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Serviceability Brief

Proposed Residential Development
3430 Carling Avenue
OTTAWA, ONTARIO

Prepared For:
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PROJECT #: 220978

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APPENDIX

1 INTRODUCTION

This brief has been prepared in support of a site plan control application to the City of Ottawa to construct two-six storey mid-rise apartment buildings, 106 units and 92 units respectively, on the property at 3430 Carling Avenue, City of Ottawa. The property is located on the south side of Carling Avenue, between Ullswater Drive and Crystal Beach Drive.

The existing site is currently occupied by a 1 storey 852 square metre commercial building. The majority of the remainder of the site area is surfaced with asphaltic concrete pavement. The existing building is provided with water and sanitary services from Carling Avenue which enter the site about 45 metres west of the east property line.

It is understood that the owner of the subject property intends to demolish the existing building and construct the proposed apartment buildings fronting onto Carling Avenue. The proposed building will be serviced by new services connecting to the water main and sanitary sewer along Carling Avenue. The existing services of the building to be demolished will be abandoned in accordance with City of Ottawa standards.

This brief presents a description of the proposed servicing and an analysis of the adequacy of the existing sanitary sewers and water main to accommodate the sewer and water demands associated with the proposed development. This brief also presents a summary of the stormwater management requirements for the site.

2 STORMWATER MANAGEMENT DESIGN

The stormwater management design for the site has been completed under a separate report Stormwater Management Report, Proposed Residential Development, 3430 Carling Avenue, Ottawa, Ontario prepared by Kollaard Associates Inc, File No. 220978 dated December 14, 2022.

The stormwater management for the site consists of controlling the post-development release rate from the stormwater originating on the roof such that the total post-development runoff rate from the site during a 100 year design storm is less than the runoff rate from a 5 year storm assuming pre-development site conditions equal to a runoff coefficient of C = 0.5. Stormwater will be temporarily stored on site and will be released at a controlled rate during and following a rainstorm event to the existing 600 mm diameter concrete storm sewer along Carling Avenue.

3 SANITARY DESIGN

Sewage discharges will be domestic in type and in compliance with the City of Ottawa Sewer Use By-law. The anticipated peak sanitary flow will be a total of approximately 4.02 L/s.

The sanitary sewage flow for the building was calculated based on the City of Ottawa Sewer Design Guidelines (as modified by the Technical Bulletins) and the Ontario Building Code (O.B.C Table 8.2.1.3A).

The sanitary service lateral from the proposed development will be connected to the existing 375 mm diameter concrete sanitary sewer along Carling Avenue. The existing sanitary service lateral to Carling Avenue will be blanked at the property line.

3.1 Design Flows

The residential design flows were calculated using the Ottawa Sewer Guidelines – Technical Bulletin ISTB-2018-01.

<u>Residential</u>

Total domestic pop:		
Bachelor units	*(0) x 1.4 ppu:*	*0*
One Bedroom units	*(106) x 1.4 ppu:*	*148.4*
Two Bedroom units	*(92) x 2.1 ppu:*	*193.2*
Three Bedroom units	*(0) x 3.1 ppu:*	*<u>0</u>*
Total:		341.6 (342)

$Q_{Domestic}$ = 342x 280 L/person/day x (1/86,400 sec/day) = 1.11 L/sec

$$\text{Peaking Factor} = 1 + \left(\frac{14}{4+\left(\frac{342}{1000}\right)^{1/2}}\right) * 0.8 \quad = \quad 3.44(4\ \text{maximum})$$

$Q_{Peak\ Domestic}$ = 1.11 L/sec x 3.54 = 3.82 L/sec

<u>Infiltration</u>

$Q_{Infiltration}$ = 0.33 L/ha/sec x 0.62ha = 0.20 L/sec

Total Peak Sanitary Flow = 3.82 + 0.20 = 4.02 L/sec

3.2 Sanitary Service Lateral

The maximum peak sanitary flow for the building is 4.02 L/sec. The Ontario Building Code specifies minimum pipe size and maximum hydraulic loading for sanitary sewer pipe. OBC 7.4.10.8 (2) states "Horizontal sanitary drainage pipe shall be designed to carry no more than 65% of its full capacity." The capacity of the proposed 200 mm diameter PVC sanitary sewer lateral at a minimum slope of 1% is 32.8 L/sec. Since 0.65 x 32.8 = 21.32 L/s is much greater than 4.02 L/sec, a single sanitary sewer service lateral of 200 mm diameter at a minimum 1% slope will be sufficient.

