Prefab: Faster, Better, Smarter

How Prefabrication Can Expedite Facility Delivery and Improve Quality
Presenters

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Case Study – Exempla Saint Joseph Heritage Project
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- 831,000+ SF
- 360 inpatient private beds
- 29 ½ month construction schedule
- Collaboration agreement
Mortenson Prefabrication History
Disney Concert Hall Ceiling System
University of Washington Benjamin Hall
Central Washington Hospital

- Ext. wall panels
  - ✓ Saved 6 wks
- 144 Patient head walls
  - ✓ 18% labor savings
- Delivered project 10 weeks early
- $7 Million under budget
"All In Prefabrication" - Ft. Carson WT Barracks

Innovation Speeds Warriors' Road to Recovery

The Warriors in Transition (WT) program is designed to provide a healing and recuperative environment for wounded soldiers returning from combat. Due to limited existing facilities, soldiers were being placed in hotels and other facilities that were not consistent with the WT Unit's mission. The integrated design-build project team quickly understood that there would never be a more important and time sensitive customer for a project than this one. The team developed a “Soldier First” project motto, rallying around a vision that supported those who protect our freedom.

The resulting project design consisted of 80 two-bedroom units housing up to 160 recovering soldiers. The four-story, 96,400-square-foot barracks are set up as two-bedroom apartments with shared bathrooms, full kitchens and living spaces. Each furnished apartment has upgraded laminate flooring, solid surfacing counter tops, wood cabinets, walk in closets, and a washer/dryer. All of the first floor apartments comply with the Americans with Disabilities Act (ADA), while all remaining units are designed as ADA-adaptable units. Other quality of life enhancements include a landscaped courtyard, meditation garden and a large multi-purpose room ideal for group social functions.

2011 AIA BIM TAP Award Winning Submission
Prefabricated Exterior Wall Structure

- Precast insulated sandwich panels
- Load bearing
- Integral brick and cast stone
- Windows left out
Roof Trusses

- Modularized roof design
- Prefabricated trusses
- Preassembled on the ground
- Hoisted into place
Prefabricated Bathroom Units

Schedule Savings

Design Schedule Savings (Actual vs Typical)
- 4.5 months
- 6.5 months
- 30% Savings

Construction Schedule Savings (Actual vs Contract)
- 15.5 months
- 18 months
- 14% Faster
Quantifiable Results

Quantifiable Results - Leveraging VDC Strategies Leads to Real Improvements

**Schedule Savings**
- Design Schedule Savings (Actual vs Typical): 4.5 months vs 6.5 months = 30% Savings
- Construction Schedule Savings (Actual vs Contract): 15.5 months vs 18 months = 14% Faster

**Sustainability Enhancements**
- PV Array (added via project savings)
- Geothermal Field
- Solar Hot Water
- Waste Reduction
- LED Lighting
- Energy Modeling

**Safety Results**
- Safety - Recordable Incident Rate (Project vs Contractor vs Industry Average):
  - 0.83 RIR - WT Barracks
  - 1.36 RIR - Contractor
  - 4.0 RIR - Industry Ave.

  **39% Improvement**

- Field Labor Risk Reduction (Drywall/MEP):
  - 0.70 - WT Barracks
  - 1.0 - Comparable Project

  **30% Improvement**

- Field Punchlist:
  - 0.50 - WT Barracks
  - 1.0 - Comparable Project

  **50% Improvement**

The BIM Barcodes suggest R2i's improvement in field results via comparable Barracks project.
Driving the Need for Prefabrication

Original Schedule
36 months

Schedule Driven by Regulatory Agency
32 months

10% Overall Schedule Compression Required
Multi-Trade Prefabrication Approach

Looked at critical path building components: “What could be prefabricated”

- Patient & Public Restrooms (aka PODS)
- Multi trade overhead MEP racks for corridors
- Exterior wall panels
- Patient head walls
440 Prefabricated Bathroom PODS

- Complete Assembly
- Shipped from Boston via Enclosed Trailer
- Rolled into Final Location for Connection
Design Implications – Prefabricated Restrooms

- Architecturally - Standardized Configurations
- Structurally - Depressed Slabs & Sleeves
- MEP - Rough-in
- Interior Design - Early Selection of Finishes
166 Overhead Multi-Trade MEP Racks (MTR’s)

- Modularized Racks
- Assembled off site
- Local Fabrication Shop
- Reduced site installation schedule
- Cleanliness/Infection Control

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Design Implications – Multi-Trade MEP Racks

- MEP Routing
- Top of Wall
  - Deflection Head
- Rated Wall Design
  - Fire Resistive Joint System
Exterior Wall Panels

- 346 panels
- Assembled off site
- Local fabrication shop
- Flown into place
- Reduced site installation schedule dramatically
Design Implications – Exterior Wall Panels

- Panel Size & Configuration
- Slab Edge
- Shelf Angle
- Weather Barrier
Patient Head Walls

- 376 patient headwalls
- Assembled off site
- Local Fabrication Shop

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Design Impact – Headwalls

- MEP Connections
- Early Selection of Finishes
Documented Prefab Process
Value – An Expedited **AND** Less Risky Schedule

- **Original Schedule (no prefab)**: 36 months
- **Schedule Driven by Regulatory**: 32 months
- **Project Schedule (with “all in” prefab)**: 29 ½ months

10-20% Overall Schedule Savings
## Schedule Savings by Scope

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Prefab Schedule Savings - Critical Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext Panels</td>
<td>6-8 Weeks</td>
</tr>
<tr>
<td>Pods</td>
<td>10-12 Weeks</td>
</tr>
<tr>
<td>MTRs</td>
<td>4 Weeks</td>
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</table>
## Cost Implication Trends

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Prefab Direct Cost</th>
<th>Prefab Indirect Cost</th>
<th>Total Prefab Impact</th>
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</thead>
<tbody>
<tr>
<td>Ext Panels</td>
<td>Slight Savings</td>
<td>Substantial Savings</td>
<td>Substantial Savings</td>
</tr>
<tr>
<td>Pods</td>
<td>Wash</td>
<td>Substantial Savings</td>
<td>Substantial Savings</td>
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<tr>
<td>MTRs</td>
<td>Slight Premium</td>
<td>Savings</td>
<td>Slight Savings</td>
</tr>
</tbody>
</table>
Safety

Overall Reduced Labor-Hours

Field workforce reduced by 150-200

Prefabrication 17,000 Hours Onsite

135,000 Hours Diverted

Site Built 152,000 Hours Onsite
Safety

2011 Industry Average
Recordable Incident Rate 3.1

RIR at Pre-Fab Warehouse = 0
Quality Improvements

- Repeatable design and construction results
- Cleanliness of MEP systems-improved patient safety
- Manufacturing level of quality control
- Reduced punchlist in the field is expected
- Standardization of design for operational consistency and ease of maintenance
How did BIM enable the prefab process??

BIM = Coordination

Coordination = Confidence of Fit

Confidence of Fit Enables Multi-tradePrefab

Note that ALL of our examples leveraged BIM – it’s a first step to prefab effectively
Top 3 Lessons Learned

- **Need to make prefab decision early**
  - Mid way through DD at latest – to avoid redesign time/cost
  - Early involvement of prefab contractors

- **Must involve customer early**
  - Quality reviews
  - Expectation setting
  - Finish Selection

- **Work with local AHJ on inspection process**
  - Early discussion of process
  - Coordination of offsite and on site inspection processes
Thank you

- Q&A