MAXIMIZING THE DESIGN BENEFITS OF PODIUM CONSTRUCTION

Presented by: THINK WOOD.

A DOUBLE TAKE | WREN Residences, Los Angeles, CA
To meet an ambitious 195 units/acre density target, Architect Togawa Smith Martin used an innovative double-podium design supporting five levels of wood-framed structure over two levels of concrete construction. PHOTO CREDIT: Kevin Korczyk | ARCHITECT: Togawa Smith Martin

LEARNING OBJECTIVES

1. Develop an understanding of podium construction and design.
2. Discuss the advantages of podium construction and the unique design benefits of using timber as a primary building material.
3. Examine relevant building code provisions applicable to multi-story podium structures, including considerations for fire and life safety design.
4. Examine several case studies that feature podium configurations and the challenges, benefits, and best practices of using this construction typology.

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WHY PODIUMS

Throughout North America, specifying podium construction is an increasingly popular option for dense, urban areas, particularly when projects require infill scenarios. Limited space and rising costs of land and construction materials, such as concrete and steel, have prompted developers and architects to re-think building design. Rather than designing large, sprawling developments that take up an entire city block, building professionals are building higher and denser with materials that are more cost effective, lighter, and sustainable, such as wood. Podium construction allows for greater density and more rentable square footage than garden style apartments, and materials and labor tend to be more cost effective. Choosing to use wood enables the project to reap the potential benefits that inherently arise with a wood project: speed of construction, design flexibility, cost savings, and reduced environmental impact.[9]

DEFINING PODIUM CONSTRUCTION

Multi-story light-frame wood construction generally falls under construction Types III and V. Each building type is further subdivided into A and B, which have different fire-resistance rating requirements (with A being classified as more rigorous). Type IV construction, which utilizes heavy timber primary structural members, can also be used for mid-rise structures, but this type

BENEFITS AT A GLANCE

Potential benefits of podium construction that uses light-frame wood (light-frame) building systems:

- Reduced material and labor costs[2]
- Faster construction and installation[3]
- Lighter materials and lower foundation costs[4]
- Reduced environmental impact[5]
- Well suited to prefabricated construction[6]
- Boost density, building height and percentage of rentable square footage[7]
- Overall design flexibility that easily accommodates mixed-use programs and amenities such as multi-family residential, restaurants, commercial and/or retail, underground parking, lofts and mezzanines, parks and greenspace, pools and terraces.[8]

COOL FOR SCHOOL | University House Arena District, Eugene, OR
Podium construction can be an efficient and cost-effective way to meet the rapidly growing demand for student housing across the country. This 109,600 square-foot student housing project includes five stories of wood-frame construction over a concrete podium achieving an attractive yet affordable design. PHOTO CREDIT: Lincoln Barbour | ARCHITECT: Mahlum Architects

Podium construction—also known as pedestal or platform construction—typically includes multiple stories of light wood framing over a single- or multi-story podium of another construction style, which may include retail as well as above- or below-grade parking levels. Concrete podiums are the most common, though steel podiums also exist. Although not considered 'podiums' under the IBC, using a heavy timber system to separate parking from light wood-frame residential units above is also gaining popularity.

– WoodWorks | Wood Products Council

limits the use of concealed spaces and therefore requires more creativity to meet acoustic goals and conceal utilities.[10]

A provision in the *2018 IBC, Chapter 5 General Building Heights and Areas*, Section 510.2 "Horizontal Building Separation Allowance," recognizes that buildings with a podium structure are considered two distinct buildings "for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories, and type of construction" where certain conditions are met. A core benefit of this provision is it allows for more stories in a building where wood construction is limited to four stories for Type V-A Residential occupancies and five stories for Type III residential occupancies. Podiums enable more stories to "fit" into the total allowable building height, which is particularly beneficial in urban areas that require increased density.[11] The total building height as measured from grade plane cannot exceed the height limit set forth in Section 503 for the construction type having the smaller allowable height. Since the podium is required to be of Type I-A construction, which is permitted to be unlimited in height, the allowable height of the Type III or Type V building will always control the overall building height.

Podium construction, also known as pedestal construction, is ideal for mid-rise, mixed-use structures. More commonly, the construction consists of two to five stories of light-frame wood construction over a concrete podium separated by a three-hour fire resistance-rated horizontal assembly. The upper slab of the concrete podium typically acts as both a fire separation and structural transfer slab for the framing above. This construction approach allows increased density with additional stories, maximizing the use of smaller urban lots while benefitting from the typically lower cost and faster installation of light-frame wood (light-frame) construction.[12]