A 1200 mm diameter sanitary inspection and sampling maintenance hole will be installed in line with the sanitary service. This maintenance hole will be located within the Carling Avenue right of way with a maintenance and liability agreement clause added to the site plan agreement.

The new lateral is to be installed at the location indicated on the Site Servicing drawing 220978– SER. The proposed sanitary service is to connect to the existing 375 mm diameter PVC sanitary sewer with a T connection.

Due to the depth of the existing sanitary sewer main the sanitary lateral will be installed at a slope of about 13%. Sewer design calculations for a 200 mm diameter PVC sanitary sewer at 13% indicate a full flow velocity of about 3.8 m/s which is greater than the maximum allowable flow velocity of 3 m/s in a sanitary sewer. The actual flow velocity for the peak design flow rate of 4.02 L/s is 1.8 m/s which is within the allowable velocity range of 0.6 to 3.0 m/s.

3.3 Sufficiency of Existing Municipal Sanitary Sewer

The existing sanitary sewer along Carling Avenue consists of 375 mm diameter PVC sanitary sewer with a slope of 0.19 percent. From previous correspondences with the City of Ottawa as part of the J.L. Richards Limited Report No.: 3114-001, it was provided that the existing sanitary service is capable of handling an increase in flows by 5.16 L/s. The maximum peak sanitary flow as calculated above for the proposed development is 4.02 L/s, which is less than the previously accepted threshold as outlined by the City of Ottawa.

4 WATERMAIN DESIGN AND WATER DEMAND

The existing water lateral is to be blanked at the watermain on Carling Avenue to the satisfaction of the City of Ottawa Services. The building will be provided with two 150 mm diameter water services. The proposed water service laterals will be connected to the 305 mm diameter CI municipal Watermain on Carling Avenue and will be separate from each other by an existing valve on the watermain. Both services will be connected by means of "T" connections as indicated on the Site Servicing drawing 220978- SER. The water demand for the site consists of three parts which include: domestic water consumption, sprinkler flow allowance, and fire flow requirement.

4.1 Fire Flow Requirement

4.1.1 Calculation Procedure

The fire flow requirement was calculated for the proposed buildings to ensure that there is adequate flow available to put out a fire within the proposed building should it occur. The fire flow calculation determines the minimum water flow or volume required to be available for firefighting purposes to be used by firefighters. In accordance to City of Ottawa Technical Bulletin ISTB-2021-03, the fire flow requirement calculation for private property is to first consider the Ontario Building Code (OBC). If the fire protection requirement from the OBC yields a fire flow greater than 9,000 L/min then the Fire Underwriters Survey (FUS) shall be used to determine the Fire Flow Demand.

Technical Bulletin ISTB-2021-03 provides the following direction with respect to the calculation of the fire flow requirement.

> "The requirements for levels of fire protection on private property in urban areas are covered in Section 7.2.11 of the Ontario Building code. If this approach yields a fire flow greater than 9,000 L/min then the Fire Underwriters Survey method shall be used to determine these requirements instead."

Using the formula Q = KVSTot provided in the OBC results in a fire flow requirement much greater than 9,000 L/min. As such the FUS method shall be used.

4.1.2 Building Construction and Construction Type Consideration

The proposed buildings are 6 storey wood frame buildings with a foot print of 1342 m^2 for the west building and 1270 m^2 for the east building. This results in total building areas of 7686 m^2 and 7620 m^2 for the west building and east building respectively. The buildings will be equipped with a fully automatic and monitored sprinkler system. Elements of the wood framing will be sprayed with a flame retardant treatment which reduces effective flame spread between floors or dwelling units or neighboring properties. The exterior wall will be covered with non combustible gladding, have non combustible insulation and will be covered on the interior with 16 mm Type X drywall. This results in an exterior wall assembly having a minimum fire rating of at least 1 hour. The interior walls between units will have a minimum rating of 1 hours. Each floor within the building will also be constructed with a minimum fire rating of 1 hours.

