All-wood Podiums in Mid-rise Construction

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Learning Objectives

At the end of this program, participants will have:

1. Participants will analyze the code study including the opportunities and challenges for wood use in this project and be able use that knowledge to specify this type of system in the future.

2. Attendees will learn the motivational drivers associated with the use of wood for this project and why they may consider it on future projects vs. typically specified systems.

3. Participants will discover the structural challenges associated with a wood podium as designed in this project and gain a better understanding of the collaboration necessary with the structural engineer.

4. Participants will understand how the building was designed for durability and longevity using non-traditional systems and methods.

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OUTLINE:

- Podium Construction Defined
- Project Overviews
- Design Challenges and Solutions
- Features and Benefits

Podium Construction Defined

- Traditional Podium Construction
  Residential + Nonresidential concrete podium

- Wood Podium Construction
  Residential + Nonresidential wood podium

OUTLINE:

- Podium Construction Defined
- Project Overviews
- Design Challenges and Solutions
- Features and Benefits
Project Overview

Oceano at Warner Center:
- Luxury apartments, 244 units
- 4 stories above grade, one story below, 55’
- 2008 LABC based on 2007 CBC based on 2006 IBC

Galt Place:
- Affordable seniors’ housing, 88 units
- 3 stories, 47’
- 2007 CBC based on 2006 IBC

Project Overview – Oceano at Warner Center

- Project Team:
  - Owner: TDI California Construction & Oceano Partners
  - General Contractor: TDI California Construction
  - Architect: RC Alley III, NCARB, Architects Orange
  - Structural Engineer: Tom VanDorpe, SE, VanDorpe Chou Associates, Inc. (VCA)
  - Framer: Brian Larrabure, Larrabure Framing

- Construction Timeline:
  - January 2011 to occupancy in July 2012
Architectural Components:
- Construction Type: VA
- Occupancies:
  - Below Grade: S-2 Enclosed semi-subterranean parking below grade
  - Levels 1-4: R-2 Building 1 – 116 units (146,847 sf) and Building 2 – 128 units (163,468 sf)
- Sprinklers: NFPA 13 sprinkler system.

Project Team:
- Owner: City of Galt and CFY Development Inc.
- General Contractor: CFY Development Inc.
- Structural Engineer: Mike Baker, SE, Baker Guptil Structural Designs, Inc.
- Framer: Becker General Contractors

Construction Timeline:
- March 2011 to occupancy in June 2012
Project Overview – Galt

Structural Specifications
- Light-framed shear walls all levels
- Wood Podium: Engineered Wood System
  - Wood Structural Panels with gypcrete topping
  - I-joists
  - Glulaminated Beams (Glulams)

Structural Components
- Light-framed shear walls
  - Superstructure
    - Shear wall design methods
    - Architectural Gingerbread

Structural Components
- Wood Podium
  - Focus on Continuity
  - Detailing
**Structural Components**

**Engineered Wood System**
- Wood Structural Panels
- Oriented Strand Board (OSB)
- Plywood for balconies
- I-joists and Sawn Lumber

**Glulam Beams**
- **2 Stress Classes**
  - Bending Stress, Modulus of Elasticity
    - 24F-1.8E (2400 psi, 1.8x10^6 psi)
    - 30F-2.1E LVL (3000 psi, 2.1x10^6 psi)
- **Variety Sizes**
  - 5-1/8 inches to 12-1/4 inches wide
  - 10-3/4 inches to 45 inches deep

**LVL Laminations**

**Structural Steel**
- Steel Columns & Connections
- Price Steel Beams > Glulams

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Design Challenges and Solutions

Governing Codes for Engineered Wood Design

2007 California Building Code (CBC)

Design Challenges and Solutions

2008 City of Los Angeles Building Code

Design Challenges and Solutions

2010 California Building Code (CBC)
Heights and Areas

- What factors into determining allowable heights and areas?
  - Occupancy
  - Construction Types
  - Protected or Unprotected
  - Open Frontage
  - Sprinklers
  - Fire Walls/Barriers