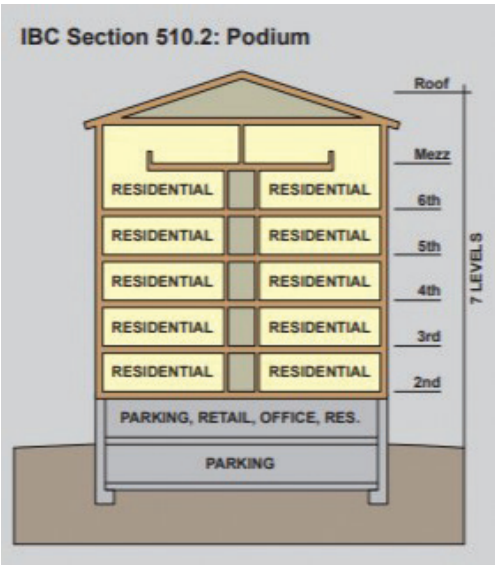
In mixed-use structures, the podium provides separation between different occupancy types; typically, the upper stories are residential or a mixed occupancy use while the first one or two levels range from parking garages to restaurants, retail, or other commercial uses. Typically, podiums are above parking levels (or other uses of a concrete podium such as commercial or retail space) and serve to separate a mixed-use building; therefore, these buildings require higher fire ratings and reduced sound transmission. It is also possible to have multiple story podiums, which will be discussed in detail in the next section.

Multiple Story Podiums

In versions of the IBC up to and including 2012, the lower portion of the construction (the podium) can be no more than one story above the grade plane. 2015 changes to IBC section 510.2 (and included in 2018) allowed multiple story podiums. This allows two stories of podium with five stories of wood framing above to meet the 85-foot maximum building height limitation while also meeting the 65-foot seismic force-resisting system (SFRS) height limit for light-frame wood stud-wood structural panel shear walls in high seismic areas (SDC D-F). For buildings designed in jurisdictions enforcing codes preceding the 2015 IBC, this requires approval of an Alternate Means and Methods Request (AAMR) by the Authority Having Jurisdiction (AHJ). However, knowing that the 2015 edition provides this allowance often eliminates the AHJ's concerns.[13]

IBC SECTION 510.4—TYPE IV PODIUM CONSTRUCTION BOOSTS VALUE AND COST SAVINGS

Although a typical podium structure is light-frame construction over a concrete or steel podium, in certain conditions, the podium itself can also be constructed of wood, which can further reduce overall construction costs and time, while creating a more sustainable and cost-effective building.[14] Type IV podium construction is covered in another special provision, IBC Section 510.4. While 510.4 is



Example of five-story light wood-frame construction with mezzanine over two-story (double) podium (Image courtesy Wood Products Council | Wood Works)

used less frequently than the 510.2 horizontal building separation allowance provision, it offers a similar opportunity for stacking buildings and gaining an additional floor.

IBC Section 510.4 recognizes and allows the use of open Type IV construction podiums for buildings with parking below (S-2 occupancy) and any Group R occupancy above. This provision allows a one-story podium of Type I or Type IV construction, but only requires a two-hour fire separation that can be further reduced to a one-hour separation if the building has a sprinkler system per IBC Table 508.4. The overall building height is limited to what is permitted for the more restrictive construction type per IBC Table 503. Assuming a parking area of Type IV construction, the height limit would vary depending on the construction type classification of the upper structure.

Engineered wood products used to construct heavy timber podium buildings are an excellent structural and fire-resistant design option. These materials provide strength and durability combined with lighter weight and flexibility, which are both important in high seismic zones where building mass affects lateral design loads. The wood podium design also allows some projects to use light-framed shear walls on the first level, as well as smaller foundations than required for a concrete podium.[15]

Writing for *Building Design + Construction*, Karyn Beebe notes:

> An all-wood building enhances construction in many ways. Field modifications of a wood deck away from the beam line are easier to accommodate because it is not necessary to X-ray the slab for rebar and/or post-tensioned strand placement. In addition, fewer building materials decreases the number of trades on the job and, as a result, reduces mobilization time and construction delays. The redundancy of constructing each floor with the same trade and materials also improves framing efficiency and decreases the amount of detailing required by designers.[16]

In addition to the benefits noted by Beebe, Architect Dan Withee of Withee Malcolm Architects, which designed an 85-unit wood podium project in San Diego, "estimated that a concrete podium can cost $15,000 per parking space compared to $9,500 for a wood podium."

Bernhard Gafner Principal with Aspect Engineering corroborates Beebe's and Withee's claims, stating, "A mass timber project is approximately 25 percent faster to construct than a similar project in concrete. Noting the advantages for urban infill sites in particular, he says it also offers 90 percent less construction traffic (trucks delivering materials) and requires 75 percent fewer workers on the active deck, making for a much quieter job site."[18]

GLOSSARY

4-over-1—four stories of wood framing over a one-story above grade podium

5-over-1—five stories of wood framing over a podium (Type IIIA and IIIB)

5-over-2—five stories of wood framing over a two-story above grade podium

Balloon Framing—involves joists hanging off of a ledger attached to structural studs

Equilibrium Moisture Content (EMC)—"moisture content at which the wood is neither gaining nor losing moisture"; the history of a wood specimen, such as its long-term environment, also affects its EMC[1]

Mass Timber Products—typically characterized by large, solid wood members often manufactured off-site; includes sawn timbers, cross laminated timber, structural composite lumber, and structural glued laminated timber

Mid-rise Structure—a general term commonly applied to buildings between measuring from the lowest ground elevation to the top of the uppermost occupied level; between four and ten stories or between 35 and 85 feet tall

Platform Framing—floor and roof framing on top of bearing walls; the most frequent framing style in conventional wood framing construction

