Building Deconstruction: an Innovative Approach to Integrating Sustainability into Construction

Presented at: Innovations in Technical Education to Advance Sustainability – Alfred State College
June 15, 2012

Presented by: Paul Crovella - State University of New York
College of Environmental Science & Forestry

ESF
State University of New York
College of Environmental Science and Forestry
Department of Sustainable Construction Management and Engineering
Presentation Overview

I. Introduction – Concepts of Sustainability and Inquiry-based Learning

II. Application of Concepts to Construction

III. Course Development and Implementation
   a. Project Scenario
   b. Identify Facts
   c. Generate a Hypothesis
   d. Research Knowledge Deficiencies
   e. Apply New Knowledge
   f. Abstraction

IV. Conclusions
Inquiry-based Learning

Why Inquiry-based Learning?

- Student-centered vs. Teacher – centered experience
- Student responsible for acquiring and immediately applying information
- Recognition of need for collaborative problem resolution in AEC industry
Appropriate Problem Types for Inquiry-based Learning

• Problems must be multi-faceted, and include aspects that are difficult to quantify

• Problems encountered in applying sustainable criteria are multi-variate, sometimes ambiguous, often require “design thinking”

• What definition to use for sustainability?
  – The “Triple Bottom Line”
    – simultaneous consideration of Social, Economic, and Environmental concerns
  – “People, Profits, and Planet” turned out to be useful form for student application
Applications of Sustainable Concepts to Construction

• Sustainable Construction requires consideration of production and final disposition of construction materials (LEED Materials and Resources)
• Life Cycle Assessment recognizes embodied energy in materials and cradle-to-cradle approach
• Construction and Demolition wastes form about 1/3 of landfill volume
• “Greenest Building is the One that is Already Built.” Carl Elefante
Course Design

• Name change: Sustainable Construction Management and Engineering
• Traditional teacher-centered courses in Sustainability
  – Intro to Sustainable Const.
  – Sustainable Energy System for Buildings
  – Environmental Metrics for Construction
• Fall 2010 – Student Centered - Seminar in Deconstruction
Project Scenario

- Syracuse, NY
- SU & ESF
- 2 blocks of houses
- Oakland - 18 houses
- Standart/ Raynor - 11 houses
Project Scenario – Block 1

- 18 houses
- Demolished summer 2010
- Lightly skimmed – 1%
- 1,008 tons landfilled; 1,102 hard fill
Project Scenario – Block 2

- 11 houses
- Student housing
- 1920-40s vintage
- 33 apartments
- 33,382 sf
Identify Facts

• No Instructor lectures
• Speakers –
  – Social - Local Habitat leader
  – Economic – Industrial designers
  – Environmental – Ecological Builder
Generate a Hypothesis

• Administration met to give reasons for demolishing Block 1
  – Schedule
  – Risk
  – Accountability
• What is the best use for next 11 houses?
  – Harvesting material
  – Harvesting information

If presented with a clear representation of the externalities (environmental and social impacts) as well as a well defined cost and schedule for deconstruction, the administration would select deconstruction over demolition for the block two homes.
## Research Knowledge Deficiencies - Inventory

### Architectural Salvage Inventory

<table>
<thead>
<tr>
<th>Material</th>
<th>Item</th>
<th>Qty</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Porch</td>
<td>1</td>
<td>1 = Full front porch. Any other number is in relation to that.</td>
</tr>
<tr>
<td></td>
<td>Fan/light combo</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Switch/Outlet</td>
<td>17</td>
<td>new gas stove, refrigerator, dishwasher</td>
</tr>
<tr>
<td></td>
<td>Exterior Door</td>
<td>3</td>
<td>asbestos wrapping in basement</td>
</tr>
<tr>
<td></td>
<td>Interior Door</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lighting</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Window</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heat/Reheat</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cabinets</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sink - Bath</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sink - Kitchen</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toilet</td>
<td>2</td>
<td>1.6 gpf? no</td>
</tr>
<tr>
<td></td>
<td>Tub</td>
<td>2</td>
<td>Efficiency old</td>
</tr>
<tr>
<td></td>
<td>Furnace</td>
<td>2</td>
<td>basement ceiling 1.6 gpf?</td>
</tr>
<tr>
<td></td>
<td>Plumbing Items</td>
<td>(copper, plastic, iron, etc.)</td>
<td></td>
</tr>
</tbody>
</table>