Design Challenges and Solutions

IBC 2009 Special Provisions – 509

- **509.1 General.** The provisions in this section shall permit the use of special conditions that are exempt from, or modify, the specific requirements of this chapter regarding the allowable heights and areas of buildings based on the occupancy classification and type of construction, provided the special condition complies with the provisions specified in this section for such condition and other applicable requirements of this code. The provisions of Sections 509.2 through 509.8 are to be considered independent and separate from each other.
Design Challenges and Solutions

IBC 2009 Special Provisions – 509

- 509.4 Parking beneath Group R.
- Possibility of a Type IV podium where number of stories starts above parking:
  - 1 hr horizontal assembly
  - one story above grade of Type IV open with sprinklers below separation
  - occupancy above is R
  - occupancy below is S-2
  - overall height is still limited

Design Challenges and Solutions

Considering a Conventional Code “Podium”
Will the parking work?

Sec. 406.3.3 states Open parking garages shall be of Type I, II or IV construction.

Design Challenges and Solutions

Enclosed Parking Garage

- Ventilation Systems required for Enclosed Garages
  - Mech Code: 403.8 Exhaust Ventilation for Enclosed Parking Garages. Exhaust airflow for enclosed parking garages shall be provided in accordance with the requirements in Table 4-4 and this Section. Exhaust makeup air shall be permitted to be any combination of outdoor air or transfer air.
  - Table 4-4 Parking garages 0.75 cfm / sq ft
  - 403.8.2 Alternative Exhaust Ventilation for Enclosed Parking Garages. Mechanical ventilation systems used for enclosed parking garages shall be permitted to operate intermittently where the system is arranged to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.
  - Part natural and part mechanical ventilation permitted by code
    - Final result: 10,000 cfm system …cost 10K

Enclosed Garages: 406.4
Height and area as per table 503 as modified by sections 504, 506, and 507
Type V is OK for S2 Occupancy per table 503 Parking Garage is OK in Type VA construction /If it is enclosed
Design Challenges and Solutions

IBC 2009 Special Provisions – 509

508 Mixed Use & Occupancy

• Separated Occupancies 508.3.3 (06 IBC) 508.4 (09 IBC)
• Separation of Occupancies Table 508.3.3 (06 IBC) 508.4 (09 IBC) – 1-hour fire resistive rating
• References Section 711 (06 IBC) 712 (09 IBC)

Construction – Horizontal Assemblies

• 711.2 (06 IBC) 712.2 (09 IBC) Materials. The floor and roof assemblies shall be of material permitted by the building type of construction.

Design Challenges and Solutions

Automatic Sprinkler Increase for Height

• IBC 504.2 Where a building is equipped throughout with an approved sprinkler system…
  • maximum height is increased by 20 feet
  • maximum number of stories is increased by one.

• Can be combined with frontage area increase - 506.2
• Can be combined with sprinkler area increase - 506.3
  • EXCEPT for high-rise buildings, Group A, E, H, I, L and R (not including R-2 Type VA) occupancies (CBC Amendment)

Design Challenges and Solutions

Area Modification – IBC 506

\[ A_a = A_t + [A_t \times I_f] + [A_t \times I_s] \] (Equation 5-1)

• \( A_a \) = Allowable area per story (sq. ft.)
• \( A_t \) = Tabular area per story (Table 503) (sq. ft.)
• \( I_f \) = Area increase factor due to frontage (IBC 506.2)
• \( I_s \) = Area increase factor due to sprinkler protection (IBC 506.3)

Design Challenges and Solutions

Why incorporate fire walls?

– 705.1 General - Each portion of a building separated by one or more fire walls that comply with the provisions of this section shall be considered a separate building.
– For example if an 18,000 sf building is desired using type VB the maximum square footage is 9,000sf.

\[
\begin{array}{ccc}
\text{Max Size Type VB} & \text{Max Size Type VB w/firewall} \\
9,000sf & 9,000sf, 9,000sf
\end{array}
\]
Design Challenges and Solutions

Oceano at Warner Center

Architectural Components:
- Construction Type: VA
- Areas & Occupancies:
  - Below Grade: S-2 Enclosed semi-subterranean parking below grade with 353 parking stalls (78,650 square feet)
  - Levels 1-4: R-2 with a total of 244 units (310,195 square feet) Building 1 has – 116 units (146,847 square feet) and Building 2 has –128 units (163,468 square feet)
- Sprinklers: NFPA 13 sprinkler system.

