Review of Building Code Approaches for Podium Structures – Western US Examples

BC Advisory Group on Advanced Wood Design Solutions

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Edited by: Conroy Lum

STATUS see Appendix I for background

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SUMMARY

A relatively new building design referred to as a “podium structure” is more readily being constructed in the mid-rise building development industry in western Canada, and to a much greater extent on the west coast of the United States. As a result of previous research conducted on multi-level wood-frame over concrete podium building designs in Canada (refer to previous FPInnovations Technical Review Report from April, 2014), a further research effort has been made to examine the building code applications associated with podium-type structures in the Western United States (US) jurisdictions.

Under the requirements and “special provisions” of the International Building Code (IBC 2012), stacked podium or pedestal type mixed-use projects are typically being designed and constructed using 1-storey of fire-resistive concrete at ground level, with multiple wood-frame levels (3-4 storeys) stacked on top of the upper podium plane. However, in many western US jurisdictions such as the City of Seattle, City of Portland, and many city/county jurisdictions in California, these base-line building code provisions have been modified further to allow podium building designs of greater area, ranging from 6-7 storeys in total height.

Figure 1 7-storey podium buildings on sloping site – UW west campus housing

Having conducted a survey of on-going and completed podium building projects in the metro Seattle area, in conjunction with interviews with various industry stakeholders in the western U.S., the main purpose of this report is to outline the applicable building code requirements for podium building structures, and to further discuss the experience with and examples of these projects, in general. These multi-storey mid-rise buildings are typically of 5-7 storeys in building height, and often entail “mixed-use” occupancies with commercial-type (i.e., retail, restaurants, offices or other commercial

premises) uses on the ground level massing of 1-2 storeys (of fire-resistive concrete construction), with multi-storey wood-frame residential building areas positioned on top of the horizontal podium slab, although other occupancy and construction combinations are also possible.

This report is a continuing study from the initial technical research work and guideline report on podium building design issues published by FPInnovations, entitled “Guideline on Building Code Approaches for Podium Structures”. The findings and results of this companion technical guideline report clearly indicate that podium structures are becoming more and more prevalent in the modern design/construction community, especially in terms of delivering a relatively cost-effective, sustainable and adaptable construction method for mixed-use developments in an urban or suburban setting.

Figure 2 Rendering of 7-storey podium building – UW west campus (Malhum Architects)

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1 INTRODUCTION

This technical report has been prepared at the request of FPInnovations, to provide a further technical resource document on building code approaches for a relatively new building type in Canada; the "podium building" structure. Due to the prevalence of mixed-use podium building designs in the western US, the main focus of this report will be the applicable building code requirements (under the IBC 2012) that permit this type of mixed-construction mid-rise project, and examples/experience with these podium building projects in local north-west jurisdictions (i.e., City of Seattle).

As part of this research effort, the following contacts, meetings and site reviews are acknowledged and were completed from November 2014 to February 2015:

1. Attendance at US WoodWorks conference in Chicago, IL on November 6-7, 2014, entitled "Toward Taller Wood Buildings" which was a good information source and networking opportunity for the contents of this report (presentation materials for this conference are available for viewing at http://www.woodworks.org/education/event-presentations/)

2. Review of applicable building code sections of International Building Code 2012 (IBC 2012) and related document entitled, "2012 Code Conforming Wood Design" relative to "stacked" podium building requirements.

3. Discussions with representatives of the American Wood Council (Ms. Michelle Kam-Biron, Director of Education and Mr. Dennis Richardson, West Coast Manager, Codes and Standards) during conference call on February 9, 2015, to review and discuss the applications of IBC 2012 (and future changes to IBC 2015) relative to podium buildings.

4. Discussions with Mr. Jon Siu, Principal Engineer/Building Official of the City of Seattle Department of Planning & Development, regarding the City of Seattle specific building code requirements related to podium buildings and the impetus for liberalization of these building code requirements in the past 10-20 year period.

5. Discussions with members of Coughlin Porter Lundeen Structural Engineers of Seattle, WA (Mr. Chris Duvall, Ms. Bobbi Fisher and Mr. Ben Frizzell) and on-site visits of multiple on-going podium construction projects in the metro Seattle area (refer to separate section in this report and associated photographs).

6. Discussions with Mr. Joseph Mayo of Mahlum Architecture of Seattle, WA, regarding the design of the recently completed University of Washington West Campus Student Housing projects (refer to separate section in this report and associated photographs).

1.1 Podium Building Defined

A podium is defined as a platform that is used to raise something above its surroundings. In the context of building architecture, a podium design is used to elevate one component (or occupancy) of a project above another (i.e., mixed-use podium building), and can consist of a single podium area with a similar size structure above, or a large podium with multiple structures above. Although multiple building configurations will be mentioned in this report, for sake of simplicity the main podium building

configuration that will be addressed relative to the western US experience, will be a typical 1 or 2-storey commercial podium (IBC Type I fire-resistive concrete construction) with 4-5 storeys of residential occupancy above (of Type III or Type V wood-frame platform construction). Applications for Type IV heavy timber type construction in podium buildings will also be discussed to some extent in this report (also refer to IBC construction categories in Section 2.1).

Figure 3 Completed 6-storey podium building – Kelowna, B.C. (MQN Architects)

For the purposes of this report, the principal building code reference used throughout the report will be the International Building Code 2012 (IBC) developed by the International Code Council, which has been in effect and adopted as the model building code in the western US states, since 2000. In addition, the base-line IBC requirements for podium or pedestal-type buildings have been adopted and modified as part of a "local" building code within such jurisdictions as the City of Seattle, City of Portland and in many southern California jurisdictions, and these will be discussed further in this report to some extent (with specific focus on the Seattle Building Code as an example).

In the Canadian code context, the National Building Code of Canada (NBCC) or provincially-adopted building codes (i.e., B.C. Building Code 2012) are the governing regulatory documents for determining the applicable building construction requirements for buildings, including mixed-use and/or mixed-construction projects. As outlined in the previous research report and discussed herein, a fundamental difference between the Canadian and US building code documents referenced above, is that the IBC incorporates specific provisions for podium building designs, whereas the Canadian building codes typically do not. One specific provision included in the NBCC and provincial building codes is the allowance for below-grade parking garage structures to be considered as separate buildings relative to the building(s) constructed on top, in accordance with the requirements of Article 3.2.1.2. While typical podium building designs in Canada are in the 4-6 storey range (maximum number of wood-frame storeys permitted by NBCC or BCBC up to 18 m building height limit), many jurisdictions in the western US are permitting podium buildings to be constructed up to 7 storeys, or more in some specific cases. Part of the reason for this is that the typical threshold building height limit (in Canadian codes) of 18 m to uppermost storey, has been pushed higher in the IBC as further discussed in this report.

2 BACKGROUND INFORMATION

2.1 Background on the International Building Code (IBC)

The first edition of the IBC was published in the year 2000, and consisted of an amalgamation of the building code requirements referenced in the various regional "legacy" building codes (i.e., BOCA, SBC and UBC) that were applicable in different geographic areas of the USA. Relative to the use of wood-frame construction, when the IBC was first developed and issued wood buildings (Type III, IV and V construction) were effectively permitted to incorporate areas and heights commensurate with the largest buildings referenced for each of these construction types, under at least one of the previous regional legacy codes. In this manner, the new IBC requirements for wood construction were developed to not be more restrictive than any of the predecessor model building codes, in most cases.

Relative to wood-frame or timber construction types, the IBC references three main categories, which could generally be used for the upper podium "superstructures":

Type III – wood-frame construction incorporating exterior walls of non-combustible materials or fire-retardant treated wood (FRTW) having a minimum 2-hour fire-resistance rating (from exterior and interior sides), with 1-hour fire-rated (Type IIIA) floor assemblies/supporting structures or unrated floor assemblies/supporting structures (Type IIIB).

Type IV – heavy timber construction (including cross-laminated timber panels - CLT) incorporating exterior walls of non-combustible materials or fire-retardant treated wood (FRTW) or CLT, and interior structural building elements made of solid or laminated wood without unprotected concealed spaces (including CLT).

Type V – wood-frame construction permitted for all structural elements including structural frame members, bearing walls, floor and roof construction, with fire-rated (Type VA) floor assemblies/supporting structures or unrated floor assemblies/supporting structures (Type VB).

Another IBC construction type that is referenced for podium buildings is "Type I – Fire Resistive" which is effectively cast-in-place concrete or other substantial fire-resistive construction material providing a minimum 2-hour fire-rating for the bottom podium level structural components (3-hour fire-rating typically required for top of podium elevated slab supporting wood-frame buildings above).

As outlined in the "AWC/ICC 2012 Code Conforming Wood Design" publication,

> *Since then (first IBC edition in 2000), allowable building sizes have not changed significantly, although the number of buildings that qualify for unlimited area under the special provisions of Section 507 (Unlimited Area Buildings) has expanded. In addition, special allowances for various building features such as sprinklers or the use of FRTW continue to be added. As a result, size thresholds for wood structures are more often determined by structural considerations than by code-limitations. This may not be the case in the future. Upcoming editions of the IBC will recognize new mass timber products such as cross-laminated timber (CLT) and other advanced engineered wood products. Because of the structural capabilities of mass timber, wood design will be*

better able to take advantage of the generous building sizes permitted by the IBC – greater building heights, commercial loads, and long clear spans will be less likely to preclude it. This means that full environmental, economic, and aesthetic benefits of designing in wood will be available for more buildings.

The general permitted building height and area provisions for buildings are outlined in Chapter 5 of the IBC, and are based on building occupancy and type of construction to be used. It is noted that these "baseline" building height and area requirements can be modified and significantly increased based on specific provisions incorporated in other IBC sections; examples of these that will be discussed further in the report include:

- installation of automatic sprinkler systems to NFPA 13 requirements,
- use of fire-retardant treated wood (FRTW) and/or heavy timber materials, and
- application of special provisions for "stacked" or podium type buildings.

2.2 Special Provisions of IBC for Podium Buildings

It is noted that podium-style building designs are becoming more and more prevalent in the western United States, in major urban centres and suburban areas of metro Seattle, Washington, Portland, Oregon, and several metropolitan areas in the State of California. One estimate obtained by the author indicated that a high percentage (70-80%) of new multi-storey mid-rise residential construction in Southern California consists of podium-type structures, with parking garage and street-front commercial uses at ground level and multiple wood-frame residential levels above.[1] With this demonstrated market demand in the western United States, it is acknowledged that the podium building trend could extend into Canada, if the applicable building codes incorporated specific provisions to better enable podium building designs.

One of the main factors in the evolution of podium building designs in the USA, is the fundamental difference in the applicable International Building Code (IBC) provisions as compared with the model Canadian building code provisions, relative to the construction classification, structural fire protection and building area/height limitations. In summary, the IBC will permit the classification of the 1 or 2-storey ground level podium floor area (typically commercial/parking Type I fire-resistive concrete construction) and upper 4-5 storey "superstructure" building areas (typically residential Type IIIA or Type V wood-frame construction), to be <u>independent of each other</u> relative to the applicable area/height limitations and overall building construction classification.

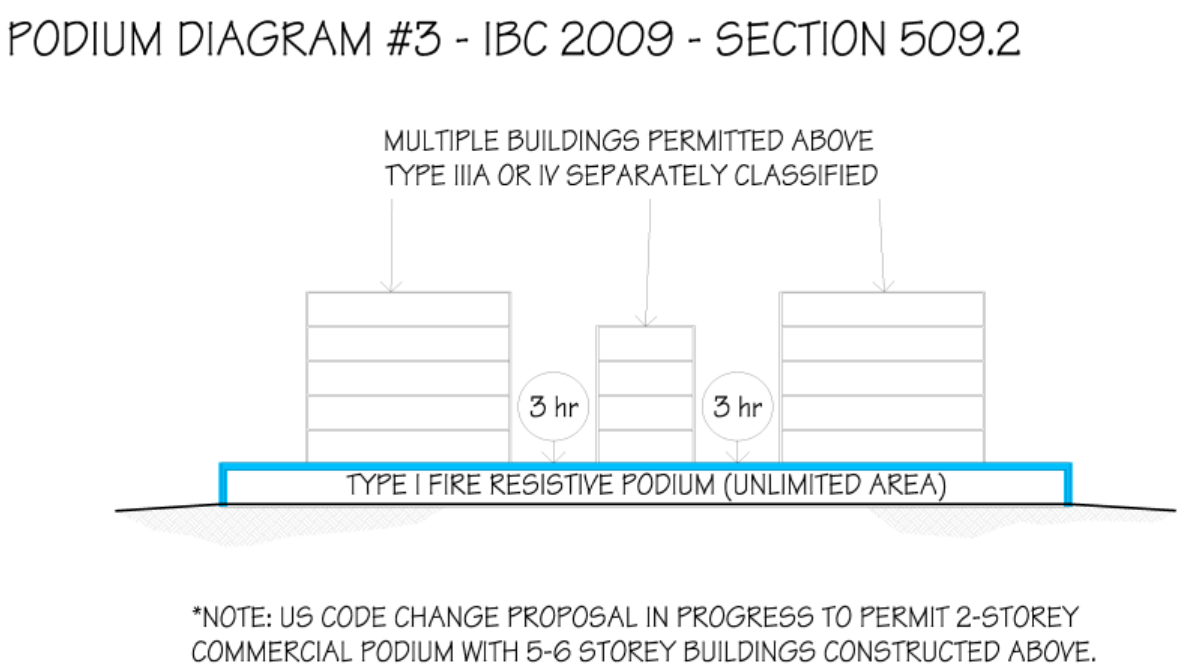
Under these special provisions, the baseline building height and area requirements of IBC Chapter 5 are permitted to be applied separately based on the differing types of construction that are allowed to be stacked on top of each other, in a pedestal or podium design approach as prescribed in detail in IBC Section 510. In this arrangement the lower building area of 1-2 storeys in height is required to be of Type I fire-resistive construction, with the upper building type of construction and building height (in storeys) permitted to be determined separately from the building footprint below.

[1] Discussion with Mr. John E. Younghusband, P.E., Younghusband Consulting, Torrance, California.

With Type I fire-resistive construction, the building (footprint) area of the ground floor area is permitted to be “unlimited” for most occupancy classifications, and a “horizontal firewall” or podium slab interface (typically 3-hour rated concrete fire separation in accordance with Section 510.2 of IBC) is permitted to be used in order to classify the superstructure building(s) above the podium level as “separate buildings” from a construction classification perspective. The explanatory information from this section states, “Section 510.2 essentially allows a 3-hour fire-resistance rated horizontal assembly to create separate buildings similar to the concept used for fire walls. This allowance provides an extensive benefit for height and area in these structures. Buildings constructed under this section are frequently referred to as “pedestal” or “platform” buildings.” In addition to the horizontal podium firewall design, the entire podium structure from foundation up to podium is required to be of Type I fire-resistive construction, and sprinkler protected.

