The Rise of Modular Construction in the U.S.

Presented by Dean Dovolis

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
Dean Dovolis
CEO / OWNER / FOUNDER

Dean worked with Twin Cities and Boston firms before founding DJR Architecture in Minneapolis, MN in 1985. He has a vast range of experience in quickly recognizing significant planning and development opportunities. His expertise in international modular design and construction has proven invaluable to government agencies, developers and clients.
Modular Projects

MOD42
The Alvera
Public Housing Scattered Sites
Stinson Apartments
St. Michael Apartments
Glenwood Avenue Apartments
The Cove – Tuscaloosa, AL
UN World Bank - Africa
Benefits of Modular Construction

- Speed to Market
- Cost Savings
- Consistent Quality
- No Change Orders
- Less Disruption to Neighborhoods
- Healthy Work Environment
- Diverse Workforce
Why Developers & Builders Are Choosing Modular

<table>
<thead>
<tr>
<th>ASSEMBLY LINE PROCESS IN CONTROLLED ENVIRONMENT</th>
<th>OFFSITE INSPECTIONS &amp; QUALITY CONTROL</th>
<th>LONG-TERM END-USER BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUALITY</td>
<td>OVERSIGHT</td>
<td>COST</td>
</tr>
<tr>
<td>Repeatable tasks and systematic quality ensuring consistency and quality.</td>
<td>Facility-based 3rd party inspection streamlines the construction process guarantying quality control.</td>
<td>In the right environment, modular construction can reduce costs by as much as 20%.</td>
</tr>
<tr>
<td>SAFETY</td>
<td>SAFETY</td>
<td>ENVIRONMENT</td>
</tr>
<tr>
<td>When compared to on-site-built projects, modular builds report 80% lower accident rates on average.</td>
<td>Manufacturing occurs simultaneously in a controlled environment with sitework.</td>
<td>Less than 5% waste compared to 15% in typical construction for a more energy-efficient build.</td>
</tr>
<tr>
<td>CONCURRENT SCHEDULE</td>
<td>ENVIRONMENT</td>
<td>SOUND</td>
</tr>
<tr>
<td>More than 5% waste compared to 15% in typical construction for a more energy-efficient build.</td>
<td>In the right environment, modular construction can reduce costs by as much as 20%.</td>
<td>Modular built units feature enhanced acoustics due to double floor-ceilings and wall assemblies.</td>
</tr>
</tbody>
</table>

(1) Source: WSP – Modular Construction for Affordable Housing (February 2018)
Modular Units are Manufactured Inside Climate Controlled Factory

Modules Are Transported to the Construction Site

Modules Are Stacked and Assembled At The Construction Site

Multi-Family and Hospitality Buildings Are Finished Onsite

Project Is Designed Using Modern Digital Technology

Speed to Market

- Construction occurs simultaneously with the site work and foundation.
- Can result in up to 30-50% reduction of time in construction schedule.
- In the right environment, modular construction can cut costs by as much as 20%.
Speed to Market

Assumptions

- # of Units: 200
- Gross Square Ft: 200,000
- Total Development Costs: $39,000,000
- Cost/Ft: $195
- Cost/Unit: $195,000
- Debt: 70%
- Equity: 30%
- Rate: 5.0%
- Term (mths): 360

Stick Construction Period 18 months

Stick Built IRR: 20.0%

Rent: $2.25 / SF

Net Margin: 65%

Exit 18 months after C.O.

IRR Impact of Faster Delivery and Cost Savings

<table>
<thead>
<tr>
<th>Months</th>
<th>0.0%</th>
<th>2.5%</th>
<th>5.0%</th>
<th>7.5%</th>
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<tr>
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<td>24.2%</td>
<td>26.1%</td>
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<td>29.9%</td>
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<td>23.0%</td>
<td>25.1%</td>
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<tr>
<td>5</td>
<td>23.9%</td>
<td>26.0%</td>
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<tr>
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<td>24.9%</td>
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<td>25.9%</td>
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<td>30.4%</td>
<td>32.6%</td>
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<tr>
<td>8</td>
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<td>31.7%</td>
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<tr>
<td>9</td>
<td>28.2%</td>
<td>30.6%</td>
<td>33.0%</td>
<td>35.4%</td>
<td>37.7%</td>
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</table>

Cost Savings

- 0.0%
- 2.5%
- 5.0%
- 7.5%
- 10.0%

Rent $2.25 / SF
Net Margin 65%
Speed to Market

Estimated Timeline Changes

**Conventional construction schedule**

- Design
- Permitting
- Foundation
- On-Site Construction

**Offsite construction schedule**

- Design
- Permitting
- Foundation
- On-Site Construction
- Off-Site Construction
- Time Saved

- Time saved on many projects could be 8 months or more
- This translates to less neighborhood disruption and the ability to generate revenue from projects much sooner
Schedule Enhanced Solutions

Volumetric Modular Shortens Construction Timelines

MODULAR BUILD

SITE WORK & FOUNDATION → STACKING & CONNECTIONS → ON SITE BUILDING CONSTRUCTION → ON SITE FINISHING → PROJECT COMPLETE

30 – 50% TIME SAVED

TRADITIONAL BUILD

SITE WORK & FOUNDATION → ON SITE BUILDING CONSTRUCTION → ON SITE FINISHING → PROJECT COMPLETE
### Assumptions
- **No. Of Units**: 200
- **Square Feet**: 200,000

### Incremental Revenue

<table>
<thead>
<tr>
<th>Time (Months)</th>
<th>Total</th>
<th>Per Unit</th>
<th>Per SF</th>
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<tbody>
<tr>
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### Incremental Net Operating Income

