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Getting to Yes: Making Effective Use of the Alternate Means Process

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Introduction

Arguably, one of the most important sections of the *International Building Code* (IBC) is not used for most construction projects. This section opens up countless performance-based paths for the successful design and construction of buildings and equipment. Codified in Section 104.11 of the IBC, it is most commonly referenced as the provision for AMMRs—shorthand for Alternate Materials and Methods Requests.

The AMMR provisions permit a Building Official to consider the *intent* of prescriptive code provisions when deliberating on new or existing technologies in materials, design and methods that are not explicitly addressed in the code. In this way, the code can provide the flexibility to address new concepts, innovations, and developments that may not have been recognized or even existed during the code's formal development process. The AMMR code section can also prove helpful in addressing code compliance paths that are by nature complex, since it creates a framework for a specific approval process, with appropriate consideration and documentation, so that in the future it is possible to retrace the logical steps that were associated with a particular permit process. For this reason, sometimes the AMMR process is used in situations where there is simply a complex enough situation that it is the preference of either the applicant or code official that it be part of the permit approval process, even though the project may not actually be incorporating newly developed materials or methods.

The IBC is not alone in its allowance of AMMRs. The legacy codes (developed by Building Officials Code Administrators International, Southern Building Conference International, and International Conference of Building Officials) had similar provisions, as do the National Fire Protection Agency (NFPA) standards and codes, which allow a designer to depart from the prescriptive wording of the code and focus instead on the performance of the building based on the code's intent. Similar provisions also exist in state code language that relates to the regulation of the built environment.

The structural system of the new Integrated Design Building at the University of Massachusetts Amherst required a variance for structural equivalency under the Massachusetts Building Code.

Credit: Alexander Schreyer, University of Massachusetts

To fully understand the implications of IBC Section 104.11, it's worth considering several attributes of the code:

- Code compliance is not necessarily the highest bar for determining the standard of care for design professionals. This is because there are so many variables that can affect how a building performs, particularly during emergency situations.
- Code compliance does not alone ensure that buildings are safe. The term 'safe' is relational and, in practical application, codes balance practical considerations such as economics and buildability.
- A building code is not design- and style-neutral because it is based on standard practices.

- A building code is not uniform in that the same result is achieved wherever and whenever it's applied. This is because of the need for interpretation of code provisions, which occurs at the individual jurisdictional level, and on a project-by-project basis.
- Direct and clear code opinion from the source (International Code Council) will not necessarily take precedence over local officials. The Authority Having Jurisdiction (AHJ) is ultimately the decision-making point for code issues relative to a particular project.
- Once a project's permit is issued, it does not mean that by definition the project is in compliance with the code. The design professional has responsibilities for code conformance even in those circumstances where a plan check process might miss some detail.

A building code is a tool used by designers and authorities with an objective of protecting the public and emergency personnel, and includes referenced standards such as the American Wood Council's National Design Standard® (NDS®) for Wood Construction. It is the duty of the designer and building official to ensure that the intent of the code is satisfied in order to achieve adequate protection of public health and safety. Although the prescriptive language of the code is intended to satisfy this for most projects, every building, site and design is unique. Even identical buildings in different locations face unique scenarios due to considerations such as surrounding buildings, capabilities of emergency responders, local geography/climate, and other factors. For these and other reasons, performance-based approaches, such as those permitted by Section 104.11, may be used to achieve code compliance. However, the intent behind all applicable requirements of the code must be well understood prior to beginning the AMMR process.

Requirements Related to an AMMR

Most jurisdictions have an application with step-by-step instructions for requesting approval through an AMMR. Regardless of slight jurisdictional differences, it is the responsibility of the applicant to prove equivalency in six listed characteristics: quality, strength, effectiveness, *fire resistance*, durability, and safety. Fire resistance is in italics because it is the only characteristic on the list defined in the IBC. Definitions of the other words are subjective, with the AHJ having final say. For this reason, it is important that an AMMR approach be organized, and that arguments be logically laid out. Many jurisdictions have a "script" or application form, which invariably includes the following elements. These elements should be a part of any submittal.