The fire flow demand using the FUS calculations were completed using the protocol established in City of Ottawa Technical Bulletin ISTB-2018-02 and in consideration of the following:

a) NRC Page G-94 5 A (second point) - Two factors should be considered when selecting coefficient C: the fuel load (total amount of potential fuel) contained within the structure of the building, and the ability of the structure to contain fires. Buildings with structural systems that include combustible materials (such as wood framing) require higher fire flows than buildings with non-combustible structures, because combustible structural materials contribute to the fuel load inside a building. In buildings with non-combustible structures, fire flow requirements depend on the ability of the structure to contain fires, as appraised by the fire-resistance rating of structural components (duration for which structural components can withstand exposure to a standardized fire).
b) NRC Page G-95 5 A (fourth point, fourth sub-point) The definition of wood frame construction in FUS corresponds precisely to that of ISO construction class 1 (frame). Buildings with a combustible structural system fall within this category when they do not qualify as ordinary construction, because their exterior walls are: (a) combustible, (b) slow-burning or (c) non-combustible with a fire-resistance rating of less than 1 hour.
c) NRC Page G-96 5 A (sixth point, third sub-point) Any building not qualifying under the fire-resistive construction or non-combustible construction types and having % (67%) or more of its exterior walls constructed from : (a) masonry or (b) non-combustible assemblies with a fire-resistance rating of 1 hour or longer can be considered to be of ordinary construction type (C = 1.0).

It is considered that a typical wood frame building would normally be considered to be classified as an ISO class 1 (frame) building or a FUS Wood frame construction with a coefficient C of 1.5. It is however considered that the construction of the proposed building will meet the fire resistive requirements of an ISO class 2 building or FUS Ordinary construction with a coefficient C of 1.0. This is supported by the proposed construction in consideration of points a, b, and c above. With respect to point a and b, even though the wood frame is combustible, the cladding, insulation and interior sheeting are non combustible reducing the available fuel within the assembly and making flame transfer and fire spread from assembly to assembly unlikely. With respect to point c, the proposed building will be constructed with more than 67 percent of its exterior assemblies having a fire resistive rating of greater than 1 hours.

4.1.3 Fire Flow Demand

The fire flow demand calculation has been included in Appendix B. Based on the FUS calculations, the fire flow requirement for the proposed west and east buildings considering total building areas of 7686 m^2 to 7620 m^2 is 15,000 L/min or 250 L/sec. Based on previous boundary conditions provided by the City of Ottawa (J.L. Richards Limited No.: 3114-001), boundary conditions for the site allow for a fire flow at 20 psi of 189 L/s. Since the required fire flow of 250 L/s is greater than the available fire flow, a firewall will be used in each building to reduce the total building floor area considered in the calculations. A firewall should be located in each building in a manner that will result in a maximum floor area of 825 m^2. The use of a firewall will result in a fire flow requirement of 11,000 L/min of 183.3 L/s, which falls within the City of Ottawa's boundary conditions.

4.2 Domestic Water Demand

The water demand for the proposed development was calculated based on the City of Ottawa Water Distribution Design Guidelines (as amended) as follows:
Residential
342 persons x 280 L/person/day x (1/86,400 sec/day)

- Average daily demand 1.11 L/s
- Maximum daily demand (factor of 2.5) is 0.27 L/s x 2.5 = 2.77 L/s
- Peak hourly demand (factor of 2.2) = 0.68 L/s x 2.2= 6.10 L/s

4.3 Boundary Conditions

The water demand due to occupancy together with the fire flow requirements were provided to the City of Ottawa in 2021 as part of the J.L. Richard Limited Report No.: 3114-001. The total population of the JLR project was slightly higher than the total population of the proposed development. For this reason, the boundary conditions provided by the city of Ottawa as a part of the previous application represent a conservative estimation. The information provided as part of the report was as follows:

- Amount of fire flow 183.3 L/s
- Average daily water demand 1.27 L/s
- Maximum daily water demand 4.11 L/s
- Peak hourly water demand 6.17 L/s

It is assumed that the water service will be connected to the 305 mm CI water main along Carling Avenue.

As previously indicated in the J.L Richards Limited Report No.: 3114-001, the following are the boundary conditions, HGL, for hydraulic analysis that were provided by the city of Ottawa in 2021 for the above indicated peak hourly demand and fire flow demand.

Minimum HGL = 105.9m
Maximum HGL = 115.5 m

Available fire flow at 20 psi = 189 L/s, assuming a ground elevation of 64.5 m

Correspondence with the City of Ottawa is included in Appendix A

Assuming a ground elevation of 64.5m, a residual pressure of 20 psi (174 kPa) is equal to a HGL of 82.25 m.

4.4 Sprinkler Flow Allowance

The sprinkler flow allowance is ultimately determined by the Mechanical Engineer during design for building permit purposes. However, at this time no mechanical engineer has been retained. For the purposes of verifying the adequacy of the available water supply and the required building service size, the sprinkler flow allowance has been determined in keeping with NFPS 13 Chapter 19.2.3. Excerpts of the NFPA 13 are included in Appendix B.