<table>
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<th>Per Unit</th>
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<td>9</td>
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<td>$9,753</td>
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### Construction Interest Savings

<table>
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<th>Per Unit</th>
<th>Per SF</th>
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<tr>
<td>9</td>
<td>$358,996</td>
<td>$1,795</td>
<td>$1.79</td>
</tr>
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Consistent Quality

- Indoor, controlled environment protects people and materials
- Repeat tasks ensures consistency and quality
- Systematic quality monitoring throughout manufacturing process
- Enhances structural integrity which minimizes damage during transportation
- Facility-based inspections streamlines construction process
- Precise manufacturing results in tighter tolerances
Inspections

• Rigorous certification ensures manufacturing to state requirements
• Communication critical for inspectors to research projects
• State inspectors visit manufacturing facility and inspect while being built
• Every project subject to inspection at any time
Inspections

- Stations have a tracking protocol - inspectors see what modules have been produced
- Plumbing and electrical inspections done at the manufacturing facility as well as on the job site
- City inspections occur once modules are delivered and being installed
- Inspectors are learning – where does their jurisdiction start and stop
Barriers and Reactions

- Officials realize requirement to understand how to inspect modular
- Local officials cautious of new process
- Difficulty with plan reviewer and specialized on-site inspectors
- Officials see how modular simplifies their risk
- Eventually become a supporter of new technology
Design Considerations For Modular

- Requires Up-Front Considerations
- Supply Chain Can Create Barriers to Construction Timing
- Design Must Be Final Before Any Modular Units are Built
- Onus on Architects / Engineers / Developers to Develop Schedule
Sample Layout

This illustration provides an example of the endless possibilities for design and layout.

Defining room types and organizing them by module size allows incredible flexibility in configuring space requirements that best meet programming intentions.
Design Considerations For Modular

- Modular builder's factory timeline has a large impact on the timing of the project.
Mod Install
Mod Install

1. Site preparation, utility work
2. Stacking & connecting of mods
3. Roof application
4. Exterior façade materials applied
5. Final site work
Building Process
Minneapolis Public Housing Authority
Scattered Sites

- **TYPE:** Modular Multi-Family (4-Plex & 6-Plex)
- **LOCATION:** Minneapolis, MN
- **PROJECT TYPE:** Affordable
- **CONSTRUCTION DURATION:** 13 months
- **NUMBER OF MODS:** 126
- **NUMBER OF UNITS:** 84 units in 16 buildings
- **PROJECT STATUS:** First building completed September 2023
Minneapolis Public Housing Authority
Scattered Sites
Minneapolis Public Housing Authority
Scattered Sites

- RFP provided the opportunity to compare traditional and modular construction
- Modular significantly aligned with the scattered-site nature of the project
- Construction timeline was 33% faster than traditional
- Reduces impact on existing residents and neighbors and allows us to house new families sooner
- The modular approach provided a 13-21% cost reduction compared to traditional in a scattered site setting at the time of RFP
- As a long-term owner, the team was excited about the superior construction product modular construction provided
- Dramatically reduces impact to the neighborhood
- Less truck traffic for material delivery
- Fewer workers onsite means less construction worker traffic/parking
- Construction activities move inside much faster
Site Analysis
Crane Swing Analysis
Minneapolis Public Housing Authority
Scattered Sites
Alvera

- **TYPE**: Modular Multi-Family
- **LOCATION**: St. Paul, MN
- **PROJECT TYPE**: Market-Rate
- **CONSTRUCTION DURATION**: 12 months
- **NUMBER OF MODS**: 155
- **NUMBER OF UNITS**: 192
- **PROJECT STATUS**: Completed 2021
Barriers to On-Site Construction

• Budget – proforma did not work
• Schedule was 18-24 months
• Tight urban site – cranes and scaffolding would have been incredibly challenging
• Logistics – there wasn’t an area near the site for staging or material storage
• Quality – onsite would have required shear walls and gypcrete
• Modular offered higher acoustical and insulation ratings
Alvera

Mod Layout and Setting Sequence
Alvera

Mod layout and setting sequence

3D FULL BUILDING
City Collaboration

- Invited city officials to tour modular plant to a quality control and inspections in action
- Also offered a 30, 60, 90-percent drawing review
- Invited inspectors to be onsite to witness the modules being set
- Once local inspectors and officials saw how a modular approach simplifies risk, they became more supportive of the process
Module Transport

Dimensional considerations
The Route – Leaving the Plant
The Route – Leaving the Plant
The Route – Leaving the Plant
Module Staging - Entering
Module Staging – To Jobsite
The Route – to Jobsite
Set Order
Alvera

- Alvera is the tallest and largest modular building in MN standing 85-feet tall
- Five stories of modular wood construction over two stories of concrete construction
- Gallery, artist-in-residence and WFH space
- Mechanized car-stacking system with 102 semi-automated stalls
- High-density - 192 units on 0.61 acres (316 units/acre)
- Project is significant in providing a solution to attainable housing as well as visually transforming and engaging the neighborhood
Alvera

• Modular maximized site to achieve unit count to make the project happen
• Timeline reduced from 24 to 14 months
• Modular worked with a tight site - developer did not have to invest in multiple staging sites
• Neighborhood impact less with a 22-day modest, less workers on site, less traffic and a significantly shorter construction timeline
• Quality of the project was improved - units have better noise and insulation
• Modular maintained high aesthetic of Alvera’s design
Speaker name: Dean Dovolis
Speaker organization: DJR Architecture & Design
Speaker email address: ddovolis@djr-inc.com