Podium Construction—"also known as pedestal […] —typically includes multiple stories of light framing over a single- or multi-story podium of another construction style, which may include retail as well as above- or below-grade parking levels"

Semi-balloon Framing—floor and/or roof framing; hangs off of bearing walls which are continuous past the horizontal framing to the underside of the floor or roof sheathing of the horizontal framing to the double top plates

SAVING WITH SAVY STYLE | Stella Residences
Stella is a great example of a project making the most of an urban infill site. Wood construction made this project more affordable while still offering amenities. To attract residents, the design team used the podium configuration to add resort-style features more typically found in luxury projects. The Stella complex includes a heated saltwater pool with hot tub and large sand beach, state-of-the-art fitness center, resident lounges and a catering kitchen, business center and conference room, private movie screening room, yoga studio and spa room, and rooftop deck. PHOTO CREDIT: Lawrence Anderson | ARCHITECT: DesignArc

URBAN INFILL: PODIUM CONSTRUCTION CAN HELP INCREASE DENSITY, AFFORDABILITY, AND ADD AMENITIES

In many projects, the fundamental value proposition of podium construction is that it is the sweet spot of value for development of certain properties, having higher densities (or total project area) than non-podium Type II, III, or V buildings. In addition, there is significantly less cost per unit/area than taller Type I buildings.

Because Section 510.2 of the 2018 IBC allows for additional stories, which enable increased density, podium construction is often ideal for urban infill projects.[19] Benefits of podium construction include sustainability, prefabrication, and less on-site labor and traffic, which is important in busy urban areas. In a presentation at the World Conference on Timber Engineering (WCTE), Kevin Cheung maintains, "The popularity of multi-storey wood frame condominium and rental apartment projects is spreading across America from coast to coast in major metropolitan areas to provide affordable housing to the growing population."[20]

Cheung cites shifting demographics and the need for "denser and taller housing […] to create affordable, healthy, sustainable communities and neighbourhoods that are

transit-oriented and pedestrian-friendly." To achieve this goal, as well as meeting increased demand for green ratings, Cheung notes that developers and other specifiers are using podium construction.[21]

Jason R. Shepard, AIA, a principal and director of multifamily housing at Atlanta-based Dwell Design Studio, maintains approximately 60 to 70 percent of Dwell Design's work is infill driven. He comments, "Most of our developers prefer to work with wood. A lot of our projects are five stories of light-frame construction over two levels of concrete podium. Most jurisdictions want retail services at ground level. Podium design supports that. […] The wood wrap achieves more density, minimizes construction costs, and helps offset land costs."[22] Many of Dwell's projects exemplify Shepard's statements. For instance, Berwyn House Road in Atlanta, Georgia, is Type III light-frame construction over an elevated podium slab and parking structure, containing 7,500 sf of amenities, including a clubroom/fitness center and a pool courtyard.[23]

Writing for Multifamily Executive, Patrick Winters states, "The critical housing shortage in many of our most dynamic cities, coupled with the ascendancy of urban living, is driving a need for larger, denser, and more amenity-rich housing projects." Amenities include everything from gyms to pools, restaurants, retail spaces, offices, parking garages, and even hotels.[24]

Like Shepard, Winters cites the hybrid nature of concrete podium construction combined with light-frame as a sustainable and versatile design solution. The podium, in addition to building lobbies and parking, often contains ground-floor retail space. He notes that typical light-frame mid-rise buildings built over podiums can "achieve densities of 65 to 100 units per acre." According to Building Safe and Affordable Communities, research shows wood construction to have been $119.7/square foot in 2017.[25]

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QUIZ

1. Using engineered wood products to construct heavy timber podium buildings provides which of the following benefits:
   a. Strength and durability
   b. Lighter weight materials
   c. Flexibility
   d. All of the above

2. In podium construction, the light-frame wood construction over a concrete podium is separated by a_____ fire resistance-rated horizontal assembly.
   a. One-hour
   b. 10-hour
   c. Three-hour
   d. Six-hour

3. According to the course, podium construction makes a positive impact on urban infill and densification strategies by:
   a. Contributing to environmentally responsible design
   b. Offering significant schedule and cost savings
   c. Allowing for flexible, innovative design within tight urban sites
   d. All of the above

4. The phrase, "_____," refers to two (or potentially) three stories of concrete construction with five stories of wood above grade podium.
   a. 5-over-2
   b. Mixed-use construction
   c. 4-over-1
   d. Multifamily housing

5. According to the IBC, the light-framed portions of multifamily podium structures may be _____ construction, both of which have basic limitations with regard to height, number of stories, and square footage.
   a. Type III
   b. Type V
   c. None of the above
   d. Both A & B

6. According to the course, wood prefabrication has which of the following benefits:
   a. Process efficiency
   b. Controlled environment
   c. Reduced waste both on- and off-site
   d. All of the above

7. In a building with five stories of residential units, density can increase to _____ to _____ units per acre.
   a. 50; 80
   b. 100; 120
   c. 200; 300
   d. None of the above

8. In the MOTO case study, prefabricated wall panels and BCI flooring and ceiling joists that arrived on the job site as needed enabled the contractors to frame each floor in _____.
   a. One week
   b. Two weeks
   c. Three weeks
   d. Four weeks