As an example of how the IBC provisions can be extended further using Type IIIA construction for Group R-1 or R-2 (Residential) occupancies, the overall height of the upper podium building areas can be increased to 5-storeys total and 75 feet where superimposed on a first floor assembly (podium level) of Type I construction having a 3-hour fire-rated horizontal floor assembly with lower podium floor areas subdivided by 2-hour rated firewalls into maximum 279 m² compartments. Refer to applicable excerpts from the IBC 2012 as Appendix II to this report for further information.

This lower podium to wood-frame superstructure subdivision can be best described as a “horizontal firewall” approach to compartmentalizing and sub-dividing the major building components of mixed-construction/mixed-use projects. This is a building design concept that is well established and documented in the applicable IBC requirements (Section 510), but is generally lacking in the model Canadian and provincial building codes (i.e., NBCC, BCBC).



It is possible under the applicable IBC requirements, to design and construct a podium building with an "unlimited" building area at the ground plane level (single-storey fire-resistive construction), with a single or multiple superstructure buildings on top, 4-5 storeys of wood-frame construction. The applicable building height limits (measured from the Fire Department entrance elevation or grade level) and building area limits for residential buildings are generally as follows (note that the IBC requires all residential occupancies to be provided with sprinkler protection):

Table 1 IBC height and area limits for residential occupancies with sprinklers meeting NFPA 13R

Group R1, R2 & R4 Residential, Sprinklered Building	Building Height	Building Area
Type VA Construction (1-hour fire-rated wood-frame construction)	60 ft. (18 m) 4 storeys	15,750 ft.^{2} (1,464 m^2)
Type IIIA construction (higher fire-rated wood-frame construction with 2-hour rated noncombustible or FRT wood exterior wall construction)	60 ft. (18 m) 4 storeys	31,500 ft.^{2} (2,927 m^2)

In addition to the above-noted IBC area/height limits, there are also other "allowances" available that permit increased height and increased area, by using more-robust sprinkler systems (e.g. full NFPA 13 vs. NFPA 13R system), which will benefit the ultimate building design. These types of allowances currently do not exist in Canadian building codes, since most building types above 3 storeys are required to be provided with sprinkler protection based on specific NFPA design criteria only. It is noted that these building code modifications or allowances are often applied differently within each state or local jurisdiction; for instance, the California State Fire Marshall typically precludes use of both the IBC building area increases and building height increase for the same project design. However, in the jurisdiction of the City of Seattle the baseline IBC code requirements have been modified to a greater extent in order to allow more flexibility for wood-frame construction in podium building designs provided they meet the same performance levels, as further discussed in Section 3 and Section 4 of this report.

As an example of the IBC building area/height modifications for sprinkler systems, with a Code-compliant NFPA 13 sprinkler system installed in the same residential building categories referenced in Table 1 above, the resulting applicable building areas and heights are as follows:

Table 2 IBC height and area limits for residential occupancies with sprinklers meeting NFPA 13

Group R1, R2 & R4 Residential, Sprinklered Building	Building Height	Building Area
Type VA Construction (1-hour fire-rated wood-frame construction)	60 ft. (18 m) 4 storeys	33,750 ft.^{2} (3,136 m^2)
Type IIIA construction (higher fire-rated wood-frame construction with 2-hour rated noncombustible or FRT wood exterior wall construction)	85 ft. (26 m) 5 storeys	54,000 ft.^{2} (5,018 m^2)

Therefore, with the modification of the building sprinkler system design from an NFPA 13R system to a NFPA 13 system, there are benefits towards the increased height (1 storey) and increased building area (roughly double) of a project relative to the use of wood-frame construction. Although Table 2 above indicates 4 storey permitted building height for Type VA construction, there are specific local examples where Type V construction is permitted up to 5 storeys in building height (in addition to being superimposed above a fire-resistive podium), and this will be discussed further in Section 3 of this report.

2.2.1 Alternate Design Approaches for Podium Buildings

As determined in discussions with representatives of the American Wood Council, it is also noted that Code variance or "alternate design" approaches have been successfully developed and incorporated on large podium building projects in the Western US, to facilitate higher and modified podium building designs, including 2-storey Type I podium construction, and 5-storey Type IIIA superstructure construction (7-8 storey building height total). One example of this has been utilized in the City of San Diego as an "alternate design" proposal for the omission of fire-retardant treated wood (FRTW) in the exterior walls of Type IIIA construction residential projects in this jurisdiction. The proposed alternate design incorporated a number of active fire protection system enhancements in conjunction with architectural design improvements to demonstrate an equal level of safety to the prescriptive requirements of the applicable building code relative to the use of FRTW for these projects.

Many of these alternate design proposals and innovative methods of adapting/ incorporating wood-based construction into mid-rise project types, are also forming the basis for proposed Code changes within the IBC/ICC administrative process. For example, proposed changes to the IBC 2015 are in process, which will effectively permit multi-storey Type I podium structures (having a 3-hour FRR horizontal building "firewall" separation), with separately classified, distinct superstructure buildings (i.e., wood-frame structures) above. The IBC Code change process and some further examples of code changes that have been proposed for future IBC editions are further discussed in the following section of this report.

As previously outlined in this report, the current Canadian code (i.e., NBCC or BCBC) requirements for construction classification, structural fire protection and building area/height limitations are generally more restrictive, and do not incorporate such specific provisions to facilitate podium type building designs. As such, for large podium building designs with building "footprint" areas that exceed the maximum permitted building area of Subsection 3.2.2., or for large podium building structures with multiple wood-frame superstructures on top, architects and developers are required to develop complex alternative solution proposals in order to obtain ultimate approval by the local Authority Having Jurisdiction. Provision of specific podium building regulations within Canadian codes would reduce cost and maintain greater uniformity for acceptable design solutions for these project types. As such, the design/construction industry in general would benefit from the development of specific building code requirements in the model NBCC and provincial building codes, relative to this mixed-construction/mixed-use building type, as it continues to grow in popularity.

2.3 Summary of ICC/IBC Code Change Process Relative to Wood Requirements

Another fundamental difference between the prevailing U.S. model building code (IBC) and the Canadian counterpart (NBCC) that has been discovered as part of this research, is the frequency of the Code change process, in general. In discussions with representatives of the American Wood Council, it was confirmed that the IBC Code change cycle is every 3 years (whereas the standard Code change cycle in Canada is typically every 5 years). However, during the typical IBC 3-year Code change cycle, it is also possible to develop and introduce "Code Change Supplements" or "Automatic Alternate Means" at the State level. Further information on the ICC/IBC Code change process can be found at: http://www.iccsafe.org/cs/codes/Documents/misc/CodeDevelopmentProcess.pdf

As examples of some recent and in-process Code change proposals that have been submitted, the following summarizes recent proposals for the soon-to-be published IBC 2015, or the next edition IBC 2018 (refer to the proposed Code changes and associated text included as Appendix III to this report):

G133-12 relative to Section 510.2 for stacked or podium buildings:

This Code change proposal to the IBC 2015 has proposed to remove the specific requirement for the lower podium building component to be limited to one storey above grade plane, which would result in the lower podium building being permitted to be any number of storeys in height, provided that the total permitted building height is not exceeded.

G134-12 relative to Section 510.2 for stacked or podium buildings:

This Code change proposal to the IBC 2015 has proposed to remove the specific occupancy references for the lower podium component and effectively allow any occupancy within the lower podium building to be permitted, with the exception of Group H (Hazardous) occupancies.

New Proposed Change to Section 510.2 to permit Type IV HT construction:

This new Code change proposal to the IBC 2018 is proposing to permit the building area located below the horizontal assembly forming the podium level, to be either Type IA fire-resistive or Type IV heavy-timber construction protected as required in Table 510.2. This proposed Code change is primarily related towards the continued interest of using cross-laminated timber and other heavy-timber structural systems in new building design, and the fire-resistance requirements relative to achieving a 3-hour horizontal podium and supporting structural fire-rating, are specified by the number of 16 mm type X gypsum board layers needed to encapsulate these mass timber elements to achieve the necessary fire-ratings. It is understood that this proposed Code change will be considered and voted on as part of the IBC 2018 review cycle.

New Proposed Change to Section 510.12 to permit Type IV HT construction:

This new Code change proposal to the IBC 2018 is proposing to permit the building height of Type IV heavy-timber construction for Group R-1 and R-2 Residential occupancies, to be increased to 9-storeys and 100 ft. (30 m) provided that the criteria of Items 1-5 of the proposed change are met. This proposed Code change is primarily related towards the continued interest of using cross-laminated timber and other heavy-timber structural systems in new building design, and the fire-resistance requirements relative to achieving the required degree of structural fire resistance and fire separation, are specified by the number of 16 mm type X gypsum board layers needed to encapsulate these mass timber elements to achieve the necessary fire-ratings. This proposed Code change also requests that this change be applied for use in stacked or podium building designs, as outlined in Item 5 of this document. It is understood that this proposed Code change will be considered and voted on as part of the IBC 2018 review cycle.

New Proposed Change to Section 504.4 to change allowable number of storey:

This new Code change proposal to the IBC 2018 is proposing to modify Table 504.4 “Allowable Number of Storeys Above Grade Plane” relative to the total number of full floor areas (or storeys) that can be constructed within the permitted building height. The proposed change is not intended to increase the overall building height, but is intended to allow additional storeys within the overall building height (where possible) instead of mezzanines, which are often used to manipulate the total building height as they typically do not contribute to the allowable floor area or number of storeys determination. It is understood that this proposed Code change will be considered and voted on as part of the IBC 2018 review cycle.

It is noted that further information, illustrations and examples of Code change proposals can be found on the following website: http://www.awc.org/Code-Officials/2015-IBC-Code-Changes/

Figure 4 7-storey podium buildings under construction – Capitol Hill area, Seattle, WA

3 PODIUM BUILDING CODE REQUIREMENTS – CITY OF SEATTLE

As outlined in the introductory section of this report, the author conducted interviews, research and site visits in the jurisdiction of the City of Seattle, Washington, in order to obtain specific examples and experience associated with the growing podium building design/construction industry in the Pacific Northwest of USA. The City of Seattle is a good example of a geographic location where readily available local forest products, steady population growth, progressive urban planning and building regulation policies and increasing skills of building designers and constructors, is resulting in the "state of the art" application of US podium building design in the city. In urban centres and outlying suburban areas such as Ballard, Belltown, Capitol Hill and the University of Washington campus, excellent examples of podium building designs have been completed and are currently being constructed (these will be discussed and reviewed further in Section 4 of this report). The contents of this section of the report were primarily obtained during discussions with Mr. John Siu, Principal Engineer/Building Official with the City of Seattle Department of Planning & Development.

The evolution of podium building design in the City of Seattle has mainly occurred over the past 15-20 years, and started in the 1980's when the City permitted 5-storey wood-frame residential construction as a specific Seattle Building Code (SBC) provision. Due to the geographic location and topography of Seattle, often these multi-storey wood-frame construction projects were being built on sloping site conditions that necessitated multiple levels of concrete foundation substructure with multiple levels of light wood-frame construction above, resulting in the beginnings of the "stacked" or podium building

design concept. According to Mr. Siu, many wood-frame residential or other construction projects in Seattle are located on sloping sites whereby the total number of storeys measured along the slope, can actually exceed the tabular number of storeys permitted. These early podium designs were the impetus for alternate design proposals and future Code modifications and/or changes within the City of Seattle (and State of Washington) as further outlined below. Mr. Siu also mentioned that the advent and provision of automatic sprinkler protection within these building types, provided a higher comfort level with respect to the overall level of fire safety for the completed buildings, and this played a big role in allowing further increases and flexibility in the SBC requirements as they evolved.

The City of Seattle has the legal ability to modify its building code and other city regulations (much like the City of Vancouver, B.C.), provided that the resulting code modifications effectively achieve the same level of building performance and does not reduce the overall level of safety from a “big picture” perspective. Therefore, in modifying its own building code, the City of Seattle has incorporated numerous “trade-offs” and alternate means for podium building designs, in order to arrive at a level of safety deemed to be acceptable to the public by government officials. As an example, the City of Seattle was one of the first west coast jurisdictions to “liberalize” or modernize the occupancy types permitted in the ground level podium areas of a Project, as the previously applicable versions of the Uniform Building Code (UBC) in Seattle allowed podium construction, but with limitations on occupancy type and mix in many cases. Part of this code change process also recognized the capability and well-equipped resources of the Seattle Fire Department, to provide effective fire suppression and response efforts for these higher wood-frame building types.

During the 1990’s, the SBC permitted podium building designs of ‘5 over 1’ (or 5+1) classification, meaning 5-storeys of light wood-frame Type III or Type V construction over 1 storey of Type I fire-resistive construction. As the Uniform Building Code (UBC) became phased out and the first edition of the IBC 2000 was issued, the City of Seattle conducted extensive reviews of their building code and did not adopt the new IBC immediately. Eventually, the City of Seattle modernized their local building code (based on the IBC 2003) with local modifications and provisions to enable more flexibility and higher use of podium building designs.

According to Mr. Siu, the City of Seattle Planning Department were leaders who drove the building code change process relative to podium building designs to a large extent, as they foresaw this building type as being a good model for sustainable, mixed-use design in the various urban and suburban geographic areas of the city. In addition, the mixed-construction podium design model was already being used as a typical solution for the challenging sloping site conditions on many projects. As the podium building design scene continued to evolve in Seattle, the city again modified the local SBC regulations to move from 5+1 to 5+2 construction (i.e., 5-storeys of wood-frame over 2-storeys of fire-resistive construction), since the city planners and developers were interested in realizing a greater mix of commercial/business uses within the street-level podium base of these urban setting projects. The ‘5 over 2’ podium design with a building height of 85 ft. (26 m) measured to the roof level, has quickly become the norm for mixed-use mid-rise development around the city, with combination of commercial/business occupancies on the lower podium levels and non-market residential occupancies (apartments) on the upper wood-frame storeys.

When reviewing the SBC 2012 relative to Section 510, “Special Provisions” it is noted that local modifications to the baseline building code requirements have been made to facilitate the podium building design concepts described above, as follows:

- height of building areas located below the horizontal (podium) assembly has been increased from one storey to two storeys,
- height of entire structure has been increased to seven storeys above grade plane, with the highest occupied floor level not exceeding 75 ft. (23 m) above the lower fire department access level,
- mixed occupancy types permitted below the horizontal (podium) assembly with the exception of Type H (Hazardous) occupancies, and
- wood stairs are specifically permitted to be used in the enclosed exit stair shafts above and below the horizontal podium assembly.

The building height increases adopted by the City of Seattle during the code change process were largely in consideration of the proven performance of automatic sprinkler systems, and the capabilities of the Seattle Fire Department in responding to a wood-frame structural fire condition.

Further details/information regarding the construction types employed in SBC Section 510 podium building designs and project examples will be provided in the following section of this report.