From Annex A of NFPA 13, the proposed residential building occupancy classification is Light hazard. From table 19.2.3.1.1 the minimum sprinkler water supply is 0.1 gpm /ft^2 using a minimum area of 1500 ft^2 or 4.1mm/min using a minimum area of 140 m^2. As previously indicated, the building footprint per floor ranges from 1281 to 1235 square metres, divided by a firewall to maximum floor areas of 825 m^2. Assuming that the sprinkler system will be designed to limit the sprinkler discharge to the area affected by a fire, the water demand area will be limited. For the purposes of estimating the sprinkler flow allowance, it was assumed that the sprinkler discharge would be limited to 25% of a single floor plus the corresponding floor areas above and below the affected area.

The water demand area would be limited to 825 m^2 x 0.25 x 3 = 206 m^2 x 3 = 619 m^2

A sprinkler demand of 4.1mm/min x 619 m^2 = 2538 L/min or 42.3 L/s.

4.5 Water Service Requirements and Pressure Loss Calculations

The maximum and minimum pressures were determined for both the mechanical room (water entry point) and the sixth floor using two water demand scenarios. The pressure losses were calculated assuming a 152mm diameter service. Using the provided maximum HGL of 115.5 m and linear interpolation, a flow rate of (42.3 L/s + 1.1 L/s) 43.4 L/s was determined to result in a maximum HGL of 107.2 m. Using the provided minimum HGL of 105.9 m and linear interpolation, a flow rate of (42.3 L/s + 6.1 L/s) 48.4 L/s was determined to result in a minimum HGL of 99.6 m.

During the first scenario, only the residential water demand was considered. The maximum pressure was determined using the maximum HGL and the average daily water demand of 1.1

m/s. The minimum pressure was determined using the minimum HGL and the maximum hourly water demand of 6.1 L/s.

During the second scenario, the sprinkler demand was added to the residential water demand. The maximum pressure was determined using an HGL of 107.3 m. The minimum pressure was determined using an HGL of 99.6 m.

The pressure loss to the mechanical room and to the sixth floor of the proposed building was calculated using Bernoulli's Equation in Combination with the Darcy – Weisbach Equation and the Colebrook Equation. The equations are shown below.

$$H_P + Z_1 - Z_2 + \frac{P_1 - P_2}{S} + \frac{V_1^2 - V_2^2}{2g} = h_f + h_m \quad \text{where:}$$

$$h_m = K_m \frac{V^2}{2g} \qquad \mathrm{Re} = \frac{VD}{\nu} \qquad Q = VA \qquad A = \frac{\pi}{4} D^2$$

$$\text{Darcy – Weisbach Equation: } h_f = f \frac{L}{D} \frac{V^2}{2g} \quad \text{where:}$$

$$\text{If laminar flow } \left(\mathrm{Re} < 4000 \text{ and any } \frac{e}{D}\right), \quad f = \frac{64}{\mathrm{Re}}$$

$$\text{If turbulent flow } \left(4000 \le \mathrm{Re} \le 10^8 \text{ and } 0 \le \frac{e}{D} < 0.05\right), \text{ then}$$

$$\text{Colebrook Equation: } \frac{1}{\sqrt{f}} = -2.0 \log\left(\frac{e/D}{3.7} + \frac{2.51}{\mathrm{Re}\sqrt{f}}\right)$$

150 mm Diameter Service			Grade Elevation		Hydraulic Grade line		Pressure	
Pipe Sections	Along	End	Start m	End m	Start m	End m	P_{start} KPa	P_{end} KPa
First Scenario								
Parking Garage Level 1								
Carling (min HGL)	Service	Mechanical Room	64.50	63.20	105.90	105.86	406	418
Carling (max HGL)	Service	Mechanical Room	64.50	63.20	115.50	115.50	500	513
Floor 6								
Carling (min HGL)	Service	6th storey	64.50	83.80	105.90	105.82	406	216
Carling (max HGL)	Service	6th storey	64.50	83.80	115.50	115.50	500	311
Second Scenario								
Parking Garage Level 1								
Carling (min HGL)	Service	Mechanical Room	64.50	63.20	99.6	97.1	344	332
Carling (max HGL)	Service	Mechanical Room	64.50	63.20	107.2	105.2	419	411
Floor 6								
Carling (min HGL)	Service	6th storey	64.50	83.80	99.6	95.7	344	117
Carling (max HGL)	Service	6th storey	64.50	83.80	107.2	104.1	419	199

In general conformance with the MOE Guidelines, and City of Ottawa Technical Bulletin ISD-2010-2, the desired range in pressure should be approximately 350KPa (50psi) to 480KPa (70psi) during normal operating conditions. Additionally the distribution system shall be sized so that under maximum hourly demand conditions the pressures are not less than 276 kPa (40 psi.). As per the Ontario Building Code, the maximum pressure should not exceed 552KPa (80psi).

