ARUP

Subject	Bakers Place		
Date	June 14, 2021	Job No/Ref	602829-01

1 Petition for Variance Application: Use of 2021 ICC Suite of Codes - Supporting Information

1.1 Introduction

Bakers Place is to be constructed at 849 E Washington Ave and will be a 15 story building with a height of 150ft. The building will be three floors of parking (S-2) with 12 floors of residential use (R-2) over. The first floor will also include retail, office, assembly and back of house uses, typical of a residential building.

This document provides support of a Petition for Variance Application to use the 2021 ICC suite of codes.

1.2 Proposed Construction Type

The building construction is proposed to be three floors of concrete construction as a podium (Type IA) with the 12 floors above the podium being cold-formed steel (CFS) load-bearing interior walls and cross laminated timber (CLT) floors, as Type IV-B. Under the 2021 IBC, construction Type IV-B is permitted up to 12 floors and 180ft, for residential, office and assembly uses.

1.3 Applicable Code

The City of Madison adopts the 2015 IBC through SPS 362 “Buildings and Structures” - also known as the Wisconsin Commercial Building Code (WCBC).

1.4 Variance Request – Use of 2021 ICC Codes

The Variance Request is to utilize the 2021 ICC suite of codes for the new construction. The proposed Variance is based on using SPS 361.51 “*Alternate standards and model building codes*”.

The 2021 IBC and IFC have been amended to include three new construction types, with two of those construction types allowing high-rise mass timber construction (Types IV-B and IV-A). The 2015 IBC and 2018 IBC permit the use of mass timber construction, but limit these to 85ft in height, based on construction Types III and IV.

The 2021 IBC includes the new Type IV-B construction that permits mass timber construction for 12 floors and up to 180ft, with increased fire protection measures, when compared with Type I-B (see preliminary code review in this document). Given that the 2021 IBC is now published and available for use and permits high-rise mass timber construction, the 2021 ICC suite of codes is the most appropriate code for the building permitting process for 849 E. Washington Ave.

Section 510.2 of the 2021 IBC will also be used which allows for a multi-floor Type I-A podium, provided the overall building height is within Type IV-B height limits.

1.4.1 Background to the 2021 IBC Changes for Tall Mass Timber Buildings

The 2021 IBC and IFC include changes to allow mass timber construction that proposed by the International Code Council Ad Hoc Committee on Tall Wood Buildings (TWB). Given the anticipated demand for taller mass timber buildings, it was deemed in the best interests of the building safety community to develop comprehensive and enforceable construction requirements. In recognition of the array of benefits provided by large mass timber buildings, but also cognizant of the fire safety implications of taller buildings constructed with combustible materials, the ICC BOD established the TWB in December 2015.

The Committee was tasked with exploring the building science of mass timber and, if supported by the science, investigating the feasibility of and developing code changes for safe, tall mass timber buildings. Any such proposals were to provide assurance to the public and the fire service that code-compliant tall mass timber buildings have rigorous and redundant systems of fire protection, both passive and active, suitable for protecting the public and fire responders. Consistent with the professional expertise and stakeholder interest of the TWB, a rigorous set of performance objectives was adopted to provide guidance in the development of code change proposals:

- No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered.
- No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios.
- No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios.
- No unusual fire department access issues.
- Egress systems designed to protect building occupants during the design escape time, plus a factor of safety.
- Highly reliable fire suppression systems to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The greatest challenge for the TWB involved developing an approach to compensate for the combustible nature of mass timber while recognizing its inherent fire-resistance and fire performance. The first step was to develop a protection system which would result in performance akin to that of existing Type I-B construction, then assigning fire-resistance requirements to a proposed new construction type (IV-B) for mass timber buildings. The same process was used to evaluate IV-A and IV-C in turn.