9. The IBC treats podium-style buildings as ____ separate buildings, which boosts the number of potential stories that can be built.
   a. Six
   b. Three
   c. Two
   d. Four

10. Which of the following factors make wood podium construction ideal for urban infill projects?
    a. Use engineered wood products
    b. Provide for movement in the mechanical systems
    c. Include an expansion joint in the cladding
    d. All of the above

SPONSOR INFORMATION

GIVE THEM GREEN | University of Washington Student Housing, Seattle, WA
The University of Washington student housing building takes advantage of several benefits of podium construction such as the open green spaces and courtyards incorporated into its design. The project is comprised of five mixed-use buildings, each designed with five stories of light-frame Type V-A wood construction over a two-story Type I-A concrete podium. PHOTO CREDIT: Benjamin Benschneider and WG Clark Construction | ARCHITECT: Mahlum Architects

HOW PODIUM CONSTRUCTION MAKES A POSITIVE IMPACT ON URBAN INFILL AND DENSIFICATION STRATEGIES[26]

1. Provides solid separation between different occupancies, along with sound and fire protection
2. Economically meets urban housing needs and can contribute to greater affordability
3. Contributes to growing civic commitment to environmentally responsible design
4. Provides versatile design solutions that can include a variety of mixed-uses, including residential, retail, commercial office, parking, greenspace, and other uses[27]
5. Provides large open spaces at or below grade, well suited for retail, restaurants, pools, and gardens[28]
6. Can offer significant schedule and cost savings in comparison to other building typologies
7. Allows for flexible, innovative design within tight urban sites, including greater use of prefabrication and offsite construction
8. Cost-efficient strategies for secure structured parking[29] and podium garage auto entry[30]

PERKS OF PREFAB | The Cubix at Othello, Seattle, WA
Caption: The Cubix at Othello project in Seattle, Washington uses prefabrication and mass timber in addition to a podium-configured construction. Prefabricated wood construction offers a number of advantages including greater control over construction conditions and improved safety oversight for all material types while requiring less skilled labor on site. All this contributes to faster construction timelines. PHOTO CREDIT: Metric Modular

THE BENEFITS OF COMBINING PODIUM AND PREFABRICATED WOOD BUILDING SYSTEMS

Typically, light-frame wood construction uses a prescribed combination of dimensional lumber, I-joists, trusses, structural composite lumber, and plywood or oriented strand board (OSB) sheathing for floors, walls, and roof decks. While mass timber structures are often built as components off site and assembled at the project site, light-frame construction has historically occurred entirely on site. Increasingly, however, components of light-frame buildings are manufactured off site and assembled on the job. Off-site construction offers greater control over construction conditions and improved safety oversight for all material types while requiring less skilled labor onsite and contributing to faster construction timelines.[30]

In addition to sustainability and reducing carbon footprint, wood prefabrication has many benefits, including process efficiency, a controlled environment, a greater return on investment, material efficiency, and reduced waste both on and off site. This can provide additional value and cost savings to podium construction.

Detailed planning allows construction processes to be standardized and streamlined, including construction efficiency that meets aggressive schedules and decreases on-site assembly time. Because prefabricated components are produced in a controlled environment, quality and precision of components improve, fabrication productivity increases, safety for tradespeople improves, and weather is less of a factor in slowing down the construction process.

IT PAYS TO PANEL | MOTO, Denver, CO
Caption: Construction of the MOTO residences used a podium construction along with prefabricated panelized walls, helping the project save time and money. Because they are assembled in a controlled environment, finished panels typically meet tighter tolerances, which can help reduce shrinkage due to gaps. PHOTO CREDIT: Ryan Gobuty | ARCHITECT: Gensler

An example of the benefits of combining podium and prefabricated wood-building systems is MOTO, a mixed-use, 64-unit boutique apartment in Denver, Colorado. MOTO is comprised of four stories of wood-frame construction over a two-level concrete podium and above-grade parking garage. Because the architects utilized a prefabricated panelized wall system, assembly was completed in less than a month, and each level of the structure took approximately one week to be framed. This further equated to substantial savings with the cost of construction estimated at $125/sf.[32]

UNDERSTANDING THE CODE COMPLIANCE PATH FOR PODIUM-STYLE BUILDINGS

According to the IBC, the light-framed portions of multifamily podium structures may be Type III or Type V Construction, both of which have basic limitations with regard to height, number of stories, and square footage. Each building type is further subdivided into A and B, which have different fire-resistance rating requirements (A being more rigorous). Type IV construction can also be used for mid-rise structures, but this construction type limits the use of concealed spaces and therefore requires more creativity to meet acoustic goals and conceal utilities.

A wood building categorized as Type III-A construction is very similar to one of Type V-A construction in practice, with two notable exceptions. Where a designer wants to use wood for exterior walls in Type III construction, it must be fire retardant-treated (FRT) wood, and exterior bearing walls must be two-hour fire-resistance rated. In multi-family occupancies, a Type III-A or III-B building can include five stories of light-frame construction while type V-A can include four stories of light-frame construction.