Based on the results of the analysis as presented in the above tables, when using 152 mm diameter service, the above minimum and maximum HGL provide a water pressure of between 418 KPa and 513 KPa at the proposed building. The minimum residual pressure, calculated at the mechanical room, when there is sprinkler demand would be 340 kPa or well above the minimum of 276 kPa. However the residual pressure at the sixth floor will be below the minimum pressure of 276 kPa (40 psi.) during minimum HGL conditions assuming Residential flow only and will be below 276 kPa in all senarios when there is sprinkler demand. As such, an internal booster pump will be required to ensure adequate pressure and flow in the top storeys of the building.

The City Boundary Conditions are provided based on computer modeling of the water network. During construction, a pressure check is to be completed to determine that the pressure in the system at the building does not exceed 552 KPa. If the pressure does exceed 552 Kpa a pressure reducing valve would have to be installed downstream of the isolation valve and water meter in the building.

Based on the above calculations and in consideration of the proposed building sprinkler demand a 150mm diameter service is proposed.

4.6 Existing Fire Hydrants

City of Ottawa Technical Bulletin ISTB-2018-02 Appendix I Table 1 provides guidance with respect to the contribution of nearby fire hydrants to the required fire flow. From this table, a Class AA hydrant can contribute a maximum flow of 5,700 L/min when located less than 75 metres from the building and 3,800 L/min when located between 75 and 150 metres from the building.

Four Class AA fire hydrants have been located in the vicinity of the development and are considered for fire flow requirements. Two of the hydrants are located on the 305mm CI watermain beneath Carling Avenue. The first hydrant is located on the subject property, and the other is located on the north side of Carling Avenue adjacent to the western property line approximately 31m from the subject property. One of the hydrants is located on a 203mm DI along the Elterwater Avenue is approximately 33 metres south of the site.

One class AA hydrant, located on the 152mm DI watermain along Sunny Brae Avenue across the road from the north east property corner (approximately 94 metres from the subject property), is less than 150m but greater than 75m from the site.

Building	Fire Flow Demand (L/min)	Fire Hydrant(s) within 75m x Hydrant Contribution	Fire Hydrant(s) within 150 m x Hydrant Contribution	Combined Available Fire Flow (L/min)
6 Storey Sprinklered Apartment	11,000 L/min	3 x 5,700 L/min	1 x 3,800 L/min	20,900 L/min

Notwithstanding the above:

The flows provided for in City of Ottawa Technical Bulletin ISTB-2018-02 Appendix I Table 1 are the fire hydrant capacities based on hydrant class and distances to proposed buildings. Those flows are not available flows but the maximum flows that can be obtained from a hydrant.

The available fire flow at the watermain at 20psi is 11,340 L/min. This was provided by the City at the time of boundary conditions (Per J.L. Richards Report No.: 3114-001). As such, the above calculated combined available flow of 20,900 L/min overestimates the actual available flow of 11,340 L/min.

There are enough fire hydrants to accommodate a required fire flow of 11,000 L/min.

Since the calculated flow demand of 11,000 L/min is less than the maximum theoretical flow from the hydrants and is less than the available flow of 11,340 L/min, the existing nearby hydrants will adequately service fire flow requirements. Since there is an existing fire hydrant on the subject site, as well as all building entrances being within 90 metres of en existing hydrant, there is no requirement for an additional onsite hydrant to service the proposed buildings.

5 CONCLUSIONS

This report addresses the adequacy of the existing municipal sanitary sewer system and watermain to service the proposed development of the residential use building on Carling Avenue. The report also provides a summary of the stormwater management design presented under separate cover. Based on the analysis and summary provided in this report, the conclusions are as follows:

Stormwater management for the site has been designed to ensure that post-development runoff rate from the site during a 100 year storm event does not exceed the pre-development runoff rate during a 5-year storm assuming an average runoff coefficient of C = 0.5 for pre-development runoff conditions. Stormwater storage will be provided on site and released at a controlled rate. Discharge will be directed to the existing sewer along Carling Avenue.