1. Specific code section for which an alternative is being proposed
2. Analysis of the intent of that specific code section's requirements
3. Reasons why compliance with the literal text of the code language is not possible and/or desirable
4. Proposed alternative
5. Explanation of how the alternative meets or exceeds the intent of the code
6. Request for acceptance of the alternative materials, design, and methods of construction and equipment as allowed by IBC Section 104.11

Just as the applicant has responsibilities, it is similarly expected by the applicant that any alternative presented will be thoroughly evaluated by the building department for compliance with IBC 104.11 and equivalency with the intent of the specific, applicable code requirements. Though it is the responsibility of the building official to utilize any resources necessary for him or her to interpret the intent of the code provision(s) in question, it is prudent to supply all relevant information with a request, as the building official may have high demands on his or her available time and resources. Information that could help facilitate a review includes research reports and test results.

Research Reports

Evaluating the equivalency of a proposed alternative can be difficult, sometimes because the alternative is new and unique and may require considerable time and effort to research. If they exist, research reports authored by properly credentialed individuals or firms can support the proposed alternative as meeting code objectives through documented research, comparison with accepted technologies or designs, and acceptable testing results.

A commonly utilized tool in the AMMR process is the evaluation report provided by ICC Evaluation Service (ICC-ES). ICC-ES reports are freely available to the public (http://www.icc-es.org/) and follow a format familiar to building officials. However,

while they fulfill the criteria of acceptable research reports, they alone do not guarantee approval. The building official is always the final authority with respect to acceptance or denial of the alternative material, design, or method. ICC-ES might be the most common form of AMMR research report; however, AHJs are permitted to accept research reports from other sources, such as the International Association of Plumbing and Mechanical Officials (IAPMO).

Other research reports may be public domain references that cite research and data gathered from many sources. One such comprehensive tool available for free is the U.S. Department of Housing and Urban Development (HUD) publication, *Guideline on Fire Ratings of Archaic Materials and Assemblies* (February 2000), available here: https://www.huduser.gov/portal/publications/destech/fire.html. A library of research related to mass timber is also available on the reThink Wood website (www.rethinkwood.com).

Test Results

A building official is permitted to request testing in accordance with established acceptance criteria to substantiate arguments for equivalent compliance with code requirements. Alternative testing may be required when there is insufficient evidence, evidence that a material or method does not conform to the requirements of the code, or in order to substantiate claims for alternative materials or methods. Test methods can be specifically mentioned in the construction code or referenced standards, or a recognized, national test standard. When standards do not exist, a building official has the authority to determine the testing procedures and acceptance criteria necessary to demonstrate compliance. Examples of testing entities include Underwriters Laboratories (www.ul.com) and Factory Mutual (www.fmapprovals.com).

Deciding to pursue an AMMR

Sometimes, it is clear from the outset of a project that an AMMR will be necessary. Reasons could include (among others) exposed structural material, complicated existing conditions, tested assembly modifications, means of egress design alternatives, mixed construction types, or unique design concepts. Other times, situations discovered during construction may require a post-permit AMMR. Just as all buildings and projects are unique, so are the circumstances regarding a project's completion. For the sake of simplicity, design modifications to a project which keep the design and construction within the scope of the prescriptive requirements of the code should at least be considered.

Issues an AMMR May Solve

It may be prudent to pursue the approval of alternative means and methods when the prescriptive language of the building code cannot accommodate the desired or necessary design or construction features. Common reasons to request an AMMR are explained below.

New Innovations

Innovative products that provide aesthetic advantages, offer cost or environmental benefits, or make construction easier are introduced almost daily. However, since the IBC is updated on a three-year cycle, the acceptance of newly-created methods and materials are delayed. Lags inherent in the jurisdictional adoption process could add another three years or more, resulting in an enforced code that is six or more years old. For example, there was a time when cross-linked polyethylene (PEX) piping was not permitted by code. Though it was common in design and construction, many jurisdictions required anyone utilizing PEX for a project to fill out a special AMMR form developed just for that issue. Eventually, the code caught up to common building practices and permitted PEX. The use of cross-laminated timber (CLT) presented similar difficulties and will continue to face challenges even under the 2015 and 2018 IBC where CLT provisions have been incorporated. While new provisions are added every cycle, it may take several cycles to get comprehensive code coverage for a new technology.

Multi-level podiums were added to the 2015 IBC, but require an AMMR under previous versions. This University of Washington student housing development was built under the Seattle Building Code, which permitted multi-level podiums years before their adoption in the 2015 IBC.