When using IBC provision 510.2, for the podium to be considered as a separate and distinct building when it comes to determining story and area limitations and for allowing a break in vertical continuity of fire walls, the following must apply:

UNDERSTANDING TYPE III, IV AND V CONSTRUCTION TYPES[33]

- Type III construction permits any code-defined construction material, including wood framing, for all interior framing elements (floors, roofs, interior walls, structural frame) and permits the use of fire retardant-treated wood framing in exterior walls with a required fire resistance rating of two hours or less.
- Type IV construction requires the use of heavy timber members for all interior elements (floors, roofs, interior walls, structural frame) with the exception that partitions may be constructed of one-hour fire resistance-rated construction. Minimum heavy timber member sizes are given in IBC Section 602.4. Type IV construction permits the use of fire retardant-treated wood framing in exterior walls with a required fire resistance rating of two hours or less.
- Type V construction permits any code-defined construction material, including wood framing, for all framing elements (floors, roofs, interior and exterior walls, structural frame).

TWO BECOME ONE | MOTO, Denver, CO
This 82,000 square-foot building includes four stories of wood-frame apartments over a two-level concrete podium and above-grade parking garage. Its podium design accommodates an outdoor pool and terrace. Under construction, the separation from concrete to wood construction is visibly apparent. Once complete, with attractive wood and exterior cladding, the building achieves a sleek uniform design. Left PHOTO CREDIT: Ronnie Leone | Right PHOTO CREDIT: Ryan Gobuty | ARCHITECT: Gensler

- The building portions are separated by a horizontal assembly with a minimum three-hour fire resistance rating
- The building below is of Type I-A construction and is protected throughout with NFPA13 sprinklers
- Shafts, stairways, ramps, and escalator enclosures penetrating the horizontal assembly have a two-hour fire resistance rating
- The maximum building height measured in feet above grade is not exceeded[34]

Occupancies above the podium are permitted to be A, B, M, R or S, while occupancies below the podium are permitted to be any except H. The overall height of each building is measured from grade plane and is limited by the provisions of Chapter 5 (with increases).[35]

The 2015 IBC expanded the opportunity for podiums from earlier editions by allowing podiums to include two or more stories below the three-hour horizontal fire assembly with the caveat that the overall building height above grade (from grade plane to the average of the highest roof plane) must still not exceed the limits set in Chapter 5 for the more restrictive of the two buildings.

When utilizing IBC Section 510.4, open Type IV podium construction not exceeding one-story is permitted for buildings with parking below (S-2 occupancy) and any Group R occupancy above. When it comes to determining story and area limitations and for allowing a break in vertical continuity of fire walls, the following must apply:

- The building portions are separated by a horizontal assembly with a minimum two-hour fire resistance rating, but can be reduced to one-hour if the building has a sprinkler system per IBC Table 508.4.
- The height is limited to the more restrictive building height requirement for the occupancy classification per IBC Table 503 (comparing the construction type of the building above with that below).

One issue that can impact the height measurement is the elevation of the grade plane. For structural purposes, height can be determined beginning at the podium, but this is not true for the architectural height. Per section 502 Definitions, the IBC considers grade plane to be the average finished grade at exterior walls, and finished grade to be the lowest point between the building and the property line or six feet, whichever comes first.[36]

Flexible Configurations and Design Options

The IBC treats podium-style buildings as two separate buildings, constructed one on top of the other, and this design boosts the number of potential stories that can be built, enabling various design challenges to be solved through different podium configurations. For example, Type III-A and III-B can have five stories of light-frame construction over a podium for residential occupancies, Type III-A can have six for commercial office use, and Type V-A allows for four stories of light-frame construction, known respectively as "5-over-1" and "4-over-1."

Additionally, starting with the 2015 IBC, IBC 510.2 has allowed multiple story podiums for a total of up to eight stories ("5-over-3"). This means two (or potentially three) stories of concrete construction above grade with five stories of wood on top, often referred to as "5-over-2."

We already discussed the less used but still relevant second provision, 510.4, that allows a one-story podium to be considered Type IV construction. A third special design provision, 510.5 Group R-1 and R-2 buildings of Type III-A construction, presents a rare opportunity for a six-story, 75-foot-tall, Type III-A building with floor areas compartmentalized to 3,000 square feet. Below-ground parking would require a three-hour fire separation, and a two-hour fire wall continuous from slab to roof is needed to achieve this level of compartmentalization. This design would likely be most cost effective when the building has a small footprint, minimizing the need for fire walls.[37]

The continuing evolution of building codes can help solve urban density issues, as discussed in the previous section, as well as provide design flexibility. Four stories of residential occupancy over a non-residential podium will achieve densities similar to wrap-around construction. With five stories of residential units, density can increase to 100 to 120 units per acre. An additional 20 units per acre are achievable when the podium levels include residential occupancy rather than commercial.

BOOSTING ALLOWABLE BUILDING AREAS

2018 IBC section 506.2.4 on mixed-occupancy, multi-story buildings, provides a tabular allowable area factor in accordance with Table 506.2 for a sprinklered building that is three times the unsprinklered value.[39]

There are opportunities within the IBC to increase the size of wood buildings. The complexity of these calculations is beyond the scope of this course.