The proposed buildings will be serviced by a 200 mm diameter PVC sanitary service. The proposed sanitary service will be connected to the existing 375 mm diameter sanitary sewer on Carling Avenue. The peak sewage flow rate from the proposed development will be 4.02 L/sec. The existing municipal sanitary sewer should have adequate capacity to accommodate the increase in peak flow. The City has not identified any capacity issues in the existing sanitary sewer system.

The proposed building will be serviced by two 150 mm diameter PVC water services.The proposed services will be connected to the existing 305 mm diameter CI watermain along Carling Avenue. There is sufficient capacity and pressure within the municipal water system adjacent the site to meet the domestic and fire flow requirements.

We trust that this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we can be of any further assistance to you on this project, please do not hesitate to contact our office.

Sincerely,
Kollaard Associates Inc.

Prepared by:

Nick Recoskie, EIT

Reviewed by:

LICENSED PROFESSIONAL ENGINEER
14.DEC.2022
S.E. deWit
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Steve deWit, P.Eng.

Appendix A –Correspondence With City of Ottawa

- Boundary Conditions

Guy Forget

From:	Valic, Jessica <jessica.valic@ottawa.ca>
Sent:	Wednesday, July 14, 2021 3:39 PM
To:	Annie Williams
Cc:	Lucie Dalrymple; Guy Forget; 'resposito@omnipex.ca'
Subject:	RE: 3430 Carling Ave - Request for Hydraulic Boundary Conditions
Attachments:	3430 Carling Avenue July 2021.pdf

Good afternoon Annie,

As requested, here are the boundary conditions for the proposed development:

The following are boundary conditions, HGL, for hydraulic analysis at 3430 Carling Avenue (zone 1W) with an assumed dual connection to the 305 mm watermain on Carling Avenue (see attached PDF for location).

Minimum HGL: 105.9 m

Maximum HGL: 115.5 m

Available Fire Flow at 20 psi: 189 L/s, assuming a ground elevation of 64.5 m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Thanks,
Jessica

From: Annie Williams <awilliams@jlrichards.ca>
Sent: July 09, 2021 2:54 PM
To: Valic, Jessica <jessica.valic@ottawa.ca>
Cc: Lucie Dalrymple <ldalrymple@jlrichards.ca>; Guy Forget <gforget@jlrichards.ca>; 'resposito@omnipex.ca' <resposito@omnipex.ca>
Subject: RE: 3430 Carling Ave - Request for Hydraulic Boundary Conditions

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ATTENTION : Ce courriel provient d’un expéditeur externe. Ne cliquez sur aucun lien et n’ouvrez pas de pièce jointe, excepté si vous connaissez l’expéditeur.

,

You are correct, we should have five (5) floors at 912 m2.

Please find attached the updated attachments and I've updated our summary below:

Average Day = 1.27 L/s
Maximum Day = 4.11 L/s
Peak Hour = 6.17 L/s
Minimum Hour = 0.33 L/s
Required Fire Flow (RFF) for Critical Fire Area 1 = 16,000 L/min (267 L/s)
RFF for Critical Fire Area 2 = 14,000 L/min (233 L/s)

Please let me know if you have any other questions.

Thank you,
Annie

Annie Williams, P.Eng.
Civil Engineer

J.L. Richards & Associates Limited
700 - 1565 Carling Avenue, Ottawa, ON K1Z 8R1
Direct: 343-803-4523

From: Valic, Jessica <jessica.valic@ottawa.ca>
Sent: Friday, July 9, 2021 2:10 PM
To: Annie Williams <awilliams@jlrichards.ca>
Cc: Lucie Dalrymple <ldalrymple@jlrichards.ca>; Guy Forget <gforget@jlrichards.ca>; 'resposito@omnipex.ca' <resposito@omnipex.ca>
Subject: RE: 3430 Carling Ave - Request for Hydraulic Boundary Conditions

Hello Annie,

Can you please confirm that the building areas used for the FUS Calcs are correct for both buildings? The floor areas for both Buildings seems to be short 912 m2. Are there four floors or 5 floors at 912m2?

If the floor areas need to be amended, can you please revise the FUS sheets to reflect any trickle-down effects on the required fire flow? I will submit for boundary conditions after this is confirmed.