Three new types of construction, Types IV-A, IV-B and IV-C, have been defined and are included in IBC Chapter 6, “Types of Construction”. Additionally, requirements were added to other chapters of the IBC, including Chapter 5, “General Building Heights and Areas”; Chapter 7, “Fire and Smoke

Protection Features"; Chapter 17, "Special Inspections and Tests"; Chapter 23, "Wood"; and Chapter 33, "Safeguards During Construction", among others. Collectively, these new requirements allow the use of mass timber and CLT (a type of mass timber) for buildings of taller heights, more stories above grade, and greater allowable areas compared to existing provisions for heavy timber buildings.

Further information on the code approval process, fire testing and background documents can be found at the ICC site for the TWB.

https://www.iccsafe.org/products-and-services/i-codes/code-development/cs/icc-ad-hoc-committee-on-tall-wood-buildings/

1.4.2 Use of Section SPS 361.51

SPS 361.51 "*Alternate standards and model building codes*" allows for the use of a more recent edition of a model code either through the options listed under sub-sections (2) to (7), or under sub-section (8) (copied below for information).

This Variance Application is based on Section SPS 361.51(8), which requires the proposed model code, 2021 ICC, to be noted on all documentation and used in its entirety, as per Section SPS 361.51(8)(a) to (c).

If the City of Madison consider that SPS 361.51sub-sections (2) to (7) are a more appropriate path for the Variance Application, this approach can also be followed for the project.

> ***SPS 361.51 Alternate standards and model building codes.***
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> *(1) Alternate standards or model building codes that are equivalent to or more stringent than the standards or model building codes referenced in chs. SPS 361 to 366 may be used in lieu of the referenced standards or model building codes when approved by the department or if written approval is issued by the department in accordance with sub. (2), or as allowed for alternate model building codes under sub. (8).*
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> *(2)*
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> *(a) Except as provided in sub. (8), the department may issue an approval for the use of the alternate standard or model building code upon written request and receipt of a fee in accordance with s. SPS 302.31.*
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> *(b) The department shall review and make a determination on an application for approval within 40 business days of receipt of all forms, fees and documents required to complete the review.*
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> *(3) Determination of approval shall be based on an analysis of the alternate standard and the standard or model building code referenced in chs. SPS 361 to 366, prepared by a qualified independent third party or the organization that published the standard or model building code contained in chs. SPS 361 to 366.*

(4) The department may include specific conditions in issuing an approval, including an expiration date for the approval. Violations of the conditions under which an approval is issued shall constitute a violation of chs. SPS 361 to 366.

SPS 361.51(5)(5) If the department determines that the alternate standard is not equivalent to or more stringent than the referenced standard, the request for approval shall be denied in writing.

(6) The department may revoke an approval for any false statements or misrepresentations of facts on which the approval was based.

(7) The department may reexamine an approved alternate standard and issue a revised approval at any time.

(8)

(a) An owner or a design professional may use a more recent edition of a model building code adopted in s. SPS 361.05 in lieu of the referenced model building code if all of the following apply:

1. The title and edition of the alternate model building code is identified in plan documents as required under s. SPS 361.31 (2) (e) 3.

2. The model building code is used in its entirety, including any standards referenced in the more recent edition.

(b) A plan that includes the use of an alternate model building code submitted for plan review under this subsection is exempt from fee and approval requirements under subs. (2) to (7) and petition for variance requirements under s. SPS 361.22.

(c) Nothing in this subsection shall be interpreted to allow a municipality, county, or the department to require or otherwise compel an owner or design professional to use a more recent edition of a model building code than the edition adopted under s. SPS 361.05, nor shall this subsection be interpreted to authorize a municipality or county to adopt a more recent edition of a model building code than the model building code adopted under s. SPS 361.05.

2 Preliminary Code Review

The following sections outline the required fire safety and fire protection required for a Type IV-B building, based on the 2021 IBC. The review is primarily addressing the additional fire safety and protection measures for high-rise mass timber and is not a full code review. All references to code sections are from the 2021 IBC.