Credit: Ankrom Moisan Architects, WG Clark Construction

New Design Concepts

Design concepts that have never been built are similar to new products. At one time, shopping malls, atriums, pedestrian bridges, special amusement buildings, work/live units, and pedestal buildings were all outside the prescriptive scope of the code. As such, they could only be constructed through the use of an AMMR. In these cases, the alternate means process helped facilitate the eventual prescriptive allowances that now recognize these design concepts in the IBC.

Complex Geometries

Sometimes there are space limitations, either within a building due to its design or because of the landscape or neighboring buildings, which will not accommodate the prescriptive language of the code. Complex geometries that may require the use of an AMMR include projects involving multiple buildings and construction types, intersections of multiple rated assemblies and imaginary property lines, and very unusual geometry or detailing.

Conundrums

Conundrums such as existing conditions or immovable objects can make compliance with the wording of the code impossible. However, depending on the exact situation, it could be more appropriate to reference IBC Section 104.10, "Modifications," instead of Section 104.11. Section 104.10 permits a building official to modify requirements of the code if it is determined that strict application of the code is impractical and the modification is in conformity with the intent and purpose of the code. The approval process for a modification is the same as that described for an AMMR.

Land Use Issues

Land use issues that impact building design include those related to property lines and easements. Examples include how these issues affect fire ratings or fenestration areas of exterior wall assemblies that either cannot or should not be required to meet the literal text of the code. See project example, *Fire-Resistant Ratings of Exterior Walls.*

Interpretation Differences

Depending on the project and specific issue in question, resolving interpretation differences could potentially be handled through the use of an AMMR. Additional elements may be added to satisfy both designer and building official and avoid the cost and time delays of appeals boards, negotiations, and possibly court.

Alternative Code Paths

The use of AMMRs should not be relied upon exclusively to solve apparent discrepancies between code requirements and building designs. There are paths within the prescriptive requirements of the code that may provide viable solutions without requiring a custom-designed solution through an AMMR.

2015 IBC TABLE 716.5

Opening Fire Protection Assemblies, Ratings and Markings

Type of Assembly	Required Wall Assembly Rating (hours)	Minimum Fire Door and Fire Shutter Assembly Rating (hours)	Door Vision Panel Size[b]	Fire-Rated Glazing Marking Door Vision Panel[d]	Miniumum Sidelight / Transom Assembly Rating (hours)		Fire-rated Glazing Marking Sidelight / Transom Panel	
					Fire protection	Fire resistance	Fire protection	Fire resistance
Fire barriers having required fire-resistance rating of 1 hour: Enclosures for shafts, exit access stairways, exit access ramps, interior exit stairways and interior exit ramps; and exit passageway walls	1	1	100 sq. in.[c]	≤100 sq. in.= D-H-60 >100 sq. in. = D-H-T-W-60	Not Permitted	1	Not Permitted	W-60
					Fire Protection			
Other fire barriers	1	3/4	Maximum size tested	D-H	3/4		D-H	
Fire partitions: Corridor walls	1 0.5	1/3[b] 1/3[b]	Maximum size tested Maximum size tested	D-20 D-20	3/4[b] 1/3		D-H-OH-45 D-H-OH-20	

Prescriptive Options

Within the code, there are often multiple prescriptive-based options for achieving compliance. Some options are explicit, where a list is given and the code user is instructed to meet one or more criteria. Others are less explicit and necessitate the selection of slightly modified design choices.

An example is a building containing multiple use areas, where a designer can choose to pursue the design as non-separated mixed occupancies or separated mixed occupancies, or utilize accessary occupancies and/or incidental use. Each has different implications with regard to considerations of fire separation and allowable areas.

Another example is a design that utilizes a 1-hour-rated corridor, but exit access travel distances specified by Table 1016.2 are exceeded. Simply substituting 1-hour-rated door assemblies instead of 1/3-hour rated door assemblies can turn this exit access corridor into an exit passageway, thus reducing the exit access travel distance and making the design code compliant, provided it is supported by construction that is 1-hour fire resistance-rated. (See Table 716.5 on p.4.)

Exceptions and Footnotes

During a typical fast-paced, due-yesterday design process, exceptions within the code are easy to overlook. In some cases, an element already included in the building design (such the ability to use fire retardant-treated wood in place of non-combustible walls in Types III and IV construction) may be the exception or expanded allowance for the project to meet prescriptive requirements elsewhere. Other exceptions may require a slight modification to the design, approach, or construction materials, but the difference may be inconsequential.