Appendix B – FUS Fire Flow Calculations
– NFPA excerpts

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CALCULATION OF FIRE FLOW REQURIEMENTS - 3430 CARLING AVENUE (WEST BUILDING)
Calculation Based on Fire Underwriters Survey, 1999 and Ottawa Technical Bulletin ISTB-2018-02

Proposed Building:
6 storey wood frame building with non combustible cladding and fire protected exterior walls.
Full Building - No Fire Wall

1) An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \times C \times \sqrt{A}$$

where F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction:
- 1.5 for wood construction (structure essentially combustible)
- 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
- 0.8 for noncombustible construction (unprotected metal structural components, masonary or metal walls)
- 0.6 for fire-resistive construction (fully protected frame, floors, roof)

No. of Floors = 6 (FUS excludes basements that are at least 50% below grade)
Area (per floor) = 1342 m^2
A = 7686 m^2
C = 1.0
F = 19,287 L/min -----------------------> Rounded to nearest 1000 = **19,000** L/min

2) The value obtained in 1) may be reduced by as much as 25% for occupancies having a low

Non-combustible =	-25%
Limited Combustible =	-15%
Combustible =	0%
Free Burning =	15%
Rapid Burning =	25%

Reduction due to low occupancy hazard = -15% x 19,000 = **= 16,150** L/min

3) The value above my be reduced by up to 50% for automatic sprinlker system

Reduction due to automatic sprinker system = -40% x 16,150 = **-6,460** L/min

4) The value obtained in 2. may be increased for structures exposed within 45 metres by the fire

Separation (metres)	Condtion	Max Charge*
0m to 3.0m	1	25%
3.1m to 10.0m	2	20%
10.1m to 20.0m	3	15%
20.1m to 30.0m	4	10%
30.1m to 45.0m	5	5%
45.1m to	6	0%

Charge for separation has been modified by Technical Bulletin ISTB-2018-02 based on construction and Length-Height Factor
Lenght*Height (L * H) = Exposed wall length in feet x height of building in stories
No of Stories = 6

Exposures	Distance(m)	Length (m)	L * H	Condition		Charge
Front (north)	48.0	35	210	6	-------->	0%
Back (south)	23.7	35	210	4	-------->	10%
Side 1 (west)	21.0	25	150	4	-------->	10%
Side 2 (east)	11.6	25	150	3	-------->	15%
						35%

Increase due to separation = 35% x 16,150 = **5,653** L/min

The fire flow requirement is = **16,150**
Reduction due to Sprinkler = **-6,460**
Increase due to Separation = 5,653
15,343

The Total fire flow requirement is = 15,000 L/min
or **250.0** **L/sec**

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CALCULATION OF FIRE FLOW REQURIEMENTS - 3430 CARLING AVENUE (WEST BUILDING)

Calculation Based on Fire Underwriters Survey, 1999 and Ottawa Technical Bulletin ISTB-2018-02

Proposed Building:
6 storey wood frame building with non combustible cladding and fire protected exterior walls.
With Firewall Reducing Building Foot Floor Area

1) An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \times C \times \sqrt{A}$$

where
F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction:
- 1.5 for wood construction (structure essentially combustible)
- 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
- 0.8 for noncombustible construction (unprotected metal structural components, masonary or metal walls)
- 0.6 for fire-resistive construction (fully protected frame, floors, roof)

No. of Floors = 6 (FUS excludes basements that are at least 50% below grade)
Area (per floor) = 825 m^2
A = 4950 m^2
C = 1.0
F = 15,478 L/min -----------------------> Rounded to nearest 1000 = **15,000** L/min

2) The value obtained in 1) may be reduced by as much as 25% for occupancies having a low

Non-combustible =	-25%
Limited Combustible =	-15%
Combustible =	0%
Free Burning =	15%
Rapid Burning =	25%

Reduction due to low occupancy hazard = -15% x 15,000 = **= 12,750** L/min

3) The value above my be reduced by up to 50% for automatic sprinlker system

Reduction due to automatic sprinker system = -40% x 12,750 = **-5,100** L/min

4) The value obtained in 2. may be increased for structures exposed within 45 metres by the fire

Separation (metres)	Condtion	Max Charge*
0m to 3.0m	1	25%
3.1m to 10.0m	2	20%
10.1m to 20.0m	3	15%
20.1m to 30.0m	4	10%
30.1m to 45.0m	5	5%
45.1m to	6	0%

Charge for separation has been modified by Technical Bulletin ISTB-2018-02 based on construction and Length-Height Factor
Lenght*Height (L * H) = Exposed wall length in feet x height of building in stories
No of Stories = 6