Requirement or fire protection measure	**Summary of 2021 IBC requirements and code section for Type IV-B**	**Proposed for 849 E. Washington Ave**
Height and area	Residential and assembly uses are permitted up to 180ft and 12 floors (Tables 504.3 and 504.4). The allowable floor area is in the order of 75,000 sf per floor (Table 506.2).	Mass timber portion is 12 floors Floor area 19,000sf
Use of Type IA construction as a podium	Section 510.2 permits the use of separate and distinct buildings when considering number of stories and type of construction, when they meet with Section 510.2 ("podium construction").	Bakers Place is proposed to be three floors of concrete construction as a podium (Type IA) with the 12 floors above the podium being Type IV-B, meeting Section 510.2. See end of document for a copy of Section 510.2 from the 2021 IBC.
Fire resistance ratings	Type IV-B building requires all primary structure to be 2hr rated (Table 601) and roofs to be 1hr. Section 602.4 states that the mass timber elements can meet the FRR requirements through: a) The FRR of the non-combustible protection, or b) The FRR of the mass timber, or c) A combination of both (a) and (b), determined through meeting Section 703.2 or 703.6.	The mass timber at Bakers Place will achieve an FRR using all three options listed, dependent on location. The CLT to be used will have the FRR of 2hrs proven through a fire test report meeting ASTM E119 (meeting 703.2).

CLT manufacture	All cross laminated timber to be labeled as conforming to PRG-320:2018 (Section 2303.1.4).	CLT for Bakers Place will meet PRG-320:2018.
Mass timber protection	Type IV-B building requires the mass timber to be protected with non-combustible protection (Section 602.4.2.2.2). For ceilings only, 80% of the mass timber is to be protected. Where the mass timber is protected, under Section 722.7, the FRR of the mass timber elements is made up of the fire resistance of the unprotected element, added to the protection time of the noncombustible protection. For a Type IV-B building, with a FRR primary structural rating of 2hrs, 80mins of FRR is required to be provided by non-combustible protection, as per Table 722.7.1(1).	A potential request for variance may be requested to increase the exposed area, based on recent (2020) fire testing by the AWC and supporting analysis. Where the mass timber is protected, it will meet the required specifications of two layers of ⅝" Type X gyp, installed as per Section 722.7.2. The roof will also be protected in the same method as floors (602.4.2.4).
Concealed spaces	A Type IV-B building is not permitted to have combustible concealed spaces, where the mass timber is exposed. There is no definition on concealed space size, so any concealed space, that includes exposed timber, is deemed to be a combustible concealed space. In addition, where construction forms a concealed space (even if protected with Type X gyp), under Section 602.4.2.5, concealed spaces are not to contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code.	At Bakers Place, where construction forms a combustible concealed space, it is to be protected in accordance with Section 602.4.1.2 and 604.2.2.1. This requires non-combustible protection of 80 minutes, achieved by two layers of ⅝" Type X gyp. The gyp is to be installed as per Section 722.7.2, so that no timber is exposed within the concealed space.
Elevator and stair shafts	Elevator and stair shafts are to achieve a 2hr FRR and can be of mass timber construction (602.4.2.6)	Elevators and stairs at Bakers Place will be of non-combustible CFS and