Galt Place

Architectural Components:
- Construction Type: VA
- Areas & Occupancies:
  - Level 1: S-2 70 covered and open air parking stalls (24,633 square feet), A2, M and B– Retail/Restaurant/Office and Residential Administration (14,356 sf)
  - Levels 2 and 3: R-2– 88 Units (62,480 square feet)
  - Separated Occupancies: 1 hour maximum fire resistive rating per Table 508.3.3
- Sprinklers: NFPA 13 sprinkler system.

Design Challenges and Solutions

Ocean Wood Podium

- R-2 & S-2 Enclosed Occupancies
- Type V Construction
- CBC 508.3.3 – Mixed Use Occupancy
  - Section 712.3 for the requirements of the horizontal assembly states the floor and roof assemblies shall be of materials permitted by the building type of construction.
  - Table 508.4 specifies a fire separation between occupancies to have a 1-hour fire resistive rating.

Galt Wood Podium

- R-2 & S-2 Enclosed Occupancies
- Type V Construction
- CBC 508.3.3 – Mixed Use Occupancy
  - Section 712.3 for the requirements of the horizontal assembly states the floor and roof assemblies shall be of materials permitted by the building type of construction.
  - Table 508.4 specifies a fire separation between occupancies to have a 1-hour fire resistive rating.
Design Challenges and Solutions

Code Check Resources

Durability:
- Protected building envelope
- Different approaches
  - Oceano
  - Galt
Design Challenges & Solutions

Two accepted fire rating methods recognized in the U.S.:

- IBC Empirical Method
- NDS Mechanics Based Model

Performance of Wood vs. Steel

Compared to steel, wood has superior properties:

- Strength
- Durability
- Aesthetic appeal

Calculating Fire Resistance of Glulam Beams and Columns, Technical Note Y245

Examples of historic buildings:

- Horyu-ji temple, Ikaruga, Nara Prefecture, Japan (c. 711)
- Urnes stave church, Sogn og Fjordane County, Norway (c. 1150)
- Government Buildings Historic Reserve in Wellington, NZ (c. 1870)
Design Challenges & Solutions

Communication:
- Project team
- Subconsultants
- Single Engineering Firm
- BIM
- Glulam Manufacturers
- Emphasis on Stacking

Field Modifications:
- BIM
- Hole cutting
- Field Notching and Drilling of Glulam (APA Form S560)

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Benefits
- Enhanced constructability:
  - Fewer trades on job
  - Less mobilization time
  - Fewer construction delays
Benefits

Enhanced constructability:
- Improved framing efficiency
- Large pool experienced and competitive labor
- Easier field modifications

Benefits

Structural:
- Decreased mass for lateral design
- Continuity of lateral system
- Fewer design team members

Benefits

Improved sustainability:
- Wood as a building material
- LEED-HMR Silver (Oceano)
- LCA

FEATURES AND BENEFITS

Comparing CO₂ emissions of different materials

- Sawn lumber products have a negative net CO₂ contribution
- Wood industry often contributes biomass energy to the grid
FEATURES AND BENEFITS
Wood Structures = Long Term Storage

2,400 sf home = 32 m² structural
29 metric tons CO₂ = 5.7 passenger annual emissions

Source: FP Innovations

FEATURES AND BENEFITS
Galt Place is a great example of Smart Growth
- Mixed Use
- Infill and Urban
- Encourages transportation choice - car, bus, walk, bicycle
- High in Resource Efficiency
- Low energy and land use
- Supports existing infrastructure
- Quality Design that creates a sense of place

More economical building:
- Motivating factor to build wood podiums for both projects
- Oceano - wood podium estimated to be 2/3 cost of concrete podium
- Galt – change order - received $2 million credit primarily due to use of wood
Public Partner Perspective

- Affordable housing requires Public-Private Partnerships
- C.F.Y. Development financed this $20 million project with a combination of partnership equity, conventional mortgage, deferred profit and a loan from the City of Galt Redevelopment

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### Resources

- APA Case Study, Form No. N110: [www.apawood.org](http://www.apawood.org)
- [www.woodworks.org](http://www.woodworks.org)
Questions?

• This concludes The American Institute of Architects Continuing Education Systems Course

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