PREFABRICATION
Faster, Better, Smarter

Reduce the overall cost and time of project delivery while increasing the quality and scope.
WHY PREFABRICATION?

At Mortenson our top priority is creating value for our customers. Driving factors for prefabrication are to reduce the overall cost and time of project delivery while increasing the quality and scope.

Schedule Reduction:
Prefabrication of critical path items leads to schedule reductions. Schedule management of critical path components such as enclosures, roof trusses, and MEP systems increases the certainty of outcome.

Risk Mitigation:
Critical path components are some of the most complex pieces of the building. Simplifying the complex through prefabrication mitigates risk in safety by reducing overhead work and site congestion.

Quality Improvement:
Breaking the most complex components of the project into prefabricated pieces requires intensive coordination and enhanced virtual design and construction processes. Designers and the builders must work through a level of detail not found in most construction documents. This process ensures a high level of quality that is consistent throughout the entire project.

Repetition:
Prefabrication is warranted by calculated repetition. Hotel bathrooms and hospital room head walls are good examples of components that merit the resources required for an off-site sub assembly process.

Prefabrication is all about a balance of project demands, resource management and most importantly, a return on investment.

Mortenson recently utilized kitting, a lean process, to complete an electrical rough-in for a biopharmaceutical customer. The project team wheeled in metal stud wall framing kits resulting in a significant reduction of time allowing for the team to move onto the next phase of work.
144 Prefabricated Head Walls
To establish a head wall template, Mortenson completed a full-scale mock-up of a typical patient room for the architect and hospital to review. Once the architectural details were complete, the hospital reviewed the room with their department heads and nurses to ensure proper adjustments were made before design. Mortenson modeled the final product to create templates for the 144 prefab head walls.

The prefabrication effort saved four weeks on the interior rough-in schedule and three weeks on casework.

Coordination with Shop Fabrication
Millwork was fabricated in the shop with all cutouts complete so there was less installation time on-site. The rough-in model was sent to the casework fabricator who created four rough-in templates and two finish templates, which were then fastened to four prefab stations to ensure the outlets, light boxes, and med gas outlets were installed in the proper location.

Four headwalls were completed each day and a Mortenson engineer would QC the four walls with the finish template at the end of the day and sign-off that they could be switched out the next morning.

Prefabricated Exterior Panels
Mortenson also used prefabrication on the exterior panels. This saved six weeks on the exterior framing schedule, a 40% savings.

The panels were framed, sheeted, and air barrier installed in the subcontractor’s shop then shipped to the project site. The panels were picked with an engineered rigging device designed to keep the crane hook off the building when setting them in place.
EXEMPLA SAINT JOSEPH REPLACEMENT HOSPITAL

Healthcare projects, with ability to reach a critical mass of repeating features, such as multi-trade above-ceiling racks, patient bathrooms and head walls, offer particularly good opportunities for a strong return on investment in prefabrication.

Schedule Savings Proves Invaluable
At the largest private hospital currently under construction in the U.S., Mortenson is implementing prefabrication strategies that are allowing the team to shave several months off the construction schedule. The 831,327 square foot Exempla Saint Joseph Heritage project is one of the fastest-paced schedules in hospital construction based on volume.

The project simply could not be built to meet the three year schedule without the benefits of prefabrication. Site work started on the project in mid-December 2011 and the project must be complete for the hospital to move from existing buildings by late December, 2014 so it can be open and operational in early 2015.

Integration with BIM/VDC expertise
By integrating precise prefabricated components into the model, Mortenson is able to ensure that the “plug and play” benefits of prefabrication are seamlessly integrated.

Integrated Project Delivery Team
Mortenson’s trade and design team partners’ adoption of prefabrication is crucial to prefabrication success. For instance, at ESJH, extensive mockups of patient bathrooms at very early stages allowed hospital staff from nursing to environmental services to adjust design details from HVAC to ceiling height and tile color. This ensured the bathroom design was exactly what was needed, before prefabrication was initiated.

A Better Quality Product on a Reduced Schedule
As the bathroom pod example shows, prefabrication provides an assurance that each component is consistently assembled to the required level of quality while still meeting compressed deadlines.

Increased Safety Benefits
Assembly of some of a construction project’s most complicated and critical elements in an off-site controlled warehouse reduces congestion of both personnel and materials at the site, and significantly reduces time spent off the ground.
Mortenson’s VDC and BIM efforts on the ESJ Replacement Hospital result in a seamless transition from design to construction.

EXEMPLA SAINT JOSEPH REPLACEMENT HOSPITAL
Prefab On A Grand Scale

- 446 prefabricated bathrooms
- 250 25-foot prefab multi-trade racks
- 400+ prefabricated head walls
- 250 Prefabricated exterior panels
- Prefabricated doors and hardware
- An 18% reduction to the schedule
- Improved safety by reducing overhead work
- Reduced congestion at the site
- Certainty of quality
- Certainty of cost
Best serving the customer sometimes comes from re-thinking the more common, often-overlooked components of a project. This was the case at the Fort Carson Army Post in Colorado, where Mortenson built the new Warrior in Transition Barracks.