		Type X gyp, meeting 2hr FRR. Riser shafts for MEP & FP will be of non-combustible construction.
Interior finishes	All interior finishes will need to meet Table 803.11, which will be Class C for R-2. Class B will need to be met in some exit access routes, given the Assembly uses.	Exposed CLT at Bakers Place will meet Class C, proven through ASTM E84 testing, per 803.1.2
Penetrations	Where mass timber building elements have penetrations, the fire resistance rating will need to be retained, which can occur through a proprietary fire sealant product, as per Section 714.	Product details are to be provided, with each penetration fire seal being tested for use within CLT, meeting ASTM E119 or ASTM E814.
Mass timber junctions and connections	Connections between CLT panels are to have an FRR that is consistent with the panels proven through a fire test (in accordance with Section 703.2). All junctions between CLT that require an FRR, are to be sealed with an air-tight sealant. Sealants or adhesives shall meet the requirements of ASTM C920 or ASTM D3498 (Section 703.9). The sealant or adhesive is not required where the panel joint has a fire test that does not require them.	Connections between CLT panels for Bakers Place will have the FRR for the connections proven through a fire test in accordance with Section 703.2.
CLT covering	The CLT floor is to be covered with concrete or "dry" solution that must be a minimum of 1" thick and be non-combustible (Section 602.4.2.3). For the dry solution, there must be no gaps between layers, otherwise a concealed space is created.	Bakers Place CLT will have a lightweight concrete screed of at least 1.5".
Exterior walls	Exterior walls above 40ft are to be non-combustible and to meet with NFPA 285, as per Chapter 14. The water resistive barrier is also required to be of limited combustibility.	Exterior walls will meet NFPA 285, as per Section 1402.5.
Fire protection	As a high-rise building, Section 403 is required to be met.	Bakers Place will meet all fire protection requirements of Section

	Section 403.3.2 requires IV-B buildings of more than 120 ft in building height, to have fire pumps supplied by connections to not fewer than two water mains, located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate. Section 3007 provides requirements for fire service access elevators which will be met.	403, including two fire service access elevators.
Construction fire safety measures *(Variance to be requested – see below)*	Construction fire safety measures are included within the 2021 IFC Chapter 33 "Fire Safety During Construction and Demolition": • Standpipes are required to be provided meeting Section 3313. • A water supply for fire department operations, as approved by the fire code official and the fire chief. • Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the IBC shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels. ○ Exception: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction. • Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.	All required fire protection measures will be provided.

Special inspections	Requirements for special inspections (Section 1705) and listed in Table 1705.5.3 are included in the 2021 IBC. Section 1705.19 also requires periodic special inspections of sealants or adhesives, where those sealants or adhesives are required by Section 703.9.	WCBC does not require Special Inspections and hence this requirement is to be addressed with the City of Madison.
Building in use requirements	The IFC requires the following building in use requirement, specifically for the mass timber non-combustible protection to be inspected annually: Section 701.6 *Owner's responsibility. The owner shall maintain an inventory of all required fire-resistance-rated construction, construction installed to resist the passage of smoke and the construction included in Sections 703 through 707 and Section 602.4.1 and 602.4.2 of the International Building Code. Such construction shall be visually inspected by the owner annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained. Where concealed, such elements shall not be required to be visually inspected by the owner unless the concealed space is accessible by the removal or movement of a panel, access door, ceiling tile or similar movable entry to the space.*	The required building in use measures will be followed.

2.1 Use of Section 510.2

Section 510.2, whereby the first three floors are concrete construction meeting type IA and a 3hr separation is provided at the third floor, therefore permitting the 12 floor Type IV-B building to be constructed within height, area and number of floor limits is proposed for the building. Section 510.2 from IBC 2021 is copied below for information.

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 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. Where vertical offsets are provided as part of a *horizontal assembly*, the vertical offset and the structure supporting the vertical offset shall have a *fire-resistance rating* of not less than 3 hours.
2. The building below, including the *horizontal assembly*, is of Type IA construction.
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.

   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, the enclosure walls extending above the *horizontal assembly* shall be permitted to have a 1-hour *fire-resistance rating*, provided that the following conditions are met:

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

4. *Interior exit stairways* located within the Type IA building are permitted to be of combustible materials where the following requirements are met:
   4.1. The building above the Type IA building is of Type III, IV, or V construction.
   4.2. The *stairway* located in the Type IA building is enclosed by 3-hour fire-resistance-rated construction with opening protectives in accordance with Section 716.
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 occupancy allowed by this code except Group H.
7. 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*.