As with exceptions to code section requirements, code commentary and footnotes are laden with important information that may provide additional opportunities when certain conditions are met, especially with regard to wood. For example, Footnote (c) in Table 601 allows heavy timber to be used for roof construction of Types IB, IIA, IIIA and VA buildings where a fire-resistance rating of 1 hour or less is required. Also, Footnote (b) provides additional opportunities for unprotected wood members in roofs of non-combustible structures.

2015 IBC TABLE 601

Fire-Resistance Rating Requirements for Building Elements (Hours)

Building Element	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (See Section 202)	3[a]	2[a]	1	0	1	0	HT	1	0
Bearing walls									
Exterior[e,f]	3	2	1	0	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1 1/2[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

For SI: 1 foot = 304.8mm

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

Existing Conditions

When altering or adding onto an existing building, utilization of the *International Existing Building Code* (IEBC) may provide alternatives or exemptions to certain requirements that do not exist for new construction. In existing buildings, AMMRs may be just as (or more) useful than the IEBC because they allow the designer to connect the dots with a variety of conditions. Conversely, IEBC methods have also been referenced in AMMRs to prove code compliance for conditions in new buildings that are not prescriptively acknowledged in the IBC. One tool that exists is Chapter 14, "Performance Compliance Methods" in the 2012 IEBC, which assigns points to a project based on three categories: fire safety, means of egress, and general safety. This allows a designer to take a non-arbitrary approach to assessing existing life safety issues, whereby points are assigned that compare relative safety risks. Examples of issues that contribute to the overall point score are open stairs, fire alarm systems, and window placement on property lines.

Historic Qualification

If the building is a qualified historic building or part of an historic district, then the provisions of the code related to the construction, repair, alteration, addition, restoration and movement of structures and change of occupancy will probably not be mandatory where such buildings are judged by the building official to not constitute a distinct life safety hazard. Historic buildings and districts are those that are listed or predetermined to be eligible for listing in the National Register of Historic Places.

When an AMMR Will Not be Helpful

It is important to realize that an AMMR cannot waive requirements of the code. It does not permit a building design that circumvents accepted code practices or does not meet the intent of the code. Certain designs or configurations simply should not be built because of risks to property or life safety that cannot be mitigated to meet code intent.

Project Examples

The following projects illustrate situations where IBC Section 104.11 has been successfully utilized. It is important to note that final approval always lies with the building official to determine the intent of the code and deem the alternative proposed as equivalent or not. The successful use of an AMMR in one situation, therefore, does not grant entitlement to its use elsewhere.

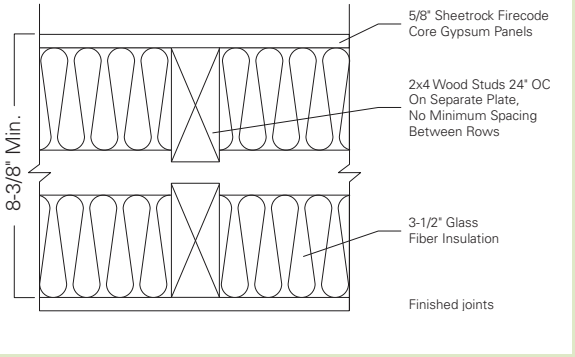
Fire-rated or Acoustic Wall Assemblies

Prescriptive Requirements – When fire-rated or acoustic wall assemblies are required by the code, a prescriptive or tested assembly is often chosen and must be followed to the letter. Some rated assemblies specify an acceptable dimension range, with nail lengths or component spacing; others, however, do not. Thousands of tested wall assemblies exist, but it can be difficult to find one that represents the real-life assembly needed and, in many cases, portions of the wall may need to be modified slightly from the tested configuration. Modifications may include (among others) alternate stud spacing, additional supports between studs, or the addition of a building component within the wall. Because it is impractical from a cost perspective to submit minor alterations such as these for individual testing, engineering judgment and rational arguments supported by technical concepts could be presented as an AMMR to maintain equivalency to the code's intent.

Specifically for fire-rated assemblies, IBC Section 703.3 Item 4 allows engineering analysis without necessarily using the alternate means process. Item 5 of 703.3 also specifically allows Section 104.11 to apply to a fire-resistance rating if needed.

Project Situation – IBC Section 420 requires that dwelling units in I-1, R-1, R-2 and R-3 be separated by fire partitions with 1-hour fire-resistance ratings. In a particular multifamily project, adjacent bathrooms on opposite sides of a tenant separation required variation from the scripted provisions of the referenced wall assembly to accommodate plumbing pipes and bathroom fixtures. The revised wall design included the same application of 5/8-inch Type X gypsum wallboard attached to wood studs on both sides as required by UL Design #U341 (see detail below), but the framing itself did not strictly conform.

