Service Learning for Sustainable Construction

Caroline Clevenger, PhD
Mehmet Ozbek, PhD
Dan Reaves, Masters Student
Applied Sustainable Project Delivery

- Offered as an experimental course, Spring 2011
- Collaborative project with Centennial High School and Unless Design Collaborative
- Teach/build/learn through service
- Design/build construction in collaboration with local high school students
- Received a small ($1000) grant from the Institute of Teaching and Learning (TiLT)
Construction Management (CM) Cares Initiative
Client
Client cont.

- Sleep curled or legs out
- Dog beds
- Occupants could eat building

Circle
Design

[Image of a dog and a structure]
Design
Design

**RIB SPACER**
Scale: 1/2" = 1'-0"

**STRUCTURAL RIB**
Scale: 1/2" = 1'-0"

NOTES:
- ALL WOOD IS KILN DRIED PINE Milled TO 3/4" X 3/2" X 3/4" X 3/2"
- RIB SPACING REQUIRED:
- 12"
- STRUCTURAL RIBS:
- USE STEEL PLATES TO LOCATE HOLES

A2.1
"STRUCTURAL RIBS"
Curriculum Tool

Interior Wall and Roof Construction

Materials
1. (8) 10' x 1' x 8' T&G pine
2. (8) 8' x 1' x 2' pine siding
3. (8) 6' x 1' x 2' pine flooring
4. (2) 2' x 4' corrugated fiberglass panels
5. (2 lbs) 2' cupped hex washer head wood screw
6. (2 lbs) 1/4" coated exterior siding screws (interior square head)
7. (1) resin exterior (weathering) white paint

Tools
- Power miter saw
- Drill (battery charged)
- Countertop drill bits
- Tape measures
- Pencils (sharpened)
- Carpenter square

Instructions
1. Roof and Side - Inner Panels (3 students per panel - 10 minutes)
   - From the plans, Roof and Side - Inner Panels 1 and 2. The dimensions for each of the pieces for both panels (examples: (a) top member, (b) bottom member, and (c) vertical members). Transfer appropriate dimensions onto the 1/4" x 2" inch wood stock and cut on the 1/4" x 2" T&G plane. Make sure that all measurements are pulled from a squared-off and (see Illustration 1) bracket. Cut off one end and if necessary to ensure it is square before measuring.
   - NOTE: Cut off one and if necessary to ensure it is square before measuring.

2. Cut pine wood stock (5-6 students - 10 minutes)
   - Using the power miter, cut each measured piece making sure that the line is cut on the appropriate side (see Illustration 2) to ensure accurate lengths at all pieces. Make sure that all measurements are pulled from a squared-off and (see Illustration 1) bracket. Cut off one end and if necessary to ensure it is square before measuring.
   - NOTE: For cutting the 1/4" x 2" T&G plane. Since you will be cutting approximately 15 of these pieces, it may help to set a stop block (see Illustration 3) at the desired length to be cut. This helps ensure accurate lengths and consistent cutting and may speed up production.

3. Cut Fiberglass Panels (student/supervisor - handled)
   - The measurements for this section of the project need to be checked against the completed roof section for accuracy. Cutting these pieces may be combined with

Waste

<table>
<thead>
<tr>
<th># Pieces</th>
<th>Cut Length (&quot;)</th>
<th>Total Length (&quot;)</th>
<th>Purchased Length (&quot;)</th>
<th># of Boards to Purchase</th>
<th>Total Waste (&quot;)</th>
<th>Waste Per Board (&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 2 Pine</td>
<td>8</td>
<td>34</td>
<td>332</td>
<td>98</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>1 x 2 Pine</td>
<td>2</td>
<td>50</td>
<td>112</td>
<td>120</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1 x 5 T&amp;G Pine</td>
<td>10</td>
<td>55</td>
<td>895</td>
<td>120</td>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td>2 x 4 Fiberglass</td>
<td>5</td>
<td>60</td>
<td>90</td>
<td>90</td>
<td>2</td>
<td>52</td>
</tr>
</tbody>
</table>

Cutting the outer roof pieces. Care must be taken when cutting this material and may require special attention and another location. Assembling fiberglass will be completed during final sections assembly.

4. Assemble plate pieces (5-6 students - 10 minutes)
   - Prior to the outer pieces, the area will be planed out of an appropriate distance from the edge of the wood and aligned within the connecting pieces. This is advisable to avoid splitting the wood and to help with alignment during assembly. Assemble plates according to plans making sure that connecting surfaces are flush and aligned.
   - Assemble plates onto the frames (roof and side wall) using 1/4" screws. Make sure that the square face of the T&G board is facing to the exterior (away from the inside). The screws should be driven in at an angle to avoid splitting the wood. A simple jg or adjustable saw can be used to mark the overcutting.
   - NOTE: It is important that both panels are square and true prior to assembly.

5. Painting pieces (5-6 students - 10 minutes)
   - Apply paint to all surfaces of both panels. If time permits, painting can take place prior to assembly but is not necessary. Place panels in a clean location following painting or leave them in place until dry. These panels will not be attached to the structure at this time and need to be protected until they are sealed.

Department of Construction Management
Colorado State University
Centennial Shop Class
Ice Breaker
Construction Safety
Construction
Construction, cont.
Construction, cont.
All School Assembly
Unveiling
Project Completion
Exteriors
Certificate of Occupancy
Presentation Board

[Image of presentation board with various images and text]

Department of Construction Management
Colorado State University

[Logo]
Project Delivery
Assessing student learning

Assessing Impact
(Pre-, Post-Surveys)

Construction Management Students

Pre-course: All students predicted they would equally valued “service” and “learning” aspects of the course

Post-course: All but one valued “service” aspect of the course more
Assessing Impact (Pre-, Post-Surveys)

Construction Management Students

• Liked building more and design less than they predicted
• Liked interacting with “at-risk” high school students and performing community service more than predicted.
• Liked teaching slightly less than predicted
• Found interacting with “at-risk” high school students, community service and teaching all easier than they predicted.
• Found constructing the built project much harder than they predicted.
Assessing Impact (Pre-, Post-Surveys) (57%, 82%)

High School Students

- Self-reported increased knowledge in:
  - Sustainability
  - Sustainable Building
  - Construction Management
- Reported that they thought sustainability was more important
- Reported more interest in attending a construction management program
- Reported that community service was less important than pre-course
Lessons Learned

1. Set proper expectations
2. Clarify logistics
3. Decrease university to high school student ratio
4. Limit concurrent design-build
5. Encourage the use of models
6. Increase pre- and post-assessments, and use of concept maps
7. Provide more shop safety instruction
Colorado State University Awards

- High honors in the Celebrate Undergraduate Research and Creativity Showcase.
- Highest honors in the service-learning category.
- Exceptional Achievement in Service-Learning Community Partner Award.
Questions?
Special thanks to:

unless design collaborative
Centennial High School
CSU Construction Management and CM Cares
The Institute of Teaching and Learning