Figure 5 7-storey student residence podium buildings at University of Washington west campus

Figure 6 7-storey student residence podium buildings at University of Washington west campus

4 EXAMPLES OF PODIUM BUILDING DESIGNS – SEATTLE EXPERIENCE

This section of the report will provide an overview of various completed and on-going podium building designs and construction techniques that are being implemented in the City of Seattle, including specific project examples in the Ballard, Capitol Hill and University of Washington West Campus vicinities. All of these project examples are located within the jurisdiction of the City of Seattle and were reviewed/permitted under the City of Seattle Building Code. Specific acknowledgements for the information on these project examples and access to the construction sites are given to Mr. Chris Duvall of Coughlin Porter Lundeen Structural Engineers and Mr. Joseph Mayo of Mahlum Architecture, Seattle, WA.

4.1 Completed Podium Projects Around Seattle

Figure 7 and Figure 8 below show recent examples of mixed-use mid-rise commercial/residential podium buildings, consisting of a 1-storey fire-resistive podium base with a 5-storey residential building component above, completed in the Ballard area of Seattle. This is a typical example of a podium style building constructed in accordance with the requirements of the Seattle Building Code (SBC), using wood-frame construction (Type V-A) for the upper residential levels and a concrete podium level (Type I) containing different types of commercial occupancies (i.e., mercantile, personal service and assembly with maximum occupant load restriction of 300 persons per “unique” SBC limitation – not typical in other model building codes).

Figure 7 Completed 6-storey podium building design – Ballard area, Seattle, WA

Figure 8 Completed 6-storey podium building design – Ballard area, Seattle, WA

The various podium building designs observed within the urban and suburban areas of greater Seattle are typically 6-7 storeys in total building height and primarily consist of mixed-use commercial occupancies on the lower 1-2 floor areas, with rental apartment type residential occupancies (Group R-2 under the IBC Occupancy Classifications) located on the upper floor areas. Much of the new housing inventory within the greater Seattle area is being provided in this manner, with new apartment rental housing out-supplying new market (condominium) housing to a large extent for the past 10 years.

In addition to the total building height of 6-7 storeys for typical podium building designs, new projects are now starting to incorporate a further occupied roof deck area and amenity space construction at the roof level (limited area/occupant load), which is extending the height of these wood-frame buildings further. Mr. Siu indicated that this design direction is the next building code challenge that they are currently examining, with potential future changes to the SBC forthcoming to address roof level construction as a result.

One other commonality in the design of mid-rise podium buildings around Seattle, is the use of typically non-combustible type exterior cladding systems, including brick veneer, metal/aluminum panelling and “rain-screen” insulated exterior plaster finishing systems, in general (combustible cladding typically not used).

4.2 Completed and On-going Podium Projects at UW West Campus

Figure 9 and Figure 10 below show two examples of the new mixed-use mid-rise podium buildings, consisting of a 2-storey fire-resistive (Type I) podium with a 5 storeys of residential floor areas above (7-storeys total), as part of the recently completed University of Washington Student Housing project located in the western portion of the UW campus. The buildings shown in Figure 9 are part of the Mercer Court Apartments completed in 2010, and Figure 10 is the more recently completed Poplar Hall Student Housing complex completed in 2012.

Figure 9 7-storey podium building on sloping site – UW west campus housing

This section of the report will describe the background on how the decision to use podium style construction was made for these projects, and some of the unique architectural features that were possible due to this type of construction being implemented for these projects. Based on the author's informal survey of numerous podium style projects completed around the greater Seattle area, the student housing buildings located at the UW West Campus are certainly the finest example of "state of the art" for this particular building type.

Relative to market needs, these projects came about as a result of the growing demand for new "on campus" student housing, which UW was lacking in. This factor was effectively having an impact on enrolment at the university, since the current trend is that students want to be able to live in the campus environment that they are studying in. Based on this need and the available capital budgets to create a new student housing "commons" on the western portion of the campus, the university and their advisors identified the "5 over 2" podium type construction model as the most cost-effective, flexible and sustainable method of delivering the approximately 1,700 new student housing units that were required in a relatively short time-frame.

Due to the unique requirements incorporated in the Seattle Building Code (applicable code for UW) and the availability of local forest products, lumber and timber elements for the wood-frame components, these projects were estimated to be constructible for under $200 per sq.ft., and this was the main deciding factor in all of the new student housing buildings proceeding with this type of construction. Again, based on the unique SBC provisions for stacked mixed-use buildings, the standard "5 over 2" configuration using Type V-A wood construction over Type I fire-resistive construction was adopted in the design and construction of these projects. As seen in the photographs of completed buildings, this was not a compromise solution relative to the use of wood-frame construction, since the finished

projects resulted in functional and aesthetically pleasing modern architecture, that offer excellent examples of the possibilities for podium building design for the future.

Figure 10 7-storey podium building on sloping site – UW west campus housing

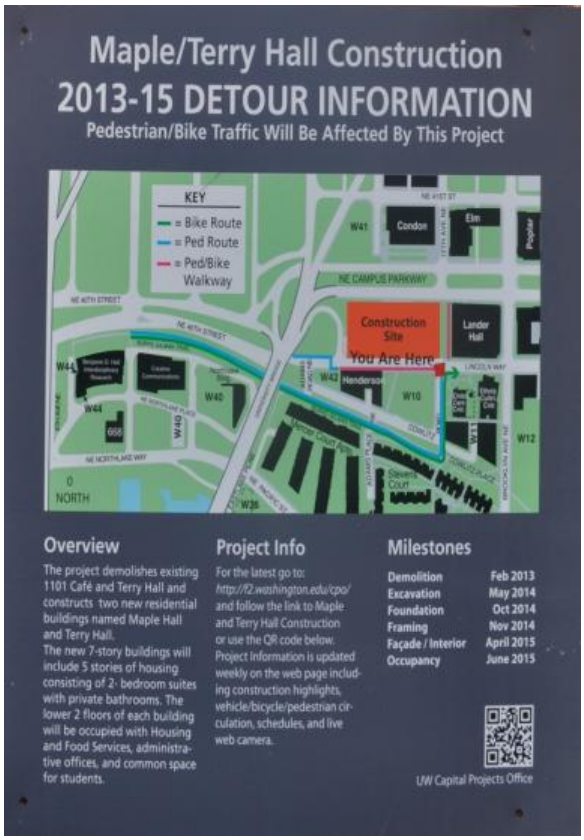
It is noted that due to the topography of the west campus areas, many of the new student housing buildings were constructed on sloping site conditions that lend themselves to podium building construction techniques, since the concrete substructure forms both the building foundation system (in contact with grade) and the lower superstructure as it extends above grade around the project perimeter. In addition, the architects/engineers of these projects skilfully utilized the lower concrete podium levels to respond to the localized grade/plaza areas around the building perimeter, to create dynamic architectural features and articulations to add visual interest and activity to the building elevations.

Another main reason that wood-frame/timber based construction systems were selected for the upper superstructure of the project, was for the “cost transfer” benefits of going with a relatively low-cost structural system, which allowed higher construction budget allocations for other aspects such as high quality exterior envelope/cladding systems (as seen in Figure 11 below). In general, an in-fill type exterior bearing wall approach was utilized in the structural design of the project, such that greater design flexibility, cost-effectiveness and thermal insulation strategies could be realized. Interior wood-frame/timber wall systems were the primary vertical loadbearing and shear elements in the structural design, with the exception of some corner locations where the architectural design necessitated load-bearing elements to be provided. Seismic design considerations and details incorporated stacked shear walls and main load-bearing walls for loading in transverse directions, lateral interior corridor shear walls and staggered wood-frame party walls (2x4 studs on 2x6 plates) incorporating floor-to-floor all-thread hold down rods and multiple 2x6 compression studs in strategic wall cavity locations.

a)

b)

Figure 11 Completed 7-storey podium buildings – UW west campus housing, Seattle, WA



a)

b)

c)

Figure 12 New 7-storey podium building under construction at UW campus (Maple/Terry Hall in west campus area)

Another interesting feature of these projects from an exterior detailing perspective is the use of extensive brick veneer cladding systems along with the level of articulation incorporated in specific areas of the building design (i.e., corner setbacks). All of the recently completed and under construction student housing projects incorporate extensive brick cladding systems on the exterior due to the attractiveness and durability of these materials over time. In order to accommodate this, careful sizing and detailing of the exterior wall framing systems was conducted to carry the additional loads imposed by the multi-level brick cladding systems. The brick cladding and support systems were detailed to provide exterior veneer ledger angles at each floor level (tied back to a structural rim board at each floor) with further detailing/execution of building movement and envelope details to address the dynamic aspects of the exterior skin of the building over time. The end result is a horizontal expression of these cladding system details as part of the exterior architectural appearance of the integral brick cladding for the completed buildings.

The use of a fire-resistive podium structure at the ground level floor areas of the project (Level 1-2) also provided interesting opportunities for creative design of the mixed-use occupancies and spaces directly relating the ground plane areas of the site. In many locations, concrete overhangs, projections and high-ceiling outdoor covered areas were created to provide visual interest and useable outdoor spaces for the occupants of the buildings. Internal open-air courtyards with covered tunnel-like entrances accessed through gaps in the building façade are implemented in the design to provide semi-enclosed private gathering spaces for students. The concrete podium levels of the project also incorporate numerous mixed-use functions not just including typical mercantile occupancies, but also including many of the “student commons” functions including cafeteria spaces, amenity rooms, lounge study spaces and academic support uses. The positioning of these high-hazard and higher occupant load functions within the fire-resistive podium areas of the buildings is appropriate and logical from a fire safety and functional use perspective. Due to the fact that the SBC limits the occupant load of Assembly type occupancies within the podium floor areas of buildings to 300 maximum, alternative approaches to building code compliance were utilized to address specific areas that exceeded the aggregate occupant load (a building code restriction that is unique to Seattle).

As shown in Figure 12 above, the University of Washington continues to build on the previous success of the West Campus Student Housing project, with the ongoing construction of the Maple/Terry Hall complex in the south-west corner of the housing site. This project is typical of the other student housing projects constructed in the area, consisting of five storeys of Type V-A wood-frame construction over two storeys of Type I fire-resistive construction. Based on the on-going construction and occupancy of these podium building types at the University of Washington campus, it is concluded that podium type construction can be seen as a cost-effective, functional and successful method of meeting housing needs for the future, in all residential building categories.

4.3 On-going Podium Projects Under Construction in Seattle

As mentioned previously in this report, there are numerous examples of podium style buildings under construction in the greater Seattle area, and one of the specific locations where these new mid-rise

projects are being constructed in a relatively dense urban setting, is the Capitol Hill area due east of downtown Seattle.

Figure 13 New 7-storey mixed-use podium project in Capitol Hill, Seattle

Figure 14 New 7-storey mixed-use podium project in Capitol Hill, Seattle

As shown in Figure 13 and Figure 14 above, the Capitol Hill area is an existing historic district of Seattle where many existing building sites are being redeveloped from 1-2 storey mercantile or light-industrial (i.e., repair garages) into modern mixed-use mid-rise projects. Due to a strong local community movement and City of Seattle Planning Department guidelines, the street-level exterior facades of the existing buildings are required to be retained, preserved and incorporated in the new developments in order to maintain the existing "streetscape", and this can be seen in the construction photo and rendering of the completed project above.

This project is located at the northwest corner of Pike Street/Boylston Avenue and encompasses approximately one-half of the entire city block in this area. Another similar podium type project is also under construction on the other half of the same city block, located at the southeast corner of Pine Street/Harvard Avenue and the proximity of the two construction sites will be examined further below.

Figure 15 New podium building wood-frame construction details

Figure 16 New podium building wood-frame construction details

Construction of these new mixed-use commercial developments are similar in arrangement, material and area/height as the UW West Campus housing projects, and generally consist of 1-2 storey Type I fire-resistive concrete podiums with 5 storeys of Type VA with some Type IIIA wood-frame structure for the upper residential floor areas. Type IIIA wood-frame construction utilizing fire-retardant treated wood (FRTW), heavy timber members (in lieu of FRTW as permitted in the Seattle Building Code - SBC), and noncombustible exterior gypsum board membrane (i.e., Densglass gypsum board) was typically used in exterior wall construction where zero lot line or reduced spatial separation conditions required, again under the requirements of the SBC. Structural/seismic design conditions are also similar to the UW West campus housing projects with details incorporating stacked shear walls

and main load-bearing walls for loading in transverse directions, lateral interior corridor shear walls and staggered wood-frame party walls (2x4 studs on 2x6 plates) incorporating floor-to-floor all-thread hold down rods and multiple 2x6 compression studs in strategic wall cavity locations (refer to Figure 16 above as an example).

Figure 17 New 7-storey podium building under construction (note existing façade)

Other examples of unique design features that are incorporated in the on-going construction of this project include:

- Use of wood-frame vertical shafts including elevator shafts and stair shafts within the upper residential floor areas of the project, which is typically permitted and utilized in Seattle as a means of avoiding differential movement/shrinkage of materials over the life of the building,
- Use of wood-frame stair construction within the overall vertical stair shaft system (not just wood-frame levels) as permitted under the SBC, and
- Installation of roofing membrane and build-up materials to form extensive green roof and hard/soft landscaped rooftop amenity areas for building residents. As mentioned previously, this is a recent design trend that is pushing podium buildings beyond 7-storeys within the City of Seattle.

Figure 18 Exterior wall details of typical podium building designs in Seattle area

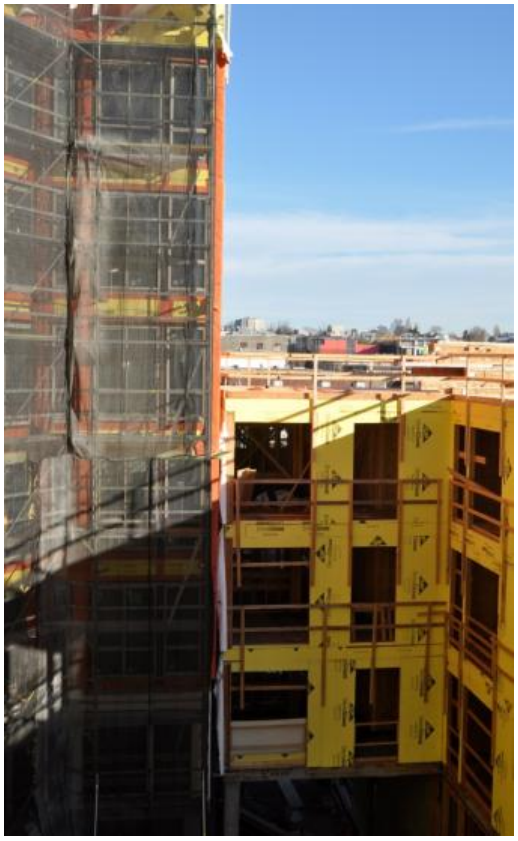


Figure 19 Exterior wall details of typical podium building designs in Seattle area

Figure 20 Exterior wall details of typical podium building designs in Seattle area

The previous photographs (#18-20) show some of the unique details that have been developed and are exclusively used on the podium building designs that are executed in the City of Seattle. Specialized angle brackets, tie-back anchors and exterior wall deck support brackets are shown in the "mock-up" construction system that was built off-site for architect/engineer review and approval purposes. These specialized hardware, bracket and anchoring systems are an integral component of the structural/seismic design of these multi-storey wood-frame building designs, and it was mentioned that in many cases customized steel bracket or hanger details are required to be developed for the unique conditions that arise from arise from various design conditions.