UL Design #U341



AMMR Argument – As a valued compensatory feature to justify the acceptance of the modified fire separation wall assembly, sprinklers were added to the bathrooms, which are not required under the installation requirements of an NFPA 13R sprinkler system. Within the AMMR, it was further pointed out to the building official that plans indicated all plumbing penetrations within the concealed wall space were to have through-penetration UL-listed fire-stop systems in compliance with Section 714, "Penetrations," and the walls fire-blocked in accordance with Section 718, "Concealed Spaces." This satisfied the building official and the AMMR was approved.

Fire-Resistant Ratings of Exterior Walls

Prescriptive Requirements – Fire separation distances are used as the determining factor when assessing the fire protection requirements of exterior walls. Because a building owner has no control over what occurs on adjacent lots, the fire protection requirements of exterior walls must be regulated relative to the lot line. When buildings are on the same lot, an imaginary lot line can be drawn to best accommodate buildings on each side. When an owner's property is adjacent to a street, alley or public way, the fire separation distance is measured to the centerline because of the assumption that such areas will remain unobstructed through the years.

Table 602 specifies the fire-resistance rating requirements of exterior walls based on fire separation distance. Table 705.8 specifies the maximum area of unprotected and protected openings based on fire separation distance. An unlimited amount of unprotected openings are permitted in the exterior wall of sprinklered buildings with a fire separation distance of at least 20 feet.

Project Situation – In this example, Phase 2 of a mid-rise residential construction project was about to break ground. However, there were code concerns over the unrated glass enclosure of a stairway adjacent to the existing Phase 1 building. To clarify the intent of the code, the imaginary lot line for fire separation distance is not required to be the mid-point between the proposed and existing buildings.

Because the facing Phase 1 building wall was not rated per the existing, as-built drawings, the building official wanted to enforce a 1-hour fire-rated exterior wall requirement for the Phase 2 building's stairs.

AMMR Argument – It was proposed that the building official allow the Phase 2 building's exterior stairway wall to be designed as a non-fire-rated glazed opening based on the following substantiation:

- The stairway is separated from the Phase 2 building by a 1-hour fire-rated wall.
- The stair could have been designed as an exterior stair under Section 1026, "Exterior Exit Stairways and Ramps," since the Phase 2 building does not exceed six stories or 75 feet in height. If it were designed as an exterior stair under Section 1026, then Section 1026.5, "Location," states that it could have been left open when located at least 10 feet from other buildings on the same lot.
- The Phase 2 building stairs are over 27 feet from the existing Phase 1 building. Therefore, since the stairway was only enclosed to protect it from the weather, and will also have sprinklers in the stair enclosure, the design with the glazed stair wall was argued to be equal to, or better than, an open exterior stair.

The building official accepted these arguments and the AMMR was approved.

Right-of-Way

Prescriptive Requirements – By definition of fire separation distance, the measurement must be taken from the building face to:

1. The closest interior lot line,

2. The centerline of a street, alley or public way, or

3. An imaginary line between two buildings on the same lot.

Because the code refers to public way, it is reasonable to assume that this would be applicable to appropriate open spaces other than streets or alleys that a building official may determine are reasonably likely to remain unobstructed over the years. An AMMR is used to document this extension of the code language.

Project Situation – The building face of a parking garage adjacent to a railway right-of-way had a fire separation distance of 8 feet measured to the right-of-way property line. The railway right-of-way had an open space width of approximately 95 feet that accommodated four active tracks for three separate train lines. If compliance with the actual fire separation distance in the code were required (Table 705.8), the exterior wall of the open parking garage structure would not have complied because it had openings in excess of those permitted. However, these openings were required for ventilation of an open parking garage design under the code. In addition, if compliance with the actual fire separation in the code were required, the unrated exterior wall would not have complied with Table 602 requirements for a 1-hour fire-resistance rating at less than 10 feet fire separation distance.

The parking garage's width was necessary to provide vehicle capacity required by the occupancy's needs. This width was also necessary to provide a parking garage that would satisfy previously-approved mandatory local requirements regarding site circulation and garage capacity, and the site was too constrained to shift the entire parking garage an additional 2 feet (the fire separation distance needed for unlimited openings in an open parking garage under Table 705.8 Footnote "g" and to be permitted to have a "0" fire-rated exterior wall under Table 602) away from the right-of-way without adversely affecting the required minimum fire separation from the buildings on the opposite side of the proposed parking structure.

