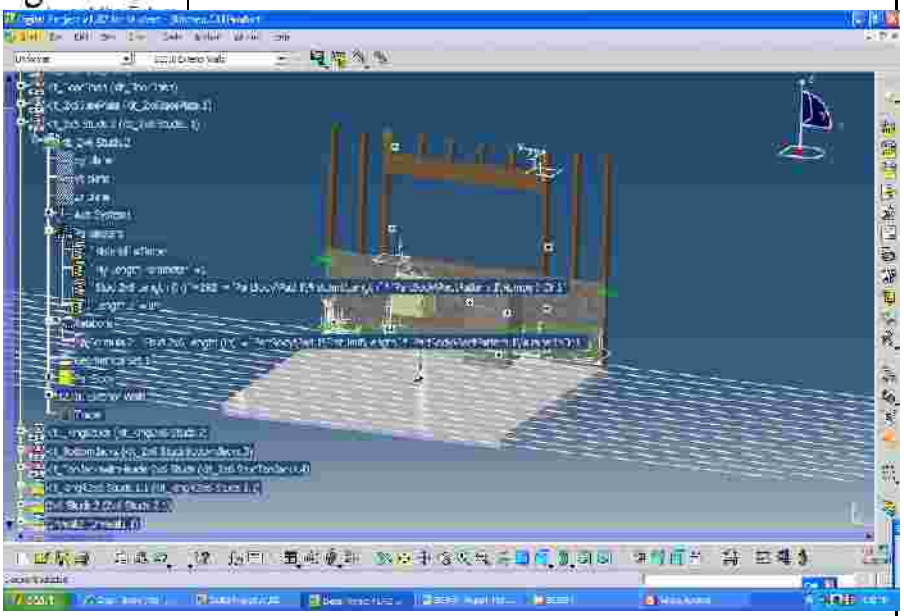
Student Project Example



Slide 34

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Student Project Example

Project Purpose

- Troubleshoot post-processing software to produce as-built documentation of the Catawba Hospital Farm

35
Slide 35

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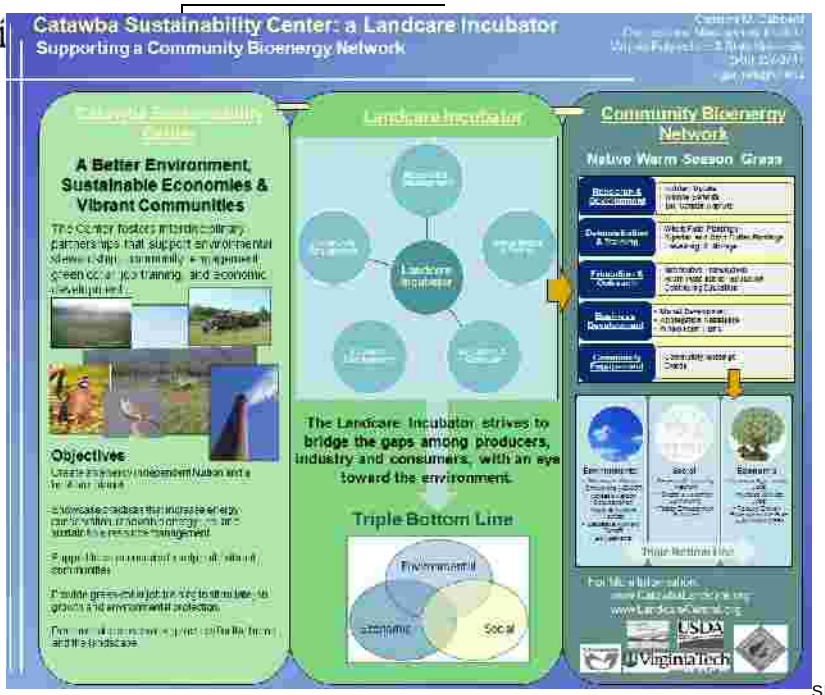
Student Project Example

