Maximizing Off-Site Modular Construction Using Lean Tools

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W-T Prefab Group

Formed in 2011 :: Mission Statement-
To create a resource within Whiting-Turner that will help everyone understand the potential benefits of prefab and modular construction.

Industries with Prefab Opportunities
Precast structure could reduce schedule from 25 weeks to 7
Overall Framing Prefabrication

- Modular Restrooms
- Prefabricated Interior Walls
- Conventional Framing
- Conventional Shaft Wall Framing
- Prefabricated Exterior Wall Framing
Co-located vs. Turn Key Pods

RFQ went out to 4 companies:
- Eggrock
- Neopod
- Ameripod
- Kullman

Constructability concerns:
- Size of pods
- Required depressed slabs
- No experience with high-end finishes
- Requires early finish information to begin manufacturing
Modular Challenges
Size Restrictions
Modular Challenges
Finishes
Model Room
Grand Floridian
Modular & Prefab Construction

Move Significant Work Offsite

Better Quality

Reduced Punch List

Schedule Benefits

Leverage D/A Partners

Construct-ability Issues

Prefabrication

Procurement

COST

Warranties

Schedule Benefits

Innovation

OPTION #1 – TURN KEY PODS

OPTION #2 :: CO-LOCATED PODS

#BIM&Prefab
Studio Pod

9 Prefab Panels per Pod
738 Total Panels
Master Bath Pod

15 Prefab Panels per Pod
1,230 Total Panels
Sequencing

Shaft wall in place

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Modular Coordination :: OH Connections
Stress Analysis
Stress Analysis
Modular Challenges
Studio Pods

BATH TUB

BATH NO. 2

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BIMFORUM
First POD Prototype

July 2011 :: POD Prototype #1

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Fourth POD Prototype

September 2012 :: Pod Prototype #4 / First Run
POD Delivery

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Production Rate

Production
Installation

Installation
Warehouse Production

Maximum Storage

328

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Warehouse Design
Warehouse Rental
Early Metrics

Man Hours to Frame *reduced* by 12.5%

Man Hours to Hang Wallboard *increased* by 18.4%

Combined Productivity *reduced* by 6.2%
## Metrics

### Right Handed POD

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Days</td>
<td>10</td>
</tr>
<tr>
<td>Total Panels Built</td>
<td>392</td>
</tr>
<tr>
<td>Average # of Panels Built per Day</td>
<td>39.2</td>
</tr>
<tr>
<td>Number of Rooms</td>
<td>7</td>
</tr>
<tr>
<td>Total Days to Complete Room</td>
<td>5.57143</td>
</tr>
<tr>
<td>Average Day to Complete Room</td>
<td>392</td>
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</table>

### Left Handed POD

<table>
<thead>
<tr>
<th>Metric</th>
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<tbody>
<tr>
<td>Days to Complete Room</td>
<td>6</td>
</tr>
<tr>
<td>Net Work Days</td>
<td>45</td>
</tr>
<tr>
<td>Rooms Completed</td>
<td>8</td>
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<tr>
<td>Average</td>
<td>5.625</td>
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### Daily Panels Built

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<thead>
<tr>
<th>Date</th>
<th>RH Panels</th>
<th>LH Panels</th>
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<tbody>
<tr>
<td>10/10/2012</td>
<td>4</td>
<td>34</td>
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<tr>
<td>10/11/2012</td>
<td>22</td>
<td>34</td>
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<tr>
<td>10/12/2012</td>
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<td>3</td>
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<tr>
<td>10/15/2012</td>
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<td>31</td>
<td>24</td>
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<tr>
<td>10/17/2012</td>
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<td>23</td>
</tr>
<tr>
<td>10/18/2012</td>
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<tr>
<td>10/19/2012</td>
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<td>40</td>
</tr>
<tr>
<td>10/23/2012</td>
<td>6</td>
<td>21</td>
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</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>RH Panels</th>
<th>LH Panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/01/2012</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>11/02/2012</td>
<td>24</td>
<td>32</td>
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</tbody>
</table>

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**BIMFORUM**

#BIM&Prefab
Modular & Prefab Summary
Design Assist Shift of Man Power Hours

(Framing & Drywall)
Total Hours on the Job: 84,100
Prefab Hours: 9,600 (just over 10%)

(Plumbing)
Total Hours on the Job: 22,800
Prefab Hours: 2,900 (just over 10%)

(Electrical)
Total Hours on the Job: 47,490
Prefab Hours: 1,900 (just under 5%)

(Mechanical)
Total Hours on the Job: 19,568
Prefab Hours: 7,248 (just over 37%)

(Fire Protection)
Total Hours on the Job: 5,400
Prefab Hours: 120 (just over 2%)

Approx. 12% shift in hours to Prefabrication
Mechanical Systems
Roof Elements
Roof Elements
Roof Elements
Food for Thought

Design-Build, Design/Assist & IPD help fuel the possibilities for prefabrication / modularization.

The BIM tools allow for greater analysis and execution of prefab opportunities.

Push the envelope –
Don't accept the ways things have always been done as the metric for what is possible.