AMMR Argument – The following alternative method of compliance and compensatory protection was proposed:

The railway right-of-way had a width of approximately 95 feet, which is enough to accommodate the four tracks. As such, it was extremely unlikely that a building would be erected in that space in the future given the critical transportation needs of the region and the limited real estate in this area making the relocation of the four active tracks impossible.

The code modification request proposed that the required exterior wall fire-resistance rating be permitted to be zero and that the percentage of openings be unlimited for the façade facing the 95-foot-wide railway right-of-way. These reductions were consistent with the code requirements if a greater than 10-foot fire separation distance were present based on Table 602 and Footnote "g" of Table 705.8, which permits unlimited openings for an open parking structure with a 10-foot or greater fire separation distance. If the fire separation distance were permitted to be measured to the center of the right-of-way as it is for streets and public ways, it would measure over 10 feet.

The open nature of the parking structure and the proposed 2-hour horizontal fire separation between the first floor enclosed parking garage and the open parking garage, together with the addition of an NFPA 72 fire alarm system connected to a remote monitoring station, greatly increased the life safety and fire protection of the structure. The proposed garage structure also contained an additional 3'-2" of open volume per tier above the code required 7'-0" vertical clearance. This additional volume would help dissipate hot gases generated by a fire within the structure.

These arguments were accepted by the building official and the AMMR was approved.

Mezzanines

Prescriptive Requirement – Mezzanines are intermediate floor levels within rooms or spaces. The conditions placed on mezzanines in Section 505 mean they do not contribute to floor area or count as an additional story. The total area of all mezzanines typically cannot exceed one third of the floor area of the space in which they are located. Due to their open nature, it is expected that occupants of mezzanines will be immediately aware of emergency situations occurring within the space.

Project Situation – A proposed design of a four-story R-2 residential apartment building with eleven dwelling units per floor included lofts (mezzanines) in seven of the eleven apartments on the fourth floor.

The proposed building construction was Type VA, and the building was to be protected by an NFPA 13R automatic sprinkler system. Means of egress were provided by interior fire-rated common corridors with fully enclosed exit stairs at the ends of the corridors that provided direct egress to the outside at grade. The height of the building above the grade plane was less than 60 feet, and all dwelling units were located at or above the grade plane.

In order to provide the desired mixture of dwelling unit bedroom types for this project, four of the seven fourth floor apartment lofts needed to exceed the allowable area limitation for a mezzanine under IBC Section 505.2.

AMMR Argument – The following alternative fire protection features were recommended to permit this proposed four-story building, with oversized lofts in four of the dwelling units, to be approved by the building official in accordance with IBC Section 104.11.

1. In lieu of an NFPA 13R residential sprinkler system, a complete NFPA 13 sprinkler system would be provided throughout the building, which would include quick response sprinklers.
2. A manual fire alarm system would be provided for the building, even though IBC Section 907.2.9, exception 2, does not require a manual fire alarm in this fully sprinklered building.
3. Smoke alarms are required by IBC Section 907.2.10.1.2. However, all smoke alarms would be both hardwired with battery backup and dual-sensor models (ionization and photoelectric), which are best for detecting most types of fires (flaming and smoldering).

The following additional life safety attributes already provided in this small, sprinklered building were also noted in the AMMR:

1. The common path of travel to the entrance door within the fourth floor dwelling units with the oversized lofts would only be 30 feet. Table 1014.3 allows up to 125 feet of common path of travel.

2. Exit access travel distance from the entrance door of any dwelling unit, to an exit stairwell door, is less than 50 feet. Therefore, the longest total exit access distance from the oversized loft in any of the fourth floor dwelling units is 80 feet. Table 1016.2 allows the distance to be as much as 250 feet in a fully sprinklered building.

These arguments were accepted by the building official and the AMMR was approved.

Fire Resistance of Components

Prescriptive Requirements – According to the text of the 2012 IBC Section 711.4, when a non-fire-rated wood stud wall assembly abuts the bottom of a wood joist floor-ceiling fire-rated assembly employing a membrane ceiling, the membrane must be continuous above the top plate of the wall assembly. Modifications to this code section in the 2015 IBC somewhat clarify this issue; however, this example provides a rational AMMR approach to similar situations.