Introduction

- Catawba Hospital Farm

36
Slide 36

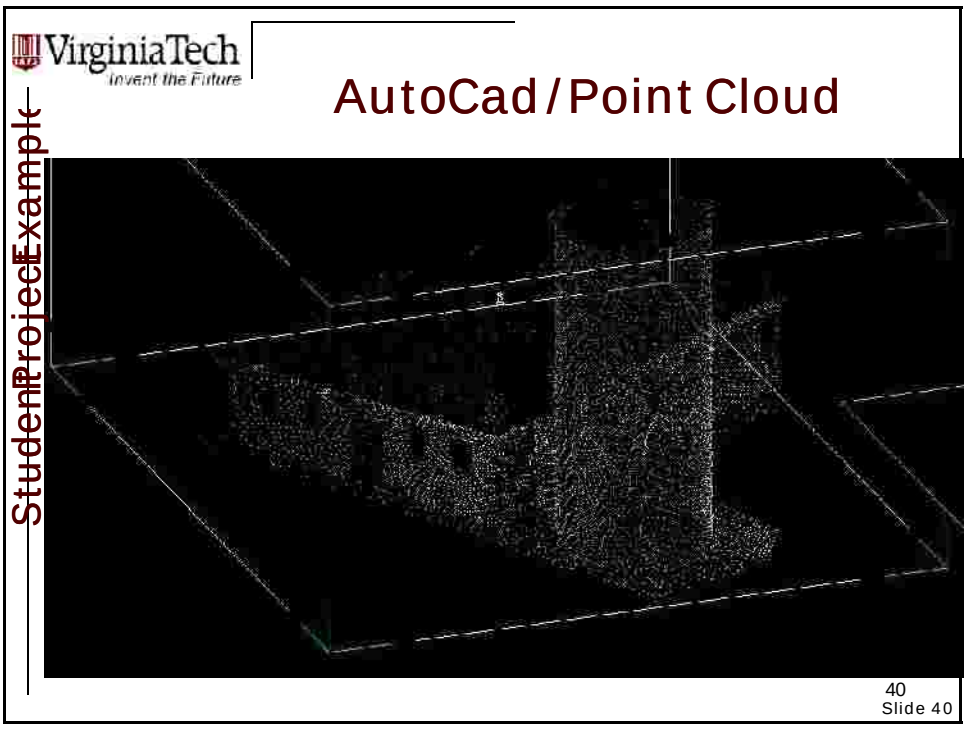
Student Project Example



Slide 37

Student Project Example


StudentProjectExample
39
Slide 39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AutoCad / Point Cloud
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40
Slide 40

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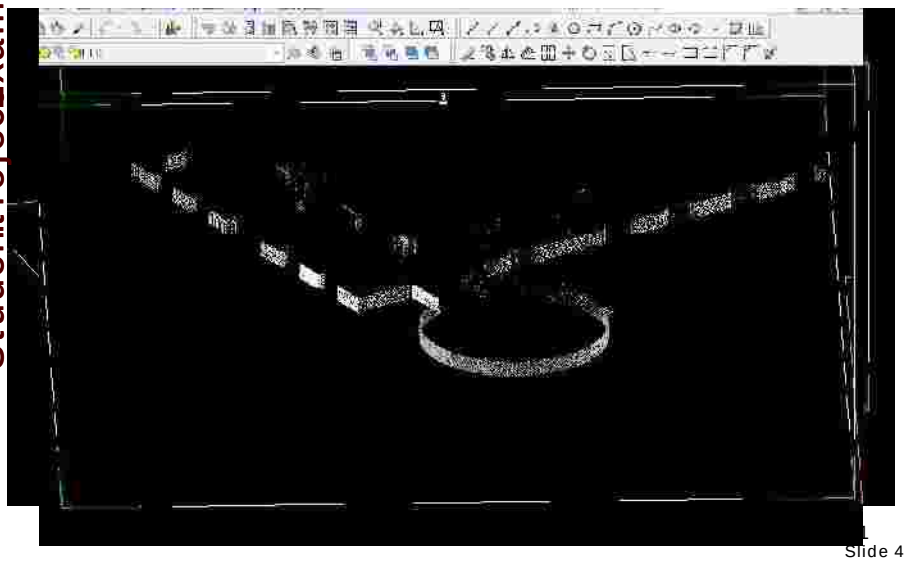
Student Project Example

Slice



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Student Project Example

Bishop-Favrao Hall Construction Simulation in SL

- Scenarios are developed by creating virtual model in SL.