The Heights and Areas (H&A) Calculator is a joint effort of the American Wood Council, WoodWorks—The Wood Products Council, and the International Code Council (ICC). It provides users with an app-based approach to calculating maximum heights and areas for buildings of various occupancies and fire protection based on 2006 to 2015 editions of ICC's International Building Code® (IBC®) provisions. Input a given building geometry, site conditions (e.g., open frontage), type of construction, and occupancy, and allowable heights and areas can be determined. Links to download Android, iOS, and MS Windows versions are shown on this page.

This H&A Calculator is not meant to be a replacement for the IBC and does not encompass all of its design options. The IBC should always be consulted for final construction type determination, in addition to state and local amendments to the IBC that may apply.

The definitive resources for understanding allowable area increases for combustible construction is jointly published by the American Wood Council and ICC.[40]

SHRINKAGE CONSIDERATIONS IN PODIUM STRUCTURES

Regardless of the framing type, building designs must compensate for the fact that wood shrinks as it dries. With respect to dimensional stability, wood is an anisotropic material. It shrinks (swells) most in the direction perpendicular to the grain, the direction of the annual growth rings (tangentially), or across the growth rings (radially). Longitudinal shrinkage of wood (shrinkage parallel to the grain) is generally quite small; from green to oven dry the average shrinkage is between 0.1% and 0.2% for most species of wood. Shrinkage continues until wood reaches its Equilibrium Moisture Content (EMC), which averages 8-12 percent of moisture content for most structures in the U.S. *The Wood Handbook*, compiled by the United States Department of Agriculture Forest Service's Forest Products Laboratory, defines EMC as "that moisture content at which the wood is neither gaining nor losing moisture."[41]

Where wood walls and bearing partitions support more than two floors and a roof, section 2304.3.3 of the IBC requires an analysis to ensure that shrinkage of the wood framing will not have adverse affects on the finishes, structure, mechanical, electrical, and plumbing systems, or other equipment. The analysis must also show that the roof drainage system will either not be affected or be designed to accommodate the differential shrinkage. The taller the building, the more significant shrinkage could become, and all structures are subject to vertical shortening due to loading.[42] As podium structures allow for an increase in building height, shrinkage must be considered.

If incorporating brick veneer, keep in mind that because masonry expands while the wood shrinks, careful detailing is critical to avoid any bulging or cracking of the building's facade.

The following tactics may be used to address shrinkage in podium construction:

- Allow wood to acclimate to an in-service moisture content during construction or use engineered wood products
- Detail building enclosures and finishes to compensate for perpendicular-to-grain shrinkage
- Use a continuous rod tie-down system with a shrinkage compensation device to limit differential deflection and avoid wall separation due to wood shrinkage under wind and seismic forces
- Include an expansion joint in the cladding
- Provide for movement in the mechanical systems
- Provide for enough movement around windows and doors so finishes remain intact as the structure shrinks and finishes expand
- Other areas of concern are horizontal duct runs, piping, non-wood fire wall separations, and cementitious floor toppings

CONCLUSION

Overall, podium construction—specifically in conjunction with light-frame structural systems—can lead to lower costs, simpler installation, and greater value for both occupants and owners. Podiums allow for the incorporation of amenities such as pools, gyms, and parking garages, as well as retail spaces and offices, maximizing limited urban space without sacrificing quality of life. Understanding code, as well as different podium configurations and material options, enables design teams to devise innovative yet practical building solutions that can help address the growing need for affordable, amenity-rich, high density urban housing. ■

MINI CASE STUDY 1: WREN

PHOTO CREDIT: Kevin C. Korczyk / K2 Creative LLC | ARCHITECT: Togawa Smith Martin

PHOTO CREDIT: Gary Leonard | ARCHITECT: Togawa Smith Martin

Location: Los Angeles, California
Architect: Togawa Smith Martin
Developers: Mack Urban, AECOM Capital, Capri Capital Partners, LLC, Architect
Structural Engineer: Englekirk Structural Engineers
Civil Engineer: KPFF Consulting Engineers
General Contractors: Morley Builders, Tishman Realty & Construction

Wood Use and Podium Design
WREN, a 362-unit multifamily housing community, was the first phase of a development in Los Angeles's South Park that eventually helped to create 2,000 more rental units for the district.

WREN is Los Angeles's first Type III double-podium design and is comprised of two seven-story, light-framed wood buildings.

Key Challenges and Solutions
Ambitious density targets were a major challenge for architects Togawa Smith Martin (TSM), as the owners requested 195 units per acre. The architects had to achieve this with 85-foot-high buildings, which was unprecedented at the time. Because this was an urban infill project where other buildings increased the amount of nearby shade, there was also a need for larger windows and deeper interlocking units. Location, too, demanded that the structure be able to withstand seismic events.

Wood proved to be a reliable and cost-effective solution; it allowed for the provision of sufficient shear walls while still permitting space for large glass windows. Jay Zapata, TSM's job captain on the project, states, "Wood is a forgiving material, especially during the construction phase, since it allowed us to quickly resolve unexpected issues in the field without compromising our original design. We were able to negotiate lengths and locations of shear panels with our structural engineer to quickly direct our general contractor and their subs."