Two other unusual aspects of these podium building designs as permitted under the applicable Seattle Building Code requirements, is the use of wood-frame wall systems for the purpose of achieving "firewall" and zero lot line spatial separation walls to adjoining properties. Due to the overall size of the Type VA wood-frame podium levels, the building is required to be subdivided into smaller building areas for the purposes of compliance with the area requirements of the SBC. The 3-hour rated firewall construction utilized on the wood-frame levels consists of wood-frame structural walls having multiple layers of 5/8" type X gypsum board in order to achieve the required fire-resistance rating. Similarly, as shown in Figure 19 above, the proximity of the east and west exterior walls at the property line between two separate developments on this city block, requires the provision of 2-hour rated exterior walls, which are permitted to be of wood-frame construction with multiple layers of gypsum board on the interior face to achieve the required level of protection between buildings.

Figure 21 Typical wood products for podium buildings before installation (floor assembly)

5 CONCLUDING REMARKS AND RECOMMENDATIONS

This technical review report has been prepared at the request of FPInnovations, to provide an overview of the experience with and examples of the "podium building" structure as it has evolved in the United States of America, and specifically in the Western USA. It is noted that this building typology is unique

to the majority of conventional building types in Canada, however podium building designs have become more regularly adopted in many western US cities such as Seattle, Washington, Portland, Oregon and many urban centres in California. As part of the research for this technical review report, site visits to multiple completed and under construction podium building projects in the greater Seattle area were completed, and it is concluded that this building type has been accepted by the design/development industry and the general public, as an attractive, cost-effective and sustainable method of delivering mixed-use mid-rise building designs in these urban and suburban settings.

One of the main observations and conclusions of this report and previous reports is that modern building codes in Canada do not classify or distinguish podium buildings as a separate building type, which has some disadvantages relative to the development and evolution of the podium building design market in Canadian urban centres where mid-rise housing is in demand. As a point of comparison, it is interesting and important to note that International Building Code incorporates multiple construction classification, building area and height requirements which allow and facilitate podium building designs of greater height and size, in general terms. For instance, the IBC permits a single-storey podium level of Type I fire-resistive concrete construction (with sprinkler protection and 3-hour podium interface above) to be "unlimited" in area, with multiple superimposed wood-frame buildings above. This type of podium building design is generally not permitted under the Canadian building codes, without the use of firewall subdivision strategies and/or complex alternative solution approaches being incorporated in the design. The main difference that limits the application of podium design strategies in accordance with Canadian building codes, is that the "building area" (footprint) is the reference point for the entire building design (under superimposed major occupancy requirements of Articles 3.2.2.4. to 3.2.2.7. This effectively limits the use of multi-level wood-frame construction where used in mixed construction podium building projects, since the combustible construction building areas are more restrictive than the non-combustible building classifications.

In the City of Seattle, the podium building regulation and design industry has evolved even further under the Seattle Building Code, which permits the use of 2-storey fire-resistive concrete podium construction (containing mixed commercial, retail, assembly or personal service occupancies) and up to 5-storeys of wood-frame construction (Type III or Type V) containing residential occupancies typically. As the Seattle Building Code has evolved and added new provisions to allow more flexibility and practicality relative to the use of wood/timber materials on podium building designs, the industry continues to challenge the Code regulators with new design concepts and directions that will be addressed as new Code provisions and/or alternative means of compliance. Many of the building code provisions and unique approaches adopted within the Seattle Building Code, have led the charge for future change and modernization of wood product related building code requirements at the model Code level (i.e., International Building Code).

In addition to the above factors, it is concluded that the installation of automatic sprinkler systems for hybrid construction, mixed-use podium structures such as those surveyed and discussed in this report, have a significant positive impact on the overall level of fire protection, life safety and property protection of the completed projects. While the current building codes developed in Canada do provide some "credit" for sprinkler protected buildings, it is concluded that the benefits of varying types of sprinkler protection for podium building designs should be examined further in terms of the applicable building area/height limits that are currently referenced (but do not actually contemplate or address

hybrid or mixed-use building designs). The current International Building Code requirements are a good example of how sprinkler protection (and other factors) are reflected well in determining the construction classification criteria, to better address and facilitate podium building designs with wood-frame superstructures above a horizontal podium interface level.

This technical guideline report has reviewed, discussed and highlighted the building code aspects of podium type structures as they have evolved in the western US, with the main conclusion that these podium building designs have become readily accepted by industry and the public for “mixed-use” mid-rise urban and suburban development projects. The benefits of wood-frame/timber construction used in conjunction with a noncombustible concrete ground level podium structure, make these building types a cost-effective, feasible and sustainable model for mid-rise structures incorporating multiple occupancies, as demonstrated in the numerous project examples mentioned in this report.

The other main conclusion of this report is that podium structures are worthy of promoting and advancing further in the Canadian design, construction and regulatory communities, including a recommendation for developing and implementing a National Building Code change proposal (or proposals) to facilitate podium building designs within Canada in the future. Specific items to investigate further in this context would be the effectiveness of suspended horizontal building assemblies (either fire-resistive concrete or mass timber panels) in creating the necessary “podium interface” between the lower podium building component and multi-level wood frame construction above, and the relationship of wood-frame superstructure building height (as measured from top of podium) versus the total building height measured from grade level.

6 REFERENCES

International Building Code 2012, International Code Council, Washington, DC

2012 Code Conforming Wood Design booklet, American Wood Council/International Code Council, Leesburg, VA/Washington, DC

Seattle Building Code 2012, City of Seattle Department of Planning and Development, Seattle, WA

Case Study of UW West Campus Student Housing brochure, WoodWorks.org

Standard for the Installation of Sprinkler Systems, NFPA 13 - 2007, National Fire Protection Association, Batterymarch Park, MA

Appendix I Guideline Review Ranking System[1]

The following ranking system has been developed to monitor the status of the wood building design guidelines[2] maintained by the BC Advisory Group on Advanced Wood Design Solutions (AGW):

RANK	DEFINITION
#	This is a draft document this is being circulated for review and comments.
A	This guideline is new and represents the best available evidence at this time. It will be periodically reviewed to determine if it remains current.
B	This guideline was last reviewed on the date indicated and there have been new studies published since the guideline was developed. However, the AGW determined that these studies are not sufficient to warrant changing the guideline. The information contained in this guideline provides the user with the best evidence available at the time the guideline was published. Readers are encouraged to search the current literature as a supplement to using this guideline.
C	This guideline was last reviewed on the date indicated. As a result of that review, the AGW determined that new studies have been published that warrant an update of the chapter/section of this practice guideline. The AGW also determined that the remainder of the chapters/sections does not require updating and these recommendations remain current.
D	This guideline was last reviewed on the date indicated. As a result of that review, the AGW determined that new data are available that are sufficient to potentially change guideline recommend and a full revision is warranted.
E	This guideline was last reviewed on the date indicated. As a result of that review, the AGW decided it is outdated; however, it has been retained for historical and/or educational purposes. These guidelines should be used with caution for design purposes.

[1] This list was adapted from the Canadian Thoracic Society Policy and Evidence-Based Medicine, and the American College of Chest Physicians (ACCP) Guidelines Ranking System.
[2] Check fpinnovations.ca for the latest edition.

Appendix II IBC 2012 Section 510

the building is of nonrated construction (Type IIB, IIIB or VB), the rated construction does not need to be supported by 1-hour fire-resistance-rated construction. In all other instances, the construction supporting incidental occupancy separations must be supported by construction with at least the same rating as the separations.

509.4.2 Protection. Where Table 509 permits an *automatic sprinkler system* without a *fire barrier*, the incidental uses shall be separated from the remainder of the building by construction capable of resisting the passage of smoke. The walls shall extend from the top of the foundation or floor assembly below to the underside of the ceiling that is a component of a fire-resistance-rated floor assembly or roof assembly above or to the underside of the floor or roof sheathing, deck or slab above. Doors shall be self- or automatic-closing upon detection of smoke in accordance with Section 716.5.9.3. Doors shall not have air transfer openings and shall not be undercut in excess of the clearance permitted in accordance with NFPA 80. Walls surrounding the incidental use shall not have air transfer openings unless provided with smoke dampers in accordance with Section 710.7.

❖ Where Table 509 permits protection by an automatic sprinkler system without fire barriers, the construction enclosing the incidental use must resist the passage of smoke. While this section can be viewed as a performance standard, construction details for resisting the passage of smoke are provided in this section. Although the section specifically states that air transfer openings must be provided with smoke dampers, it is silent with respect to ducts. If ducts are penetrating this separation, the arrangement of the duct system should be analyzed to determine if it will allow smoke to pass through the wall and not restrict it to the incidental use.

The wall construction described here is required to be neither a smoke barrier conforming to Section 709 nor a smoke partition conforming to Section 710.

509.4.2.1 Protection limitation. Except as specified in Table 509 for certain incidental uses, where an *automatic sprinkler system* is provided in accordance with Table 509, only the space occupied by the incidental use need be equipped with such a system.

❖ The point of this section is that the sprinkler system stipulated in Table 509 is required for the incidental use only. In general, the nature of these incidental uses is such that they are small areas that are not frequented by the building occupants very often in which a fire could get underway and go unnoticed for a longer time than a part of the building that is constantly occupied.

SECTION 510
SPECIAL PROVISIONS

510.1 General. The provisions in Sections 510.2 through 510.9 shall permit the use of special conditions that are exempt from, or modify, the specific requirements of this chapter regarding the allowable *building heights and areas* of buildings based on the occupancy classification and type of

TABLE 509
INCIDENTAL USES

ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen cutoff rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
Laboratories and vocational shops, not classified as Group H, located in a Group E or I-2 occupancy	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
Group I-3 cells equipped with padded surfaces	1 hour
Waste and linen collection rooms located in either Group I-2 occupancies or ambulatory care facilities	1 hour
Waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterruptable power supplies	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.

For SI: 1 square foot = 0.0929 m^2, 1 pound per square inch (psi) = 6.9 kPa, 1 British thermal unit (Btu) per hour = 0.293 watts, 1 horsepower = 746 watts, 1 gallon = 3.785 L.

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 510.2 through 510.8 are to be considered independent and separate from each other.

❖ The subsections of Section 510 are exceptions to the general height and area limitations of Chapter 5. Most of the subsections address attached parking structures and contain conditions by which these can be attached to buildings without creating hardship in regard to allowable area and height for the building. These allowances are not always related to buildings containing parking below but can involve other uses and occupancies. Also many of these scenarios will be applied such that there may be multiple buildings above the parking garage.

510.2 Horizontal building separation allowance. A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of *fire walls*, limitation of number of *stories* and type of construction where all of the following conditions are met:

1. The buildings are separated with a *horizontal assembly* having a *fire-resistance rating* of not less than 3 hours.
2. The building below the *horizontal assembly* is not greater than one *story above grade plane*.
3. The building below the *horizontal assembly* is of Type IA construction.
4. *Shaft, stairway, ramp* and escalator enclosures through the *horizontal assembly* shall have not less than a 2-hour *fire-resistance rating* with opening protectives in accordance with Section 716.5.

   Exception: Where the enclosure walls below the *horizontal assembly* have not less than a 3-hour *fire-resistance rating* with opening protectives in accordance with Section 716.5, the enclosure walls extending above the *horizontal assembly* shall be permitted to have a 1-hour *fire-resistance rating*, provided:

   1. The building above the *horizontal assembly* is not required to be of Type I construction;
   2. The enclosure connects fewer than four *stories*; and
   3. The enclosure opening protectives above the *horizontal assembly* have a *fire protection rating* of not less than 1 hour.
5. The building or buildings above the *horizontal assembly* shall be permitted to have multiple Group A occupancy uses, each with an *occupant load* of less 300, or Group B, M, R or S occupancies.
6. The building below the *horizontal assembly* shall be protected throughout by an *approved automatic sprinkler system* in accordance with Section 903.3.1.1, and shall be permitted to be any of the following occupancies:

   6.1. Group S-2 parking garage used for the parking and storage of private motor vehicles;

   6.2. Multiple Group A, each with an *occupant load* of less than 300;

   6.3. Group B;

   6.4. Group M;

   6.5. Group R; and

   6.6. Uses incidental to the operation of the building (including entry lobbies, mechanical rooms, storage areas and similar uses).
7. The maximum *building height* in feet (mm) shall not exceed the limits set forth in Section 503 for the building having the smaller allowable height as measured from the *grade plane*.

❖ Section 510.2 essentially allows a 3-hour fire-resistance-rated horizontal assembly to create separate buildings similar to the concept used for fire walls (see Figure 510.2), however consideration as separated buildings by this method is only applicable to a limited number of specified conditions. This allowance provides an extensive benefit for height and area in these structures. Buildings constructed under this section are frequently referred to as "pedestal," "podium" or "platform" buildings. It should be noted that multiple buildings may be located above the horizontal assembly. Structures built under this section are considered to be distinct buildings above and below the 3-hour fire-resistance-rated horizontal assembly. As distinct buildings, they are individually evaluated with respect to allowable building area, the number of stories and the type of construction. In addition, if a fire wall is needed to address building area issues in the upper building or buildings, the fire wall construction can stop at the 3-hour fire-resistance-rated horizontal assembly and does not need to extend to the foundation. However, other building systems and requirements must be evaluated using the total structure. For example, if the upper building is apartments and the lower building an open parking garage, both buildings will need to be protected by an automatic sprinkler system because of the requirement for buildings occupied by Group R occupancies (see Section 903.2.8).

There are seven conditions that set the limits of this design:

1. Separation of upper and lower buildings by a 3-hour fire-resistance-rated horizontal assembly.
2. The building area below the horizontal assembly is limited to having no more than one story above grade plane. There is no limit on the number of basement levels included below the single story above grade plane.
3. The building below the horizontal assembly is of Type IA construction. As such it is allowed to be of unlimited area in accordance with Table 503.
4. All openings through the 3-hour fire-resistance-rated horizontal assembly are to be protected by

a 2-hour shaft (the shaft openings having $1^1/_2$-hour protectives; see Table 715.5).