### Building footprint

<table>
<thead>
<tr>
<th>Material</th>
<th>Qty</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1x subfloor</td>
<td>1 st floor</td>
</tr>
<tr>
<td></td>
<td>1x subfloor</td>
<td>2 nd floor</td>
</tr>
</tbody>
</table>

### Internal Inventory - bulk materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Qty</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Joist size</td>
<td>Number</td>
</tr>
<tr>
<td></td>
<td>Basement ceiling</td>
<td>1 st floor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 nd floor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>attic</td>
</tr>
</tbody>
</table>

### External Inventory - bulk materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Qty</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ext walls</td>
<td>1 st floor</td>
</tr>
<tr>
<td></td>
<td>Ext walls</td>
<td>2 nd floor</td>
</tr>
</tbody>
</table>

### Roofing

<table>
<thead>
<tr>
<th>Material</th>
<th>Qty</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Roofing</td>
<td>1 layer</td>
</tr>
</tbody>
</table>

### Exception

- 7.5 ton monoparts (10), a lot of new ductwork, 64’ of 6x8 timber beam, leaded glass transom window.

### 2nd and Attic

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**ESF**

State University of New York
College of Environmental Science and Forestry
Research Knowledge Deficiencies - Markets
### Apply New Knowledge

<table>
<thead>
<tr>
<th></th>
<th>Zero Diversion</th>
<th>Hybrid Diversion to Energy*</th>
<th>Hybrid Diversion to Reuse/Recycle</th>
<th>Hybrid Diversion to Resale</th>
<th>Full Diversion to Resale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demo/Decon</td>
<td>+$88,000</td>
<td>$192,500</td>
<td>$192,500</td>
<td>$192,500</td>
<td>$330,000</td>
</tr>
<tr>
<td>Roofing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheath/Side</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumber/Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masonry</td>
<td></td>
<td></td>
<td></td>
<td>$19,819</td>
<td></td>
</tr>
<tr>
<td>Plaster/Lath</td>
<td></td>
<td></td>
<td></td>
<td>$14,350</td>
<td></td>
</tr>
<tr>
<td>Metals</td>
<td>$3,300</td>
<td></td>
<td></td>
<td>$3,300</td>
<td></td>
</tr>
<tr>
<td>Arch Items</td>
<td>$35,390</td>
<td></td>
<td></td>
<td>$35,390</td>
<td></td>
</tr>
<tr>
<td>% Diversion</td>
<td>0</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>63</td>
</tr>
<tr>
<td>COST</td>
<td>$84,700</td>
<td>$196,673</td>
<td>$199,505</td>
<td>$123,485</td>
<td>$257,141</td>
</tr>
</tbody>
</table>

* Studs 38% Rafters 62%
Abstraction

• One semester, one credit course, started one week late
• Building Materials Reuse Association developed curriculum for community colleges with Lead Renovation, Lead Abatement, Asbestos Abatement, OSHA 30hr

• ESF students in Syracuse want neighboring buildings 'deconstructed'
• Published: Thursday, January 27, 2011, 6:45 AM  Updated: Thursday, January 27, 2011, 2:04 PM
• By Charles McChesney / The Post-Standard The Post-Standard
## Conclusions – Student Evaluations