It is sometimes impractical to meet the membrane continuity requirements for fire-rated floor and wall assemblies as the code prescriptively outlines. During typical wood-frame construction, the framing contractor frames the entire building before the drywall contractor hangs any drywall. In the case mentioned above, the framing of wall top plates into the floor trusses, as well as the perpendicular framing of the ends of walls into adjacent walls, is performed as part of good construction practices to provide proper structural stability of all wall assemblies. Such solid wood connections at these points also provides for solid fire blocking throughout the project.

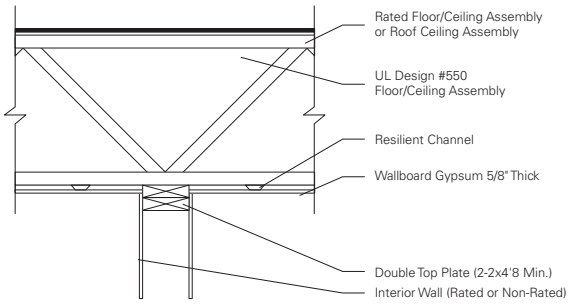
In fire-rated wood construction type buildings, there are numerous fire-rated and non-fire-rated assemblies being built at the same time. Attempting to construct the fire-rated assemblies first with the proper clearances for continuity of their "finish rating" membrane is a nearly impossible task in the real world. Having the framers attempt to place pieces of drywall between rated and non-rated assemblies during construction is likewise impractical since the building is not yet weather protected, nor can it be assured that such pieces of drywall will withstand the movement of the building during its lifetime. Having the framers maintain a minimum clearance between such assemblies is also not practical because the final stability and rigidity of walls that are not properly tied together would be extremely difficult to achieve.

Alternatives for the continuity of such membranes at connections between fire-rated and non-fire-rated wall assemblies must be practical in the real world of construction without compromising the fire ratings of the listed assemblies.

Project Situation – For an R-2, NFPA 13 sprinklered project, the floor/ceiling assembly was UL Design #L550 (1-hour-rated). This UL listed floor/ceiling assembly has a finish rating of 23 minutes. A finish rating is established by UL for assemblies containing combustible (wood) supports. The finish rating is defined in Appendix A of the IEBC as the time at which the wood stud or wood joist reaches an average temperature rise of 250°F or an individual temperature rise of 325°F as measured on the plane of the wood nearest the fire. The non-fire-rated wall assembly was constructed of minimum 1/2" regular gypsum on each side with a maximum "finish rating" of 15 minutes for the 1/2" gypsum.

Consider the following detail for the continuity of the fire-rated floor/ceiling or ceiling/roof assembly:

Connection of Non-Rated Wall to Floor/Ceiling



AMMR Argument – The following technical information regarding charring and fire resistance from the USDA Forest Products Laboratory's *Wood Handbook, Chapter 17, "Fire Safety,"* by Robert H. White and Mark A. Dietenberger (pages 17-10 to 17-12), was quoted in the AMMR:

> As noted earlier in this chapter, wood exposed to high temperatures will decompose to provide an insulating layer of char that retards further degradation of the wood. The load carrying capacity of a structural wood member depends upon its cross-sectional dimensions. Thus, the amount of charring of the cross section is the major factor in the fire endurance of structural wood members.
>
> When wood is first exposed to fire, the wood chars and eventually flames. Ignition occurs in about 2 min under the standard ASTM E119 fire-test exposures. Charring into the depth of the wood then proceeds at a rate of approximately 0.8 mm/min for the next 8 min (or 1.25 min/mm). Thereafter, the char layer has an insulating effect, and the rate decreases to 0.6 mm/min (1.6 min/mm). Considering the initial ignition delay, the fast initial charring, and then the slowing down to a constant rate, the average constant charring rate is about 0.6 mm/min (or 1.5 in/h) (Douglas-fir, 7% moisture content). In the standard fire endurance test, this linear charring rate is generally assumed for solid wood directly exposed to fire.