5. The uses in the upper building or buildings are limited to Group A occupancy uses where each Group A area has an occupant load of less than 300, or Group B, M, R or S occupancies.
6. The building below is allowed to be used exclusively for any of the occupancies listed in Items 6.1 through 6.6 or any combination of those occupancies. While historic versions of Section 510.2 limited the use of the lower building to parking, the provision has evolved to reflect a mixed occupancy setting of urban neighborhoods. The limit of the 300 occupants in Group A occupancies is also reflective of the history of these provisions from the legacy codes, and it reflects the intent of restricting the assembly spaces to smaller businesses so that the assembly use does not dominate the building.
7. The height of the combined buildings above and below the horizontal assembly is limited to the number of feet above grade plane allowed by Section 503 for the type of construction of the upper building. However, the charging language of Section 510.2 does not restrict the number of stories to the entire structure but only to that which is above the horizontal assembly. Thus, a Type VA building, protected by a NFPA 13R sprinkler system and containing a Group R-2 occupancy, can have four stories above the horizontal assembly, provided the overall height of both buildings does not exceed 60 feet (18 288 mm) above grade plane.

This is one of the rare circumstances where there could be two different construction types in a single structure without being separated by a fire wall. It is possible that following the conventional provisions for mixed occupancies in Sections 508.3 and 508.4 would be less restrictive than the conditions of this section. Compliance with the general provisions of Section 508.3 or 508.4 is permissible, and this section should be viewed as an alternative means of compliance with Section 508.3 or 508.4.

There is one exception within the seven items: the exception to Item 4 indicates the conditions by which the shaft construction protecting openings in the horizontal separation may be 1-hour rated above the horizontal separation. This allowance is only for openings connecting a maximum of four stories. This would include the connection to the area below the horizontal assembly (see Figure 510.2).

A common example of a building constructed under the provisions of Section 510.2 is a Type IA building that contains parking at grade level and below, with up to four stories of Group R-2 apartments in a Type VA, wood frame constructed building above the separation (see Figure 510.2). In many city neighborhoods where zoning laws encourage a mixture of uses, the first story is often occupied with retail shops, service businesses and small restaurants. The height of this structure measured in feet is limited by the Type VA upper structure to maximum of 70 feet (21 336 mm) above grade plane. But the number of stories of the Type VA portion of the building is determined by starting at the horizontal separation between the construction types.

510.3 Group S-2 enclosed parking garage with Group S-2 open parking garage above. A Group S-2 enclosed parking

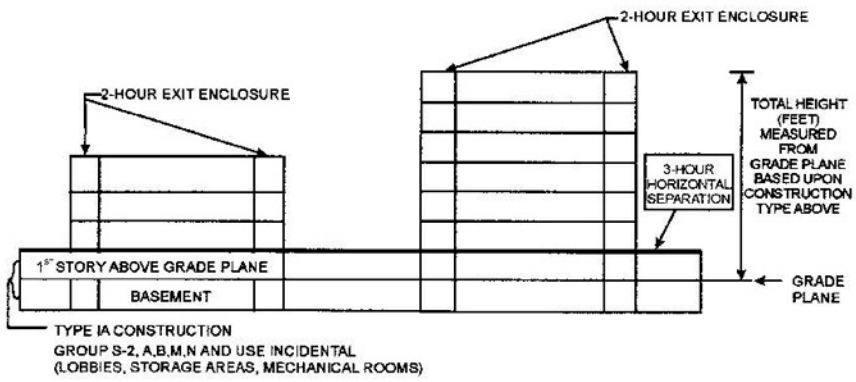


Figure 510.2
HORIZONTAL BUILDING SEPARATION

garage with not more than one *story* above *grade plane* and located below a Group S-2 *open parking garage* shall be classified as a separate and distinct building for the purpose of determining the type of construction where all of the following conditions are met:

1. The allowable area of the building shall be such that the sum of the ratios of the actual area divided by the allowable area for each separate occupancy shall not exceed 1.
2. The Group S-2 enclosed parking garage is of Type I or II construction and is at least equal to the *fire-resistance* requirements of the Group S-2 *open parking garage*.
3. The height and the number of tiers of the Group S-2 *open parking garage* shall be limited as specified in Table 406.5.4.
4. The floor assembly separating the Group S-2 enclosed parking garage and Group S-2 *open parking garage* shall be protected as required for the floor assembly of the Group S-2 enclosed parking garage. Openings between the Group S-2 enclosed parking garage and Group S-2 *open parking garage*, except *exit* openings, shall not be required to be protected.
5. The Group S-2 enclosed parking garage is used exclusively for the parking or storage of private motor vehicles, but shall be permitted to contain an office, waiting room and toilet room having a total area of not more than 1,000 square feet (93 m^2), and mechanical equipment rooms incidental to the operation of the building.

❖ Parking garages of both types, enclosed and open, are addressed in Section 406. Special height and area allowances are given in Section 406.5.4 for open parking structures; however, these special height and area provisions are not applicable if any level of the parking garage does not meet the definition of "Open parking garage" by not having the requisite clear open area to the exterior. This would normally preclude having parking levels below grade in an open parking garage.

Section 509.3 contains provisions that would allow an open parking structure to take advantage of the special height and area limits for open parking structures in Section 406.5.4 while incorporating, in the same building, enclosed parking levels below grade. This is an alternative to treating the whole building as an enclosed parking garage.

There are five conditions listed that must be met in order to use this alternative:

1. Appropriate increases in accordance with Section 506 are to be considered for each portion, and for purposes of frontage increase the same measurement of open perimeter may apply to both the upper and lower garages.
2. The enclosed parking structure below must meet or exceed the fire resistance of the open-parking structure above. At a minimum, the enclosed parking structure must be of Type IIB construction (all noncombustible materials, without fire-resistance-rated protection); however, if the open parking structure above is Type VA, IIIA, IIA or IA, the enclosed parking structure would also have to meet or exceed the required ratings of the building elements from Table 601 for the construction type of the open parking structure.
3. Both the entire height of the building and the number of tiers are limited by Table 406.5.4; therefore, even if the first story above grade is part of the enclosed parking garage portion of the building, the height of the structure above grade plane could not exceed what would be permitted by Table 406.5.4 if the entire structure above grade plane were part of the open parking garage portion.
4. Protection of the floor assembly of the Group S-2 building depends on the construction type and Table 601 for the S-2 enclosed parking garage.
5. Certain accessory uses are permitted to be present when taking advantage of these alternative provisions, such as a small office and waiting area.

510.4 Parking beneath Group R. Where a maximum one *story above grade plane* Group S-2 parking garage, enclosed or open, or combination thereof, of Type I construction or open of Type IV construction, with grade entrance, is provided under a building of Group R, the number of *stories* to be used in determining the minimum type of construction shall be measured from the floor above such a parking area. The floor assembly between the parking garage and the Group R above shall comply with the type of construction required for the parking garage and shall also provide a *fire-resistance rating* not less than the mixed occupancy separation required in Section 508.4.

❖ This section permits an extra story (above the limits of Table 503), based on construction type, for Group R buildings with parking on the first story (see Figure 510.4). There are several conditions that must be met: the parking must be limited to one story above grade; must be Type IV (if open) or I (open or enclosed) construction; the entrance to the garage must be at grade; and a 1-hour horizontal assembly must be provided between the parking and the Group R occupancy in accordance with Table 508.4. The limitation of Table 503 for height above grade plane (in feet) is not changed under this circumstance. It should be noted that all buildings containing Group R occupancies are required to be sprinklered in the code. Therefore, the separation required would only be 1 hour, but the parking area must also be sprinklered.

For instance, a fully sprinklered Group R-2 building of Type VB construction would normally be permitted to be three stories above grade (Table 503 limit of two stories plus the additional story increase for

sprinklers in Section 504.2). If it meets the conditions of this section for parking on the first story above grade, then it could actually be four stories above grade; however, the building height in feet cannot exceed 60 feet (18 288 mm) above grade plane in accordance with Table 503 for Type VB construction and Section 504.2, which allows a height increase for sprinklers. Figure 510.4 provides an example of a Group R-1 building over enclosed parking.

510.5 Group R-1 and R-2 buildings of Type IIIA construction. The height limitation for buildings of Type IIIA construction in Groups R-1 and R-2 shall be increased to six *stories* and 75 feet (22 860 mm) where the first floor assembly above the *basement* has a *fire-resistance rating* of not less than 3 hours and the floor area is subdivided by 2-hour fire-resistance-rated *fire walls* into areas of not more than 3,000 square feet (279 m^2).

❖ This section contains special provisions for increasing the height of Type IIIA Group R-1 and R-2 buildings based upon increases in fire resistance and compartmentation. More specifically, the higher rating would apply to the floor structure of the first story above grade (3 hours), and the fire walls (2 hours) subdividing the building into floor areas of not more than 3,000 square feet (279 m^2). The fire walls must extend from foundation to roof. In addition, the fire walls must comply with the requirements in Section 706.

It should be noted that this section is independent of the fire area requirements of Section 901.7 but such separations could certainly be considered as creating fire areas or separate buildings. In either case all buildings containing a Group R-1 or R-2 fire area would require sprinklers in accordance with Section 903.2.8.

This section constitutes a trade-off of building area for extra height, and depends on the materials and rating requirements for Type IIIA construction, as well as the extra fire resistance of the first story.

See Figure 510.5 for an example of a Type IIIA building height increase for a Group R-2 occupancy.

510.6 Group R-1 and R-2 buildings of Type IIA construction. The height limitation for buildings of Type IIA construction in Groups R-1 and R-2 shall be increased to nine *stories* and 100 feet (30 480 mm) where the building is separated by not less than 50 feet (15 240 mm) from any other building on the *lot* and from *lot lines*, the *exits* are segregated in an area enclosed by a 2-hour fire-resistance-rated *fire wall* and the first floor assembly has a *fire-resistance rating* of not less than $1^1/_2$ hours.

❖ This section contains special provisions for increasing the height of Type IIA, Group R-1 and R-2 buildings. The higher $1^1/_2$-hour rating would apply to the floor assembly of the first story above grade, and the exits are required to be enclosed with fire walls extending from foundation to roof, otherwise meeting all the requirements of Section 706. Such fire walls would create separate fire areas or buildings for the purposes of the application of the rest of the code.

A separation distance of at least 50 feet (15 240 mm) from other buildings on the same lot or property lines is also required to use this alternative. This section constitutes a trade-off of extra protection for exits for extra building height, and depends also on the materials and rating requirements for Type IIA construction, as well as the extra fire-resistance rating protecting the first story from the basement. The entire building must be sprinklered in accordance with Section 903.2.8. See Figure 510.6 for an example of a Type IIA building height increase for a Group

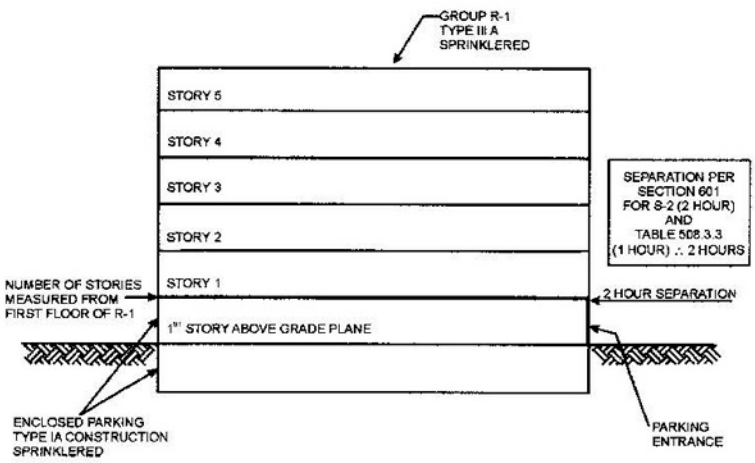


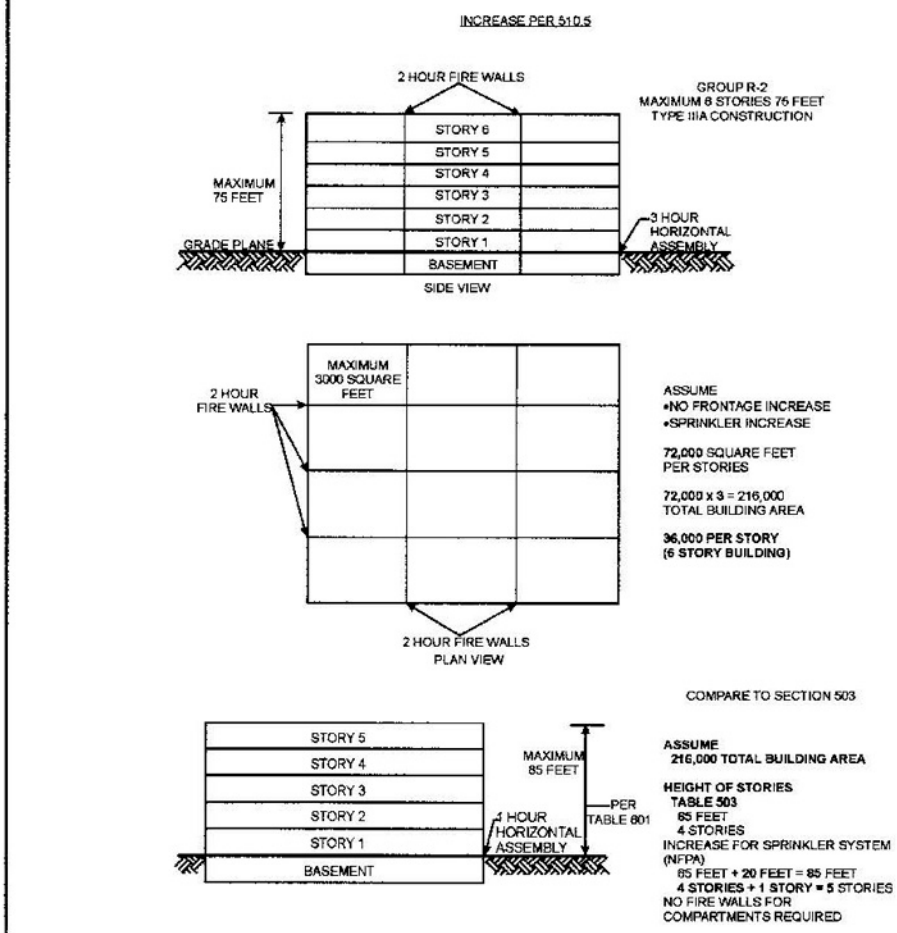
Figure 510.4
EXAMPLE R-1 OVER ENCLOSED PARKING

R-2 occupancy.

Note that such buildings will likely be considered high-rise buildings and, as such, also must comply with Section 403.

510.7 Open parking garage beneath Groups A, I, B, M and R. *Open parking garages* constructed under Groups A, I, B, M and R shall not exceed the height and area limitations permitted under Section 406.5. The height and area of the portion of the building above the *open parking garage* shall not exceed the limitations in Section 503 for the upper occupancy. The height, in both feet and *stories*, of the portion of the building above the *open parking garage* shall be measured from *grade plane* and shall include both the *open parking garage* and the portion of the building above the parking garage.