AC3D BOX Builder

Safetytrainingin Secondlife

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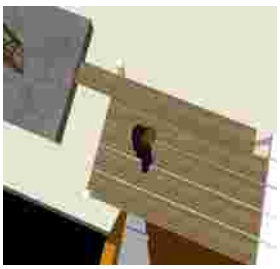
Student Project Example

•Proposed Scaffold Safety Prototype in SL

- Scaffold Erection scenario





- Trainees will be provided with planks, brackets, supports etc.
- Users need Install scaffold
- Follow proper installation sequence

Safetytrainingin Secondlife

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Student Project Example

•Tower Crane Safety training

- Optimization of crane usage can reduce cost, safety issues and scheduling delays
- Training operators can reduce fatalities


•*Craneaccidents.com ,

•*Toward Fully Automated Robotic Crane for Construction Erection, SHIHCHUNG KANG and EDUARDO MIRANDA, Stanford University

Safetytrainingin Secondlife

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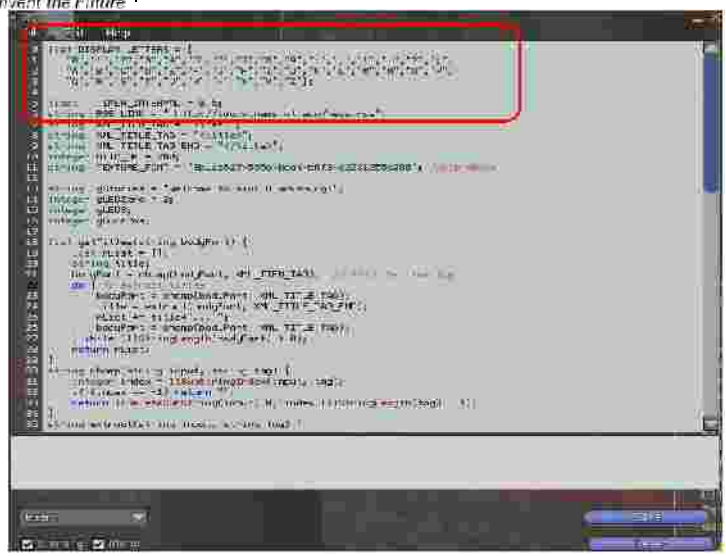
Student Project Example



• RSS Scripting- Methodology

Slide 45

BIM Pedagogy

- Goal: Cultivate an environment for creative team-based problem solving
- Focus on process innovation and digital documentation
- Learn cross-cutting analytical tools & methods such as life cycle costing, construction & building simulation, process modeling, etc.
- Provide opportunities and guidance for immersion with real world stakeholders

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Core Competencies

- Systems-based conceptualization and analysis of built facilities (integrated practice)
- Evaluation of contextual sensitivity / appropriateness of solutions and tools
- Identification, comparison, and evaluation of goals, metrics, project value, design options, etc.)
- Understanding the interaction of multidisciplinary knowledge domain including architecture, engineering, construction, computing, sustainability, etc.

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Essential Skills

- Cross-functional process modeling
- Ability to...
  - Collaborate and control processes
  - Integrate and validate models
  - Specify levels of detail and/or development
  - Articulate costs and benefits from multiple perspectives
- Parametric modeling and data specification skills
- Experience in interacting with real world stakeholders, and sensitivity to their needs

Slide 48

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Discussion

- Gaps in the current approach
- Learning/pedagogy evaluation opportunities
- Sequencing of curriculum

Slide 49