It was assumed for this code analysis that, for an alternative to the continuity of the ceiling membrane, which is constructed of a 23-minute "finish rating," such an alternative should be of construction components (i.e., gypsum and wood top plates) that would equal or exceed the "finish rating" of 23 minutes. Therefore, assuming a fire below the fire-rated floor/ceiling assembly, the time for penetration into the interstitial floor/ceiling space would be calculated as follows:

1. Through the one side of the 1/2" gypsum wall membrane = 15 minutes
2. Through the two, 2" wood top plates
    a. 2 minutes for ignition of the wood
    b. 8 minutes to char @ 0.8mm/min
    c. 116 minutes to burn through the rest of the wood plates (69.8 mm) @ 0.6 mm/min

This equals a total burn-through time of 141 minutes. The result is that the total time for the fire path from a room through the non-fire-rated wall into the interstitial space of the fire-rated assembly is substantially greater than the 23 minutes determined for the "finish rating" of the fire-rated floor/ceiling assembly by a factor of over four times.

It is worth noting that this issue was partially addressed in the 2012 IBC by Exception #7 in Section 714.4.1.2, and further cleaned up in the 2015 IBC as follows:

> The ceiling membrane of 1- and 2-hour fire resistance-rated horizontal assemblies is permitted to be interrupted with the double wood top plate of a wall assembly that is sheathed with Type X gypsum wallboard, provided that all penetrating items through the double top plates are protected in accordance with Section 714.4.1.1.1 or 714.4.1.1.2 and the ceiling membrane is tight to the top plates.

Practical Considerations

Many jurisdictions have a form that lays out the steps and requirements for AMMRs, which should be used as the starting point of any request. Providing a comprehensive understanding of the applicable code sections and supporting data within the form establishes a clear path for approval of an AMMR. Because the building official has final authority to approve or deny requests, communication throughout the process is key.

One compelling purpose of an AMMR is to document the deviation from the code. For this reason, jurisdictions have record retention requirements. In most jurisdictions, AMMRs become part of the "public record" of project approvals, and they should be prepared with the understanding they will be available to others in the future. This can assist in some future project where alterations are occurring, when the code compliance path of previous construction would not be obvious without reference to the actual AMMR provisions that were used. In some jurisdictions, the AMMRs are available in a publicly searchable database. One example is Portland, which makes AMMRs available here: https://www.portlandoregon.gov/bds/appeals/index.cfm?action=search.

In many jurisdictions, however, obtaining a copy of a previous AMMR requires the knowledge to specifically request it. This can make AMMRs effectively unreachable except by the firms involved in the original requests.

If there is an existing building with a similar situation to that in an AMMR, it is often possible to request a copy of the approved AMMR to use as an example.

Communication with the Authority Having Jurisdiction

Communication with the building official should begin as early in the project as possible. The requesting architect or engineer must take off his or her designer hat and put on a building official hat. In other words, the project's appearance, functionality, and cost are no longer considerations. Neither is the construction schedule. As a building official, the essential task is protecting public health, safety and welfare. These criteria are paramount when compiling an AMMR and its supporting data, which must provide proof that the proposed alternative provides performance that is equal to or better than the prescriptive code requirements.

A key element of the AMMR conversation is to give the authority time and space to educate themselves on the specific code requirements in question. Tactful education and organized evidence are also helpful. Many building officials will engage in problem solving dialog to try to find an acceptable solution. Brainstorming in this manner can be a worthwhile exercise to find an acceptable way to proceed. However, remember that a building official "thinking out loud" is not looking to assume ownership of the solution. The design professional should only adopt and present a suggestion believed to be amicable to the code official as the proposed solution if they (the designer) believe in the solution and can support it as their own. Characterization of a solution as the building official's direction may chill the chances of approval.

Supporting Data

Supporting data can fall into many categories, but the purpose is always the same—to support the argument that the AMMR contains performance equivalency to the prescriptive code requirements. Because "No" tends to be a conservative response, an AMMR should ideally be so compelling that, by not approving it, a building official would be condoning a lesser level of public safety. To this end, many architects entering into negotiations are prepared to provide additional safety components over and above the minimum solution. Resources that can be utilized for support are foundations in adopted codes, interpretive manuals, and published reports. Similar situations may be found in the code and, by seeing how they are addressed, a similar approach can be proposed in the AMMR. Some code design alternatives that are well-accepted include horizontal exits, imaginary lines, and special provisions.

Conclusion

Due to the performance-based nature of AMMRs, there are any number of possible situations where they could potentially be used. Regardless of the project or the reason for the request, a well-laid out argument is always necessary so the building official can justify approval. AMMRs must explicitly explain why a proposed solution is at least equivalent to the intent of the prescriptive code requirements. That can only be achieved after a comprehensive understanding of the intent behind applicable code sections.