❖ This section addresses a special mixed use condition, and is another circumstance wherein a building can be designated with two different types of construction for determining height and area. This provision is only to be applied when an open parking structure (Group S-2) is to be constructed below a Group A, I, B, M or R occupancy (see Figure 510.7). If an open parking structure is located below any other occupancy group, Section 508 must be applied, as for any other mixed use condition. In accordance with Section 510.1, this section is an alternative to the



For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 mm².

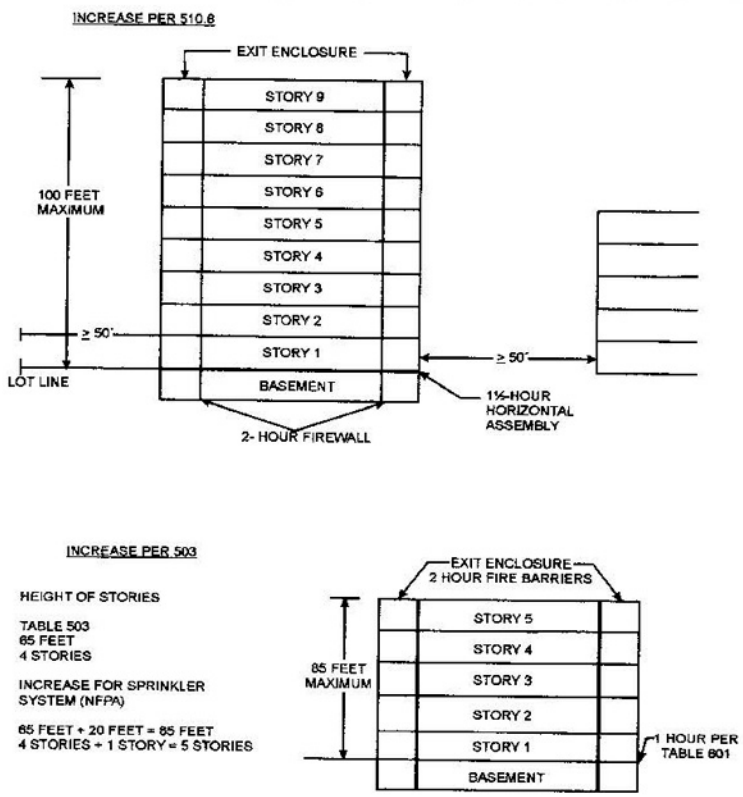
Figure 510.5
EXAMPLE TYPE IIIA, GROUP R-2 HEIGHT INCREASE

general mixed occupancy provisions in Section 508 that can be applied where advantageous to the design of buildings with open parking on the lower levels.

In the application of Section 510.7, there are two criteria that must be met for code compliance (see Figure 510.7):

1. The height and area of the open parking structure comprising a part of a mixed-use group building must not exceed the limitations for open parking structures permitted in Section 406.5.4 and Table 406.5.4.
2. The allowable height of the occupancy located above the open parking structure is to be determined in accordance with Section 503 and Table 503. The height is the vertical distance (measured in feet and stories) from the grade plane to the top of the average height of the highest roof surface, in accordance with the definition of "Building height" in Section 502.1. Allowable heights and areas may be modified in accordance with Section 504 and 506.

510.7.1 Fire separation. *Fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711 between the parking occupancy and the upper occupancy shall correspond to the required *fire-resistance rating* prescribed in Table 508.4 for the uses involved. The type of construction shall apply to each occupancy individually, except that structural members, including main bracing within the open parking structure, which is necessary to support the upper occupancy, shall be protected with the more restrictive fire-resistance-rated assemblies of the groups involved as shown in Table 601. *Means of egress* for the upper occupancy shall conform to Chapter 10 and shall be separated from the parking occupancy by *fire barriers* having not less than a 2-hour *fire-resistance rating* as required by Section 706 with *self-closing*



For SI: 1 foot = 304.8 mm.

Figure 510.6
EXAMPLE TYPE IIIA, GROUP R-2 HEIGHT INCREASE

doors complying with Section 716 or *horizontal assemblies* having not less than a 2-hour *fire-resistance rating* as required by Section 711, with *self-closing* doors complying with Section 716. *Means of egress* from the *open parking garage* shall comply with Section 406.5.

❖ This section contains additional conditions for the use of Section 510.7 as an alternative to the general mixed use provisions in Section 508. It contains an additional five criteria:

1. The open parking structure and occupancy located above must be separated, both horizontally and vertically if necessary, by fire separation assemblies having a fire-resistance rating corresponding to that specified in Table 508.4.

   Example: An open parking structure, Group S-2, is located below an office (Group B); therefore, based on Table 508.4, all vertical and horizontal assemblies separating the two groups are required to have a minimum fire-resistance rating of 2 hours in a nonsprinklered building and 1 hour in a sprinklered building.

2. The upper and lower portions of the building may be constructed of a separate type of construction (except as discussed in Item 5 below). The minimum type of construction for an open parking structure is Type IIB or IV, depending on the thresholds established in Table 406.5.4.

   Example: The open parking structure may be of Type IIB construction and the offices located above the open parking structure may be of Type IB construction.

3. Regardless of the construction types being used, all structural members, including main bracing in the open parking structure for the stability of the upper occupancy, must be rated in accordance with the most restrictive fire-resistance-rating requirement in accordance with Table 601, which would be that for Type IB construction.

   Example: Consider a building where the upper occupancy is of Type IB protected construction, and the open parking structure is of Type IIB unprotected construction. In accordance with Table 601, all load-bearing walls and structural frames, including columns and girders necessary to support the upper occupancy, must have at least a 2-hour fire-resistance rating, in accordance with the requirements of Type IB construction. This typically applies to the columns and bracing in the entire structure, beams supporting the floor separating the upper occupancy from the open parking structure and any transfer beams located in the open parking structure. The story of the open parking structure and any members supporting these stories, however, are permitted to have a zero fire-resistance rating in accordance with the requirements for Type IIB construction.

4. Means of egress facilities within and from the upper occupancy are to conform to Chapter 10. In addition, the egress facilities from the upper occupancy must be separated from the parking area by fire-resistance-rated wall assemblies of

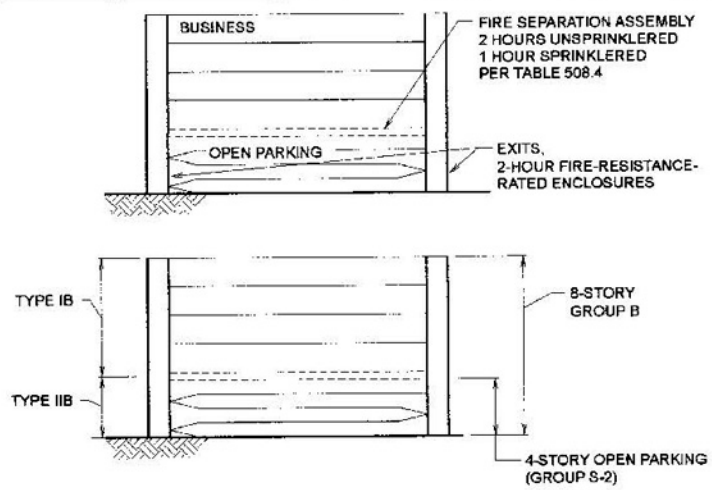


Figure 510.7
OPEN PARKING BELOW OTHER GROUPS

at least 2 hours, by fire barriers meeting the requirements of Section 707 or horizontal assemblies meeting Section 711. These egress facilities are required to maintain the 2-hour protection for their full height and must be continuous to the level of exit discharge. The fire-resistance rating reduction of interior exit stairways for structures less than four stories in height (see Section 1022.2) is not applicable to an exit passing through the open parking structure in accordance with this section. Door openings to the interior exit stairway must have self-closing doors that comply with Section 716, with a fire protection rating of $1^1/_2$ hours in accordance with Table 716.5.

5. Means of egress facilities within and from the open parking structure are to conform to Section 406.5.7, which also references Chapter 10.

510.8 Group B or M with Group S-2 open parking garage. Group B or M occupancies located not higher than the first *story above grade plane* shall be considered as a separate and distinct building for the purpose of determining the type of construction where all of the following conditions are met:

1. The buildings are separated with a *horizontal assembly* having a *fire-resistance rating* of not less than 2 hours.
2. The occupancies in the building below the *horizontal assembly* are limited to Groups B and M.
3. The occupancy above the *horizontal assembly* is limited to a Group S-2 *open parking garage*.
4. The building below the *horizontal assembly* is of Type I or II construction but not less than the type of construction required for the Group S-2 *open parking garage* above.
5. The height and area of the building below the *horizontal assembly* does not exceed the limits set forth in Section 503.
6. The height and area of the Group S-2 *open parking garage* does not exceed the limits set forth in Section 405.5. The height, in both feet and *stories*, of the Group S-2 *open parking garage* shall be measured from *grade plane* and shall include the building below the *horizontal assembly*.
7. *Exits* serving the Group S-2 *open parking garage* discharge directly to a street or *public way* and are separated from the building below the *horizontal assembly* by 2-hour *fire barriers* constructed in accordance with Section 707 or 2-hour *horizontal assemblies* constructed in accordance with Section 711, or both.

❖ This section addresses the inverse of the other circumstances in Section 510: the parking, which must be an open parking garage, is located above the other groups, in this case, Group B or M. This is a common type of construction in metropolitan areas. The parking garage is an open parking structure, with developers using the street level part of the building as an opportunity to provide retail space or other commercial space in a downtown application. The conditions under which this configuration of parking garage and Group B or M uses is similar to conditions for other circumstances is found in Section 510.

More specifically there are seven criteria that must be met.

1. Similar to Item 1 of Section 510.2, a horizontal separation is required to essentially divide the buildings into separate buildings. Again it is like having a horizontal fire wall. The separation is only required to be 2 hours, which is less than the 3 hours required by Item 1 of Section 510.2.
2. The occupancies below the separation are limited to Groups B and M, which relates to the likely application of such configurations.
3. The occupancy above the horizontal assembly is limited to a Group S-2 open parking garage.
4. The building below is required to be of Type I or II construction but must always be at least that of the Group S-2 above.
5. The Group B and M occupancies must comply with the height and area requirements of Section 503. As written this would allow increases in area and height as appropriate. Note that the height is generally restricted by the fact that such occupancies can be located no higher than the first story above grade plane.
6. The height and area of the Group S-2 occupancy shall not exceed that of Section 406.5. In addition the overall height (measured in both the number of stories and building height in feet) is further restricted by the fact that the occupancies below the horizontal assembly must be addressed.
7. Lastly, similar to Section 510.7.1, the exits from the Group S-2 must be protected within 2-hour fire barriers or horizontal assemblies and extend directly to a street or public way.

❖ See Figure 510.8 for an application of this section.

510.9 Multiple buildings above a horizontal assembly. Where two or more buildings are provided above the *horizontal assembly* separating a Group S-2 parking garage or building below from the buildings above in accordance with the special provisions in Sections 510.2, 510.3 or 510.8, the buildings above the *horizontal assembly* shall be regarded as separate and distinct buildings from each other and shall comply with all other provisions of this code as applicable to each separate and distinct building.

❖ A very common practice when applying the alternatives such as those found in Sections 510.2 and 510.3 is to have multiple buildings above the horizontal assemblies. Specifically, the concept in Section 510.2 is often called a "pedestal" building. In other words, the building below and including the horizontal assembly creates a "pedestal" on top of which many

buildings, which are considered separate from one another, can be located. This section is simply clarifying that the multiple buildings located on top of the pedestal are considered separate from one another. This can be realized by there being multiple and distinct structures separated by yards or courts between different structures, or can be the result of the use of fire walls dividing a single structure into multiple buildings.

Just as distinct buildings sitting on the ground, multiple buildings above the horizontal assemblies can be of different construction types from the pedestal building and of different construction types from each other (see Figure 510.9). This allowance is also applicable where Section 510.8 is utilized.

Bibliography

The following resource materials are referenced in this chapter or are relevant to the subject matter addressed in this chapter.

29 CFR Part 1910, *Occupational Safety and Health Act.* Washington, DC: Occupational Safety and Health Administration.

IFC-12, *International Fire Code.* Washington DC: International Code Council, 2011.

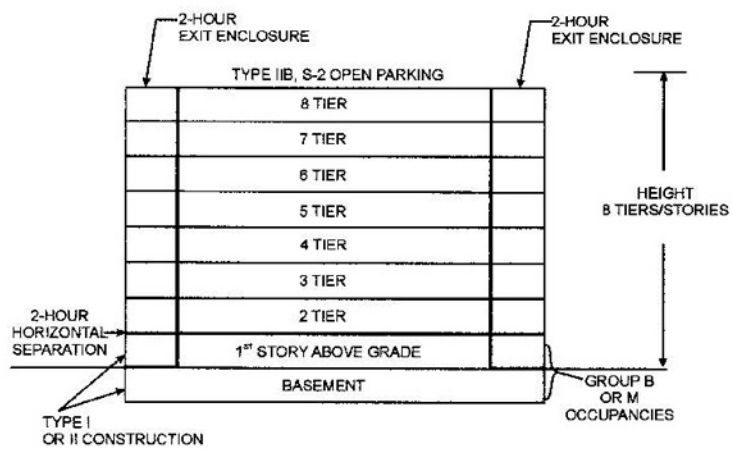


Figure 510.8
EXAMPLES S-2 PARKING OVER GROUP B AND M OCCUPANCIES

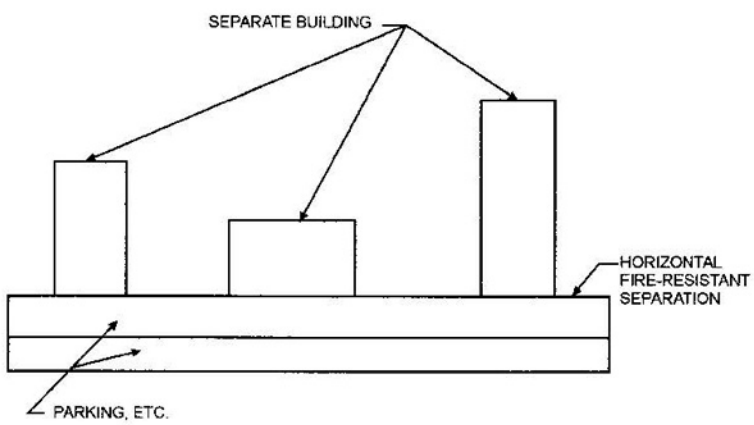


Figure 510.9
MULTIPLE SEPARATE BUILDINGS

IMC-12, *International Mechanical Code*. Washington DC: International Code Council, 2011.

NFPA 13-10, *Installation of Sprinkler Systems*. Quincy, MA: National Fire Protection Association, 2010.

NFPA 13D-10, *Installation of Sprinkler Systems in One- and Two-family Dwellings and Manufactured Homes*. Quincy, MA: National Fire Protection Association, 2010.