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The course and subject matter were well organized.</td>
<td>3.9</td>
</tr>
<tr>
<td>2. The instructor communicated effectively.</td>
<td>4.3</td>
</tr>
<tr>
<td>3. The instructor was enthusiastic about teaching.</td>
<td>4.6</td>
</tr>
<tr>
<td>4. The instructor seemed knowledgeable about the subject matter.</td>
<td>4.3</td>
</tr>
<tr>
<td>5. The instructor conveyed a positive attitude toward students.</td>
<td>4.4</td>
</tr>
<tr>
<td>6. Tests, assignments, and projects were fair.</td>
<td>4.3</td>
</tr>
<tr>
<td>7. Grading was fair.</td>
<td>4.4</td>
</tr>
<tr>
<td>8. The instructional approach(es) used was (were) appropriate to the course.</td>
<td>4.1</td>
</tr>
<tr>
<td>9. The instructor motivated me to do my best work.</td>
<td>4.3</td>
</tr>
<tr>
<td>10. I gave my best effort in this course.</td>
<td>4.4</td>
</tr>
</tbody>
</table>

1-Strongly Disagree;  2-Disagree;  3-Neutral;   4-Agree;  5-Strongly Agree
Conclusions – Student Evaluations

• **What was the most effective part of this course?**
  
  • Feel the entire class was motivated by the subject matter. Kind of a different scenario from when students enroll to meet a requirement.
  
  • A basic understanding of how to take inventories and how it can be used lecture and class participation.
  
  • Willingness of the group hands-on learning.
  
  • Seeing the inventory for ourselves and documenting it.
  
  • Conducting Building Inventories and researching different options for various materials.
  
  • The most effective part of this course was performing the inventories at the homes on Standart and Raynor Streets. These homes contain a variety of salvageable material, all of which would be a shame for it to go directly to a landfill. It was important to be able to see the material in person.
Conclusions – Student Evaluations

• Given all that you learned as a result of this course, what do you consider to be most important?
• How hard it is to get the information necessary to convince a panel
• understanding markets for material.
• difficulties within these markets or lack of.
• Deconstruction of the Standart/Raynor block should be viewed as an opportunity for ESF to be a forefront leader in Sustainable Practices.
• If the College of Environmental Science & Forestry does not approve deconstruction over demolition, then there is no hope for others with equivalent or less knowledge to participate in deconstruction.
My Conclusions

• Lack of certainty that all students received an equivalent experience – student centered

• Students covered QTO, Estimating, Means and Methods, Safety, but hard to have confidence in treatment across curriculum

• Students developed great confidence to present material
Thank You - Innovations in Technical Education to Advance Sustainability

Questions....

Paul Crovella, Instructor
1 Forestry Drive
219 Baker Laboratory
SUNY College of Environmental Science and Forestry
Syracuse, NY 13210
Phone (315) 470-6839
Fax (315) 470-6879

plcrovella@esf.edu
http://www.esf.edu/scme/crovella/default.htm

ESF State University of New York
College of Environmental Science and Forestry
Potentially Salvageable

- 9,700 sf hardwood flooring
- 40,466 bf joists, rafters, beams (minus studs)
- 41,000 bricks
- 200,000 cf masonry
- Estimated $300 in recyclable metals/house
Resale or Recycling Value

- Bricks 41,000+ @ $0.35 ea $14,350
- Lumber 40,466 bf @ 0.25 ea $10,116
- Hardwood Flooring 9,703 SF @ $1/SF $9,703

TOTAL $34,169
Architectural Components

- 126 Bathroom Fixtures
- 33 Kitchen Sinks
- 502 Cabinets (LF)
- 128 Registers (Heat/Cold Air)
- 344 Windows
- 239 Light Fixtures
- 781 Switches and Outlets
- 66 Exterior Doors w/Hardware
- 236 Interior Doors w/Hardware
Waste to Energy

- Onondaga County Resource Recovery
- Power 30,000 homes
- 357,775 tons non-recyclable waste 2010
- 50,455 tons C&D waste (14%) 2010
- HHV C&D = increased electricity