Lessons Learned
Zapata further notes that meeting code was not an issue. The 2015 International Building Code permitted multiple levels without code modification, which in the case of WREN, led to greater density. The use of wood also permitted architects to do more with exterior wall insulation and interior wall acoustics. Overall, Zapata maintains, "Wood is a material that lets you achieve your design goals without affecting the budget or the time schedule."

MINI CASE STUDY 2: MOTO

PHOTO CREDIT: Michelle Meunier| ARCHITECT: Gensler

Location: Denver, Colorado
Architect: Gensler
Developers: Elevation Development Group
Structural Engineer: Monroe & Newell Engineers, Inc.
General Contractors: Foxworth Galbraith Lumber Company

Wood Use and Podium Design
Completed in 2015, MOTO ("Middle-of-Town") is comprised of six stories, 82,000 square feet, and 64 units.

With four light-frame stories that sit atop a two-level concrete podium, MOTO is a Type V-A structure according to the IBC. The mixed-use building includes an above-ground parking garage and two ground-floor retail spaces.

Key Challenges and Solutions
Aesthetics were a key concern for architects at Gensler. The firm ultimately chose a horizontal aesthetic where cantilevered, stacked floors with cedar soffits offered a warm offset to the raw concrete base and modern industrial look of the building's metal panel cladding. Nick Seglie, senior designer at Gensler notes, "From a design standpoint it was an exciting challenge for us to take a familiar typology and do something new, interesting, and contextual with it."

The urban site also dictated the need for a quick build, with Seglie claiming, "Speed is really the most surprising feature of a pre-built strategy." Prefabricated wall panels, BCI flooring, and ceiling joists that arrived on the job site as needed enabled the contractors to frame each floor in a week and the entire building in less than a month.

Finally, as MOTO complied with code, city officials were collaborative. The building adheres to the NFPA 13 sprinkler standard—even the balconies, because of the cedar soffits, have sprinklers. The soffits were further treated with a fire-resistant sealant, and fire doors and smoke curtains were used at the elevator lobbies.

Lessons Learned
Wood was elemental in the build beyond the structure and cedar soffits. It was also specified for the trellis and pool deck, and pine trees killed by the mountain pine beetle were used for the pine slab doors. Overall, the use of wood in a variety of applications enabled the project to be on time, on budget, and aesthetically innovative.

CASE STUDY 3: THE SOTO, SAN ANTONIO, TX

Artist Rendering Courtesy Lake|Flato Architects and BOKA Powell

First Mass Timber Office in Texas
The Soto, Spanish for a grove of trees or small forest, represents the building's material origin and its location a stone's throw from the San Antonio River. The Soto is a 140,000 square-foot podium construction building consisting of a six-story office building and ground-floor retail. Developed by Hixon Properties and designed by Lake|Flato Architects and BOKA Powell, it is the first phase of an 8.5-acre mixed-use area in San Antonio that will include food and beverage, entertainment, office, apartment, and retail. The Soto is a model of sustainable design. The primary design direction was to provide a unique and beautiful workplace that appeals to tenants, is highly flexible, and incorporates technologies that make the building operationally efficient and sustainable. Soto was the first mass timber office building in Texas, which was made possible by podium construction. Mike Powell of BOKA Powell says, "The podium structure was beneficial from a life safety standpoint and provided additional shear capacity for the mass timber floor system."

A Raised Floor System Allowed Type IV Construction
The project is mixed-use on the ground floor with one level of below-grade structured parking. Constructing the basement, ground floor, second floor, vertical circulation, and office core in concrete provided the needed hourly separation and life safety protection per Code. Having a concrete core also enabled the heavy timber structure to have shear support without adding additional bracing.

One inch of Concrete Topping Solves Combustibility Issues and Adds Acoustical Benefits
To truly showcase the beauty of the mass timber DLT panels on floors three through the roof, the designers incorporated an underfloor air distribution (UFAD) system as part of the raised floor. This completely removes ductwork and electrical/telecom/data raceways from the ceilings. However, one consequence of this system is that it introduces a combustible concealed space, which is not allowed in Type IV construction. To remedy this, the project team reviewed applying 1" of gypcrete over the top surface of the mass timber (DLT) panels with the AHJ and received their approval. This solved the combustibility issue and provided additional acoustical benefits.

The pressurized UFAD plenum for the Soto is only seven inches deep and is therefore not a security concern. It relies on three highly efficient air tower closets per floor that force air through the plenum to condition approximately 25,000 sf of floor area. The reduced floor space for mechanical provides more leasable area and a heating/cooling system that is better performing and much more flexible for future tenant space planning.

Mass Timber Columns Transfer Masonry Loads to the Foundation
The conventional wisdom for heavy timber since the 18th century has been to use loadbearing masonry as the means of supporting timber beams for floors or roofs in multi-story buildings. The Soto flips this means of support by using the mass timber axial loading of the columns as the primary means of transferring masonry loads to the foundation. The spandrel masonry elements are supported on steel lintels that tie into a series of steel tees placed perpendicular to the lintels at each column line. Since a dowel laminated timber (DLT) panel behaves similarly to a one-way concrete system, it has a primary orientation for its capacity in resisting loads.