**Simplifying Troublesome Components**
To deliver the best product to the customer, the design-build team took what is traditionally one of the most problem-ridden aspects on a construction project – the bathrooms – and engineered a solution during the design process that improved overall quality and reduced the time and cost of the Barracks's construction.

The solution was to use prefabricated bathrooms in all 120 of the Barrack's units. This process provided consistency and decreased construction time, and reduced the number of punch list items in the process. Mortenson partnered with KHS&S/Eggrock to incorporate modular bathroom “pods” into the project. The bathroom pods are complete, self-contained bathrooms that include fixtures, lighting, tile and doors, and are designed to be installed and connected much like a dishwasher.

**Virtual Design & Construction Expertise Benefits Process**
Through the use of VDC, Mortenson engineers modeled the precise spaces for each bathroom pod. After the pods were assembled offsite and delivered to the project, they were seamlessly installed into location using plumbing and electrical connections that fit perfectly as a result of the exacting VDC processes.

This simple “plug-and-play” design idea helped Mortenson save two months on the schedule. It also represents the type of early planning and decision-making that can produce far superior results when compared to traditional linear construction methods.

**A CLOSER LOOK**
- 120 prefabricated bathrooms
- Two-hour installation for each unit
- Two months saved on project schedule
- No broken mirrors, no cracked grout, no installation issues
- No bottlenecks: One subcontractor instead of eight
- Perfect fit with plumbing and electrical hooks
- 100% dimensional consistency for all 120 pods
- Minimal punch list, completed early
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

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

Sustainability Enhancements

PV Array (added via project savings)
Geothermal Field
Solar Hot Water
Waste Reduction
LED Lighting

Waste Reduction

65 - WT Barracks
1.0 - Comparable Project

35% Reduction in Landfill Waste

Energy Modeling (Per SF/Year)

27Kw/h - WT Barracks
50Kw/h - Comparable

46% Improvement

Birds-eye picture of completed project superimposed with MEP and bathroom modules.
## RECENT EXPERIENCE

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Cost</th>
<th>Prefab Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exempla Saint Joseph Heritage Project Denver, CO</td>
<td>$367 million</td>
<td>Bathrooms, MEP above-ceiling corridor racks and exterior enclosure systems</td>
</tr>
<tr>
<td>Denver International Airport Westin Hotel Denver, CO</td>
<td>$150 million</td>
<td>Bathrooms, demising walls, horizontal MEP above-ceiling, Vertical MEP chase, doors and hardware, unitized curtain walls, structural steel</td>
</tr>
<tr>
<td>University of Washington Benjamin D. Hall Interdisciplinary Research Building Seattle, WA</td>
<td>$24.5 million</td>
<td>Bathrooms</td>
</tr>
<tr>
<td>Providence Regional Medical Center Cymbaluk Medical Tower Everett, WA</td>
<td>$296.5 million</td>
<td>Headwalls</td>
</tr>
<tr>
<td>Central Washington Hospital Expansion Wenatchee, WA</td>
<td>$85 million</td>
<td>Enclosure, headwalls</td>
</tr>
<tr>
<td>Confidential Biopharmaceutical Customer Thousand Oaks, CA</td>
<td>Confidential</td>
<td>In-Wall Electrical Kits</td>
</tr>
<tr>
<td>Fort Carson Warrior in Transition Barracks Fort Carson, CO</td>
<td>$25 million</td>
<td>Bathrooms, Roof trusses, Precast Wall Panels</td>
</tr>
<tr>
<td>Chicagoland Speedway Restroom Improvements Joliet, IL</td>
<td>$1.3 million</td>
<td>Bathrooms</td>
</tr>
<tr>
<td>Ralph L. Carr Colorado Judicial Center Denver, CO</td>
<td>$186.9 million</td>
<td>Wall rack assemblies, Wall rough assemblies, media collection boxes, floor box assemblies, above ceiling distribution racks</td>
</tr>
<tr>
<td>Denver Health Pavilion C Women &amp; Children's Wing Denver, CO</td>
<td>$58 million</td>
<td>Exterior windows, MEP systems, electrical box assemblies, bathroom piping.</td>
</tr>
<tr>
<td>Exempla Lutheran Medical Center North Pavilion Wheat Ridge, CO</td>
<td>$143 million</td>
<td>Exterior enclosure, MEP systems</td>
</tr>
<tr>
<td>Walt Disney Concert Hall Los Angeles, CA</td>
<td>$212 million</td>
<td>Ceiling Panels, metal panels</td>
</tr>
</tbody>
</table>