NFPA 13R-10, *Installation of Sprinkler Systems in Residential Occupancies Up to Four Stories in Height*. Quincy, MA: National Fire Protection Association, 2010.

NFPA 20-10, *Installation of Stationary Pumps for Fire Protection*. Quincy, MA: National Fire Protection Association, 2010.

NFPA 409-10, *Standard on Aircraft Hangars*. Quincy, MA: National Fire Protection Association, 2010.

Appendix III Proposed IBC Change

G133–12 relative to Section 510.2 for stacked or podium buildings

G133 – 12
510.2

Proponent: Marshall Klein, P.E., Marshall A. Klein & Associates, Inc., representing (NMHC) (makleinfpe@comcast.net) and Jason Thompson, P.E., National Concrete Masonry Association, representing Masonry Alliance for Codes and Standards

Revise as follows:

510.2 Horizontal building separation allowance. A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of *fire walls*, limitation of number of *stories* and type of construction where all of the following conditions are met:

1. The buildings are separated with a *horizontal assembly* having a *fire-resistance rating* of not less than 3 hours.
2. ~~The building below the *horizontal assembly* is not greater than one *story above grade plane*.~~

(Portions of text not shown remain unchanged)

Reason: (Klein) Item #2 of Section 510.2 is an antiquated section of the Code that was a carryover from the legacy 1997 UBC Section 311.2.2.1, **"Group S, Division 3 with Group A, Division 3; Group B, Group M or R, Division 1 Occupancy above"**. Under this section of the UBC the occupancies permitted below the 3 hour fire rated horizontal separation (i.e. parking garage, B, M and A-3 occupancies) were ***not*** required to be sprinklered. In the 2009 IBC, we revised the requirements under this Section of Code to **require** the building below the 3 hour fire rated horizontal separation to be sprinklered per Section 903.3.1.1 (NFPA 13) (See 2012 IBC Section 510.2(6)). Therefore, to limit the building under Section 510.2 that is of Type 1A Construction Type and sprinklered makes no sense anymore, and limits the use of this section of Code in major urban renewal areas of the US.

From a life safety/fire protection standpoint, permitting the Type 1A portion under the 3 hour horizontal separation to go to any number of stories, is an equal or better type of construction that is permitted by this section of code under Section 510.2(7). Section 510.2(7) permits the building(s) above the Type IA portion to be a maximum height in feet not to exceed the height limits set forth in Section 503 for the "…building having the smaller allowable height as measured from the grade plane…". Therefore, a project built under Section 510.2 can presently have above the Type IA portion an R-2 occupancy, sprinklered per NFPA 13R, 4 story, Type 5A, maximum of 60' above grade plane (or an R-2 occupancy, sprinklered per NFPA 13, 4 story, Type 5A, maximum of 70' above grade plane). However, if Item #2 is deleted, then as the Type IA portion is increased in its number of stories above grade plane, the portion above is still limited by Item #7's height limitation and its "height footprint" is being reduced. The net effect is that because this section of the Code will not permit more stories for the Type IA Construction Type, sprinklered portion of the project, the net effect is the reduction of the height of the portion of the project that is of a lesser construction type that is above the Type IA portion. Therefore, from a life safety/fire protection standpoint, we have an equal or better code requirement that is more flexible to provide for the needs of our urban needs to bring people back into our major cities to live and work.

(Thompson) Section 510.2 of the IBC has requirements to allow buildings with certain occupancies to be constructed with mixed construction types by using what is commonly referred to as pedestal construction where a building of a lesser type of construction is permitted to be built on top of a building of Type IA construction and the different types of construction are allowed to be considered separate buildings. This method of construction is allowed provided specific criteria are met including the installation of a 3 hour horizontal assembly that acts as a de facto "fire wall" separating the two buildings from vertical fire exposure (Item 1) and by limiting the total building height to the maximum height permitted in Table 503 for the lesser construction type (Item 7). However, the present code limits the height of the Type IA portion of the building below the 3 hour horizontal assembly to a single story above grade plane (Item 2).

Type IA is the most stringent construction type in the IBC from a fire resistance and noncombustibility point of view. According to Table 503, except for Group H-1 and H-2 occupancies, all other occupancies in buildings of Type IA construction are permitted to be of unlimited height and area due to the inherent fire safety provided by the most fire resistive construction type. However, Item 2 in Section 510.2 limits the Type IA building serving as the base of the pedestal construction to one story in height. This code change proposes to delete the one story limitation for the Type IA building portion of the pedestal construction. This will allow the Type IA building serving as the base of the pedestal construction to be multiple stories while still maintaining the total building height limit in Item 7 of Section 510.2 which is based on the construction type of the lesser type of construction built on top of the Type IA pedestal. This makes good sense since the more stories of Type IA construction allowed above the grade plane, the less potential stories of combustible construction with less fire resistance there will be in the building above.

Cost Impact: (Klein) The construction will cost more because of the additional cost of Type IA construction, but without the additional story or stories of Type IA podium for commercial development the project would not be cost effective to build to promote urban development.

(Thompson) This will not increase the cost of construction.

ICC PUBLIC HEARING ::: April - May 2012 **G246**

G133-12

Public Hearing:	Committee:	AS	AM	D
	Assembly:	ASF	AMF	DF

510.2-G-KLEIN-COMBINED.doc

ICC PUBLIC HEARING ::: April - May 2012 G247

G134–12 relative to Section 510.2 for stacked or podium buildings

G134 – 12
510.2

Proponent: C. Ray Allshouse AIA, CBO, City of Shoreline, WA, representing the Washington Association of Building Officials Technical Code Development Committee (rallshouse@shorelinewa.gov)

Revise as follows:

510.2 Horizontal building separation allowance. A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of *fire walls*, limitation of number of *stories* and type of construction where all of the following conditions are met:

1. The buildings are separated with a *horizontal assembly* having a *fire-resistance rating* of not less than 3 hours.
2. The building below the *horizontal assembly* is not greater than one *story above grade plane*.
3. The building below the *horizontal assembly* is of Type IA construction.
4. *Shaft*, *stairway*, *ramp* and escalator enclosures through the *horizontal assembly* shall have not less than a 2-hour *fire-resistance rating* with opening protectives in accordance with Section 716.5.

   Exception: Where the enclosure walls below the *horizontal assembly* have not less than a 3-hour *fire-resistance rating* with opening protectives in accordance with Section 716.5, the enclosure walls extending above the *horizontal assembly* shall be permitted to have a 1-hour *fire-resistance rating*, provided:

   1. The building above the *horizontal assembly* is not required to be of Type I construction;
   2. The enclosure connects fewer than four *stories*; and
   3. The enclosure opening protectives above the *horizontal assembly* have a *fire protection rating* of not less than 1 hour.

5. The building or buildings above the *horizontal assembly* shall be permitted to have multiple Group A occupancy uses, each with an *occupant load* of less 300, or Group B, M, R or S occupancies.
6. The building below the *horizontal assembly* shall be protected throughout by an *approved automatic sprinkler system* in accordance with Section 903.3.1.1, and shall be permitted to be any ~~of the following occupancies:~~ occupancy allowed by this code except Group H.
   ~~6.1. Group S-2 parking garage used for the parking and storage of private motor vehicles;~~
   ~~6.2. Multiple Group A, each with an *occupant load* of less than 300;~~
   ~~6.3. Group B;~~
   ~~6.4. Group M;~~
   ~~6.5. Group R; and~~
   ~~6.6. Uses incidental to the operation of the building (including entry lobbies, mechanical rooms, storage areas and similar uses).~~
7. The maximum *building height* in feet (mm) shall not exceed the limits set forth in Section 503 for the building having the smaller allowable height as measured from the *grade plane*.

Reason: Current code language unnecessarily limits occupancy types under the building separation allowances in the case of horizontal separation assemblies when compared with vertical assemblies. Since a building is considered separate and distinct provided that all seven conditions listed in Section 510.2 are met, noting that these conditions specifically include Type IA construction below the 3-hour fire resistance rated horizontal assembly and the maximum building height shall not exceed Section 503 limits above the grade plane, why does the code also restrict Group E, I and F occupancies from consideration? Such occupancies could exist immediately next to these buildings limited by precisely the same height limitations with a less restrictive fire separation rating.

Cost Impact: The code change proposal will not increase the cost of construction.

G134-12

Public Hearing:	Committee:	AS	AM	D
	Assembly:	ASF	AMF	DF

510.2-G-ALLSHOUSE

ICC PUBLIC HEARING ::: April - May 2012 **G248**

New Proposed Change to Section 510.2 to permit Type IV HT construction

510.2, 510.2 (New)

Proponent: Dennis Richardson, representing American Wood Council (drichardson@awc.org)

Revise as follows:
510.2 Horizontal building separation allowance.

A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of *fire walls*, limitation of number of *stories* and type of construction where all of the following conditions are met:

1. The buildings are separated with a *horizontal assembly* having a *fire-resistance rating* of not less than 3 hours.
2. The building below the *horizontal assembly* is of Type IA construction or Type IV construction protected as required in Table 510.2.
3. *Shaft*, *stairway*, *ramp* and escalator enclosures through the *horizontal assembly* shall have not less than a 2-hour *fire-resistance rating* with opening protectives in accordance with Section 716.5.
   - **Exception:** Where the enclosure walls below the *horizontal assembly* have not less than a 3-hour *fire-resistance rating* with opening protectives in accordance with Section 716.5, the enclosure walls extending above the *horizontal assembly* shall be permitted to have a 1-hour *fire-resistance rating*, provided:
     1. The building above the *horizontal assembly* is not required to be of Type I construction;
     2. The enclosure connects fewer than four *stories*; and
     3. The enclosure opening protectives above the *horizontal assembly* have a *fire protection rating* of not less than 1 hour.
4. The building or buildings above the *horizontal assembly* shall be permitted to have multiple Group A occupancy uses, each with an *occupant load* of less 300, or Group B, M, R or S occupancies.
5. The building below the *horizontal assembly* shall be protected throughout by an *approved automatic sprinkler system* in accordance with Section 903.3.1.1, and shall be permitted to be any occupancy allowed by this code except Group H.
6. The maximum *building height* in feet (mm) shall not exceed the limits set forth in Section 504.3 for the building having the smaller allowable height as measured from the *grade plane*.

TABLE 510.2
TYPE IV BUILDING BELOW, PROTECTION CRITERIA

	Required layers of 5/8" type X gypsum board for protection based on Occupancy or Fire Area Occupancy Conditions: [a, b]		
Type IV (HT) building element:	**A, B, E, F-2, I, R, S-2 occupancies**	**F-1, M, S-1 occupancies**	**F-1, M, S-1 occupancies with:** • **the manufacture, storage or display of upholstered furniture or mattresses exceeds 2500 sq. ft.;** • **woodworking operations in excess of 2500 sq. ft. ;** • **repair garages greater than 10,000 sq. ft or located in basements;** • **repair or storage of commercial vehicles greater than 5000 square feet;** • **the bulk storage of tires exceeding 20,000 cubic feet**
Interior vertical surface of heavy timber beams, columns, and CLT walls	2	3	4

Interior horizontal or sloping surface of heavy timber beams and CLT ceilings	3	4	5
CLT exterior wall surface; FSD < 10 feet	2	2	2
CLT exterior wall surface; 10 ≤ feet FSD < 30 feet	1	1	1
CLT exterior wall surface; FSD ≥ 30 feet	Section 602.4	Section 602.4	Section 602.4

For SI: 1 foot = 304.8 mm

a. Heavy timber columns and beams that are designed to be 2 hour fire resistance rated as exposed wood members, as allowed by Section 722.1 and the NDS Chapter 16, are permitted to be considered 3 hour fire resistance rated when further encapsulated as incorporated in this table.

b. Wall and ceiling assemblies with multiple layers of gypsum board shall be permitted to be furred with noncombustible or FRT lumber furring provided the cavity is filled with securely attached mineral wool insulation and at least one layer of gypsum board is directly attached to the heavy timber structure. Multiple layers of gypsum board shall be permitted to be secured to furring as required in Section 722.5.1.2.1 ,or Figure 722.5.1(3) for columns and in Section 722.3.2.5 for walls. Attachment of multi-layer gypsum wallboard to ceilings shall be permitted to be as required for two layer assemblies attached to resilient channels in Table 721.1(3) and the base layer or layers shall be permitted to be attached directly to the type IV structure as required by item 21 of Table 721.1(3). Other attachment shall be permitted to be used if specified by the manufacturer and approved.

Reason: There has been considerable interest in the utilization of wood for urban infill residential projects where land costs are at a premium and there is a need to utilize the full extent of the allowable height to incorporate housing over commercial uses below. G133 in the 2015 IBC allows type IA three hour podiums to be more than one story. That code change was successful as proponents pointed out that many jurisdictions already allow this practice approving multi-story podiums through alternate methods of construction. The three-hour separation at the top of the lower building must be supported by three-hour construction to the foundation. Another code change lessened the occupancy restrictions on the three-hour type IA lower building. These two changes allow significant retail and commercial mixed use projects with larger commercial occupancies below while maintaining light frame residential uses above.

The provisions for 510.2 are the most stringent in the code as the podium or pedestal is currently required to both be noncombustible and provide both 3 hour separation and support of the structure up above. Many have referred to it as a horizontal fire wall since fire walls from the structure above are not required to extend into the structure below and different types of construction can be utilized in the structure above and below.

This code change proposes to allow Type IV heavy timber construction below that is 3 hour fire reistance rated instead of the noncombustible podium.

Cross Laminated Timber has been manufactured for over 30 years in Europe and has just recently caught hold on the American Continent where some major structures are under way in Canada and smaller buildings are being built in the US. In Europe buildings of 8 to 10 stories and above are regularly constructed. The following link gives examples of CLT buildings throughout the world. http://www.rethinkwood.com/tall-wood-survey

Basically 2x nominal lumber is laminated in alternate 90 degree directions forming a solid billet of wood from 4.5 inches to 18 inches in thickness perpendicular to grain and in-plane dimensions of up to 9 feet by 65 feet. This material is extremely strong and stiff particularly in the plane direction where both sheet directions have parallel to grain laminated lumber elements. Because of this two way parallel grain it is dimensionally stable in the 9 foot and 65 foot direction.

CLT was approved for use in the 2015 IBC and the design standard can be found in Section 2303.1.4. As part of that public comment code submittal an E119 test was provided showing a five layer CLT wall loaded with 87,000 lbs. and with one layer of 5/8" type X gypsum board on each side. The test resulted in a three hour fire resistance rating and was stopped when fire came through near an edge of the wall panel. Manufactures have run additional tests since then in a variety of configurations.