The panels on the Soto are oriented in the north/south direction, which places the majority of the masonry along its weak axis. This, in turn, requires additional support from miscellaneous steel members to aid in keeping the masonry in place. The building structure is essentially a hybrid structure—concrete, mass timber, and steel. The use of masonry was a contextual material choice in keeping with the industrial character of the neighborhood.

Please watch the following video to see a podium project come to life. https://vimeo.com/352726288

CASE STUDY 4: MARSELLE, SEATTLE, WA

5½-story Podium Design Takes Wood to New Levels
Podium construction using light-frame wood building systems is not new for the Pacific Northwest. But, when developers built the Marselle Condos, they did something new by literally taking wood to the next level. By designing the 160,000-square-foot condominium complex to meet Type III-A construction requirements, they were able to build five and one-half floors with wood over a two-story concrete podium deck. The extra half-story mezzanine added about $250,000 to the construction cost of the building, but the architect and builder estimated that the added height and space increased the value of the complex by $1 million.

According to PB Architects, "citation of the techniques used in its construction contributed to a 2009 change to the British Columbia Building Code, allowing the development of timber-frame medium-rise structures, firmly planting The Marselle in the pantheon of buildings that are part of a worldwide movement to use more cost-effective, greener building materials."

Smart, Speedy
The Marselle is a hybrid concrete and wood structure consisting of five stories of light-frame wood plus a wood mezzanine and six stories of concrete, two of which are above ground. The combination of 'five and one-half over two' made Marselle the tallest modern light-frame wood structure in Seattle.

PHOTO: Matt Todd Photography | ARCHITECT: PB Architects

From the outside, the Marselle looks like a typical 132-unit condominium structure. However, on closer inspection, wood framing added value in a number of ways.

Located just north of the city's downtown core, not far from Seattle's famous Space Needle, Marselle was certified Built Smart™ by Seattle City Light and constructed to meet the Master Builders Association Built Green™ program by utilizing wood as an earth-friendly, energy-efficient building material.

While the environmental recognition was an added benefit, the decision to use wood was primarily a financial one, according to Kory Knudson, vice president of Norcon, NW, Inc. "If the project had been built using all concrete, for instance, it would have cost about 30 percent more. If we had built the entire project out of steel, it would have taken much longer and we would have had to make many energy modifications."

Construction began in August 2007 and was completed in April 2009. Joe Hanley, president of Norcon, NW, Inc., said the use of wood contributed substantially to the speed with which the building was able to be constructed. "The concrete and steel hotel right behind Marselle had a similarly-sized footprint, but floor-by-floor, our framing went up much faster. They had a lot of on-site welding but by using wood, we were able to work through all types of weather."

Code Advantage
Marselle's main distinction lies in the way light-frame wood construction was used to maximize the value of the finished space. Two key code

requirements allowed that to happen. The City of Seattle's 2003 Building Code (SBC), under which the Marselle was built, was based on the 2003 International Building Code (IBC). As is the case with many cities, though, the SBC contains a number of changes adopted by the City of Seattle. One of those changes was that, under the IBC, mezzanines were limited to 33 percent of the floor area beneath. However, SBC allowed five stories of wood construction over two stories of Type I construction plus 50 percent for a mezzanine. Mezzanine levels are not considered floors.

Under the SBC, Type V-A construction allowed a fully-sprinklered 70-foot maximum height for five stories while Type III-A allowed a fully-sprinklered 85-foot maximum height for five stories. Zoning regulations allowed a maximum height of 85 feet. Therefore, the design team took advantage of Type III-A construction by adding a mezzanine level on top of the allowed five-story structure, to fill in the building envelope to the 85-foot maximum zoning height allowed.

The second criteria concerned construction type. According to architect Michael Shreve with PB Architects, "under the 2003 SBC, section 504.2, the allowable height for buildings of Type III-A construction in Group R-2 could be increased to five floors of light-frame wood construction above two stories of Type I concrete construction and an 85-foot maximum height. The two floors of concrete construction were required to be Type I construction with a three-hour horizontal fire rating separating the wood construction from the concrete construction."

"Once built, the top level units would have water views of Seattle's Lake Union," explained structural engineer Panos Trochalakis P.E., S.E., principal with YT Engineers. "For obvious reasons, the developer wanted to take advantage of that."

In looking back on the job, all involved were able to identify the advantages of using wood to frame the five and one-half story over two podium structure.

"Lower construction costs were the number one reason to use wood," said Trochalakis. "Light-frame wood construction is virtually impossible to beat in terms of cost. It's also light, which is a big benefit from a seismic standpoint."

Pre-panelized walls and speed of construction also made a big difference for Marselle's schedule. "If you can install the walls on a building the size of Marselle in less than two weeks per floor, then you lower construction costs significantly," Trochalakis added. "Plus, wood offers quite a few advantages from an environmental standpoint."

Since 2009, Norcon has built several other wood podium structures in Seattle. "But Marselle was different in that it was a five and one-half stories over two; most have been five over one," said Knudson. "We knew at the time this building was unique. Together, we were able to help the developer maximize the potential of the building site. We built a structure that had more value for less money—by using wood."

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