The following link provides access to additional information regarding this or other code changes proposed by American Wood Council.

http://www.awc.org/Code-Officials/2015-IBC-Code-Changes/

Recently, the 2015 NDS was published which provides for calculated fire resistance of CLT as well as other exposed timber. Chapter 16 of the NDS has been recognized for years in the IBC as a procedure whereby exposed glulam and timber beams and columns can be calculated to provide fire resistance up to 2 hours. Newly updated Technical Report 10 is available on the AWC website providing more detail of this method. Fire resistance rating of exposed wood occurs because the exterior of the wood chars and insulates the interior of the wood member. The member is designed and detailed to meet the required structural performance with the outer char layer sacrificed to provide protection from heat and fire. The 2015 NDS extends this calculation method to CLT. Members with calculated fire resistance of exposed wood can be provided with further fire resistance rating by providing additional protection of that member with gypsum board. Recent tests show the horizontal surfaces of a timber beam to be protected for approximately 30 minutes for each 5/8" layer of gypsum board applied on the horizontal beam bottom and and 40 minutes for each layer applied vertically on both sides. Similar timeframes are added to CLT wall and floor ceiling materials when gypsum is applied. This is not much different, in the case of walls, to a method for calculating the fire resistance rating of concrete walls that are further protected with gypsum board found in IBC Section 722.2.1.4.

All building materials have some form of "bad behavior". Some other materials significantly loose strength when subjected to elevated temperatures and must be protected. Many other materials may suffer significant distortions causing structural failure due to uneven heating of some portions of the structure when subjected to a compartment fire while other portions of the structure remain at room temperature. Still other bad behaviors include brittle spalling of material when subjected to heat.

Heavy timber wood construction has the advantage of remaining relatively dimensionally stable as the wood chars and is not a good conductor of heat. Wood also retains its strength in the remaining section as large members char to around exposed surfaces. The main issue raised about wood is the potential to contribute to the fire as additional fuel. The code relies on the limitation of noncombustible materials in the definition of Type IA construction to limit the potential of the structure to contribute to the fire. This is especially critical in taller major structures and podium type buildings supporting other buildings.

In order to obtain similar performance regarding the potential contribution of wood to a fire, this code change proposal gives the requirements for additional gypsum board protection to delay the onset of the fire causing the wood to char and contribute to combustion. Although the building is required have NFPA 13 sprinklers throughout that is not considered in the design and provides a belt and double suspender approach to ensuring safety while protecting the heavy timber structure and gypsum board from the effects of common nuisance fires.

Table 510.2 is provided which specifies increased protection of the proposed heavy timber structure based on the potential fire load of the occupancy. Fire area requirements in certain occupancies with additional combustible material typically call for reduced fire area size or sprinklers in section 903 due additional fire load. These are also provided with additional layers of gypsum board keeping the CLT cool and delaying the onset of wood contribution to the fire load in these fire areas with up to 4 layers of 5/8" type X gypsum board on walls and 5 layers on the ceilings. This protection can push the fire resistance rating performance in an E119 test upwards of 4 to 5 hours or more with a four layers of gypsum on a CLT wall. The heavy amount of additional gypsum board provided in this proposal for podiums is used to limit the probability of contribution of the wood structure to a fire also serves to provide a substantial margin of safety against structural failure when compared with other materials. Once the wood structure starts to char, it still has a large margin time where the strength of the material is not affected.

It is worthy to note that not all fires are equal and the only time the E119 time and temperature curve is standard is when in the controlled environment of a test furnace. Actual time temperature curves are affected by a variety of factors including fire load, insulation of compartment, ventilation, and configuration. All materials are affected differently some leading to brittle failure or sudden onset of strength loss. The actual performance of any material is affected by specific material characteristics and fire conditions.

The E119 test while not intended to measure contribution of the tested material to the fire does provide an apple to apple measure of performance of measurable characteristics of test assemblies subjected to the same conditions. By significantly delaying or eliminating the contribution of the heavy timber with heavy gypsum board protection, this apple to apple comparison is made more consistent. Typical fires may actually have higher spiking of temperatures well above the E119 levels with decay in temperature as the fire progresses and decays. E119 tests also may not predict the performance of materials where the strength or dimensions are temperature sensitive. Heavy timber tends to remain stable in actual fire conditions and the main adverse effect of the early spike in temperature is slightly faster char rates but followed by slower char rates when the fire decays. The predictability, strength and dimensional stability of highly protected heavy timber, is not nearly as susceptible to non-standard

fires as may be with other materials.
In Section 510.2 the three hour type IA structure below is unlimited in size. This proposal relies on the allowable area of type IV construction in the building below and is more conservative since the 3 hour building below would be required to be limited as allowed for type IV or divided by three hour fire walls if the allowable area of the lower building exceeds the allowable area for type IV construction.
This code proposal is a first attempt at utilizing massive timber in a new way. Because of that, the level of gypsum protection is conservative based on fire load. This is in addition to the behavior of wood char in heavy timber to provide reliable structural performance and in addition to the installation of an NFPA 13 sprinkler system.

Cost Impact: Will not increase the cost of construction
This code change provides a new option for construction that is not currently available.

New Proposed Change to Section 510.12 to permit Type IV HT construction

510.12 (New)

Proponent: Dennis Richardson, representing American Wood Council (drichardson@awc.org)

Add new text as follows:
510.12 Group R-1 and R-2 buildings of Type IV HT construction. The height and story limitations for buildings of Type IV HT construction in Groups R-1 and R-2 shall be increased to nine stories and 100 feet (30 480 mm) provided all of the following criteria are met:

1. The heavy timber construction is protected with a minimum of one layer of 5/8" type X gypsum board on all interior wall surfaces and a minimum of two layers of 5/8" type X gypsum board on the ceiling side of all horizontal assemblies.
2. The building has a FSD of not less than 50 feet (15 240 mm).
3. The exits are segregated in an area enclosed by a cross laminated timber 2 hour fire-resistance-rated walls protected with two layers of 5/8" type X gypsum board or equivalent on the room side of all walls adjacent to the enclosure.
4. Wall and ceiling assemblies with multiple layers of gypsum board shall be permitted to be furred with noncombustible or FRT lumber furring provided the cavity is filled with securely attached mineral wool insulation and at least one layer of gypsum board is directly attached to the heavy timber structure. Multiple layers of gypsum board shall be permitted to be secured to furring as required in section 722.5.1.2.1 or Figure 722.5.1(3) for columns and in section 722.3.2.5 for walls. Attachment of multi layer gypsum wallboard to ceilings shall be permitted to be as required for single assemblies attached to resilient channels in table 721.1(3) and the base layer or layers shall be permitted to be attached directly to the type IV structure as required by item 21 of table 721.1(3). Other attachment shall be permitted to be used if specified by the manufacturer and approved.
5. Buildings of type IV construction shall be permitted to be located over a building with multiple occupancy groups meeting the provisions of section 510.2.

Reason: Reason: Mass timber products such as cross-laminated timber (CLT) provide the structural and fire resistance capabilities necessary for taller buildings. This proposal closely follows the special occupancy for Type IIA structures in 510.6 as a model. Existing section 510.6 allows 1 fire resistance rated light frame steel buildings to be up to 9 stories and 100 feet tall when surrounded by 50 feet. This proposal goes to the same height and number of stories but requires additional fire resistance (2 hours instead of 1 hour throughout). The CLT is provided with minimum protection throughout the inside with 5/8" type X gypsum (one layer at all interior walls and two layers at all ceilings) and the overall assembly must meet the 2 hour E119 fire resistance test. In addition to the mass timber protected with type X gypsum board, the building is provided with an NFPA 13 sprinkler system throughout and is surrounded by yards of 50 feet. The entire fire and life safety "package" is at least equivalent to what is currently specified in 510.6.
The current section 510.6 applying to one hour type II construction requires stairways to be segregated into areas separated by a two hour fire wall. Although the existing language for 510.6 is somewhat unclear, this can be accomplished in the current 510.6 with a two hour fire wall separating the one hour type II building into two fire areas, each with stairways or with separate fire walls at each exit enclosure.

A fire wall is not necessary with this proposal since the entire building is two hour fire resistance rated construction. Stairways are provided with additional protection with a second layer of 5/8" type x gypsum board on the fire side of rooms adjacent to the stairways. Provisions are included to allow the installation of resilient channels and spaces filled with insulation for sound attenuation. Additionally it is noted this building may incorporate a 3 hour separation below if additional occupancies are to be housed in a podium below.
This code change helps address concerns about climate change by allowing a taller building to utilize cross laminated timber which sequesters carbon and has low embodied energy. There is much focus on the future utilization of this building system. The following link gives examples of CLT buildings throughout the world. http://www.rethinkwood.com/tall-wood-survey
In addition the following link provides access to any additional information regarding this or other code changes proposed by American Wood Council.
http://www.awc.org/Code-Officials/2015-IBC-Code-Changes/

Cost Impact: Will not increase the cost of construction
This new code section provides a new option for construction that is not currently available.

New Proposed Change to Section 504.4 to change allowable number of storey

504.4

Proponent: Dennis Richardson, representing American Wood Council (drichardson@awc.org)

TABLE 504.4
[a, b] ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	2	1
	S	UL	6	4	3	4	3	4	3	2
A-2	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-3	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-4	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	3	2
	S	UL	12	6	4	6	4	6	4	3
E	NS	UL	5	3	2	3	2	3	1	1
	S	UL	6	4	3	4	3	4	2	2
F-1	NS	UL	11	4	2	3	2	4	2	1
	S	UL	12	5	3	4	3	5	3	2
F-2	NS	UL	11	5	3	4	3	5	3	2
	S	UL	12	6	4	5	4	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	1	1	NP
	S									
H-2	NS[c, d]	UL	3	2	1	2	1	2	1	1
	S									
H-3	NS[c, d]	UL	6	4	2	4	2	4	2	1
	S									
H-4	NS[c, d]	UL	7	5	3	5	3	5	3	2
	S	UL	8	6	4	6	4	6	4	3
H-5	NS[c, d]	4	4	3	3	3	3	3	3	2
	S									

I-1 Condition 1	NS[d, e]	UL	9	4	3	4	3	4	3	2
	S	UL	10	5	4	5	4	5	4	3
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	4	3	2
	S	UL	10	5						
I-2	NS[d, f]	UL	4	2	1	1	NP	1	1	NP
	S	UL	5	3						
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	1
	S	UL	5	3	2	3	2	3	3	2
I-4	NS[d, g]	UL	5	3	2	3	2	3	1	1
	S	UL	6	4	3	4	3	4	2	2
M	NS	UL	11	4	2	4	2	4	3	1
	S	UL	12	5	3	5	3	5	4	2

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R-1	NS[d, h]	UL	11	4	4	4	4	4	3	2
	S13R	4	4						4	3
	S	UL	12	~~5~~ 6	5	~~5~~ 6	5	~~5~~ 6	~~4~~ 5	3
R-2	NS[d, h]	UL	11	4	4	4	4	4	3	2
	S13R	4	4	4					4	3
	S	UL	12	~~5~~ 6	5	~~5~~ 6	5	~~5~~ 6	~~4~~ 5	3
R-3	NS[d, h]	UL	11	4	4	4	4	4	3	3
	S13R	4	4						4	4
	S	UL	12	5	5	5	5	5	4	4
R-4	NS[d, h]	UL	11	4	4	4	4	4	3	2
	S13R	4	4						4	3
	S	UL	12	5	5	5	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	3	1
	S	UL	12	5	3	4	3	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	2
	S	UL	12	6	4	5	4	5	5	3
U	NS	UL	5	4	2	3	2	4	2	1
	S	UL	6	5	3	4	3	5	3	2

Note: UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the *International Existing Building Code.*

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code.*

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

Reason: Large buildings of R-1 and R-2 occupancies and one hour fire resistance rated construction are highly compartmentalized. Not only are they divided up by 2 or 3 hour fire resistance rated fire walls, each living unit is separated by a combination of horizontal one hour assembly conforming with Section 708 and one hour fire partitions conforming with Section 711. This proposal is the logical expansion of G108-12 of the last code cycle which received an initial tie vote but was disapproved with the committee chair tiebreaker. The intent of that code proposal in the 2012 Group A cycle was to increase the density for infill construction on a given lot area in buildings of type IIA and VA while serving to encourage green construction practices and while making the resulting buildings safer. This approach has been called counterintuitive by some, but once the math is done every quantifiable measurement of occupant safety either stays the same or improves: Fire area goes down, distance between fire walls goes down, area per story goes down, travel distance to fire walls goes down and the overall height remains unchanged.

This change does not increase the building height. This change does not increase the height or protection of 2 hour stair enclosures going to the top floor in a maximum build-out scenario.

On projects where the design professional is trying to maximize density, the result of one additional floor is to replace a mezzanine level with a story within the existing permitted allowable height allowance. Since mezzanines do not contribute to the allowable floor area or number of story determination (IBC Section 505.2), this code change actually results in greater number of units for a given footprint but with less light frame construction in each fire area between fire walls. This is because fire walls are move closer together for a given building width. Because the lot footprint between fire walls is reduced in the examples provided on our website for a 100 foot wide building from 17% to 22%, the travel distance until an occupant goes from one fire compartment to another is also reduced. Because an open mezzanine level is replaced with a one hour floor ceiling assembly the building compartmentalization is improved and the fire area

between fire walls is decreased.

This is true for all R-1 and R-2 one hour buildings (Type IIA, IIIA, IV and VA). Traditional Type IV heavy timber is not normally considered a one hour fire-resistance rated building, however for R-1 and R-2 occupancy groups, IBC Sections 420, 708 and 711 combine to require all walls and horizontal assemblies between dwelling and sleeping units, including their supporting construction, to be one hour fire resistance rated construction. This makes an R-1 and R-2 occupancy, type IV heavy timber building a de facto one hour building. The National Design Specification (NDS), Chapter 16 gives requirements for calculation of one hour fire resistance if exposed wood members are used.

Concerns were raised by a few code officials last code cycle that the G108-12 code proposal of could be used as a work-around allowing NFPA 13R sprinklers in buildings taller than 4 stories. This was not true because of the limitations on NFPA 13R sprinklers to 4 stories in Section 903.3.1.2. This concern is further negated because of the new format of Table 504.4 in the 2015 IBC. Modifications included in this proposal only apply to the row marked "S" corresponding to buildings equipped throughout with an NFPA 13 sprinkler system in accordance with IBC 903.3.1.1.

For a 100 foot wide building separated by multiple fire walls, the distance between fire walls goes from: 144 feet to 120 feet in Type IIA and IIIA; 123 feet to 102.5 feet in Type IV HT; and from 90 feet to 72 feet in a Type VA building. Examples with illustrations are provided for all affected construction types the American Wood Council website at the following web link:

http://www.awc.org/Code-Officials/2015-IBC-Code-Changes/

Building safety measures of distance, story area and fire area between fire walls all go down. Because of this the number of occupants per story between firewalls goes down and the distance an occupant must travel to go from one fire area to another decreases while the maximum height stays the same. The safety of the building is improved by all applicable metrics.

Cost Impact: Will not increase the cost of construction
This code change provides additional options to the designer and does not create new requirements.

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