Exposures	Distance(m)	Length (m)	L * H	Condition		Charge
Front (north)	48.0	66	396	6	-------->	0%
Back (south)	23.7	62	372	4	-------->	10%
Side 1 (west)	Fire Wall	22	132	#N/A	-------->	0%
Side 2 (east)	11.6	22	132	3	-------->	15%
						25%

Increase due to separation = 25% x 12,750 = **3,188** L/min

The fire flow requirement is = **12,750**
Reduction due to Sprinkler = **-5,100**
Increase due to Separation = 3,188
10,838

The Total fire flow requirement is = 11,000 L/min
or **183.3** **L/sec**

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CALCULATION OF FIRE FLOW REQURIEMENTS - 3430 CARLING AVENUE (EAST BUILDING)

Calculation Based on Fire Underwriters Survey, 1999 and Ottawa Technical Bulletin ISTB-2018-02

Proposed Building:

6 storey wood frame building with non combustible cladding and fire protected exterior walls.
Full Building - No Fire Wall

1) An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \times C \times \sqrt{A}$$

where F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction:

1.5	for wood construction (structure essentially combustible)
1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
0.8	for noncombustible construction (unprotected metal structural components, masonary or metal walls)
0.6	for fire-resistive construction (fully protected frame, floors, roof)

No. of Floors =	6	(FUS excludes basements that are at least 50% below grade)	
Area (per floor) =	1270	m^2	
A =	7620	m^2	
C =	1.0		
F =	19,204	L/min ----------------------->	Rounded to nearest 1000 = **19,000** L/min

2) The value obtained in 1) may be reduced by as much as 25% for occupancies having a low

Non-combustible =	-25%
Limited Combustible =	-15%
Combustible =	0%
Free Burning =	15%
Rapid Burning =	25%

Reduction due to low occupancy hazard = -15% x 19,000 = **16,150** L/min

3) The value above my be reduced by up to 50% for automatic sprinlker system

Reduction due to automatic sprinker system = -40% x 16,150 = **-6,460** L/min

4) The value obtained in 2. may be increased for structures exposed within 45 metres by the fire

Separation (metres)	Condtion	Max Charge*
0m to 3.0m	1	25%
3.1m to 10.0m	2	20%
10.1m to 20.0m	3	15%
20.1m to 30.0m	4	10%
30.1m to 45.0m	5	5%
45.1m to	6	0%

Charge for separation has been modified by Technical Bulletin ISTB-2018-02 based on construction and Length-Height Factor
Lenght*Height (L * H) = Exposed wall length in feet x height of building in stories
No of Stories = 6

Exposures	Distance(m)	Length (m)	L * H	Condition		Charge
Front (north)	45.7	35	210	6	-------->	0%
Back (south)	16.1	35	210	3	-------->	15%
Side 1 (west)	11.6	25	150	3	-------->	15%
Side 2 (east)	53.3	25	150	6	-------->	0%
						30%

Increase due to separation = 30% x 16,150 = **4,845** L/min

The fire flow requirement is = **16,150**
Reduction due to Sprinkler = **-6,460**
Increase due to Separation = 4,845
14,535

The Total fire flow requirement is = 15,000 L/min
or **250.0** **L/sec**

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CALCULATION OF FIRE FLOW REQURIEMENTS - 3430 CARLING AVENUE (EAST BUILDING)

Calculation Based on Fire Underwriters Survey, 1999 and Ottawa Technical Bulletin ISTB-2018-02

Proposed Building:

6 storey wood frame building with non combustible cladding and fire protected exterior walls.
With Firewall Reducing Building Foot Floor Area

1) An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \times C \times \sqrt{A}$$

where F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction:

1.5	for wood construction (structure essentially combustible)
1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
0.8	for noncombustible construction (unprotected metal structural components, masonary or metal walls)
0.6	for fire-resistive construction (fully protected frame, floors, roof)

No. of Floors = 6 (FUS excludes basements that are at least 50% below grade)
Area (per floor) = 825 m^2
A = 4950 m^2
C = 1.0
F = 15,478 L/min -----------------------> Rounded to nearest 1000 = **15,000** L/min

2) The value obtained in 1) may be reduced by as much as 25% for occupancies having a low

Non-combustible =	-25%
Limited Combustible =	-15%
Combustible =	0%
Free Burning =	15%
Rapid Burning =	25%

Reduction due to low occupancy hazard = -15% x 15,000 = **= 12,750** L/min

3) The value above my be reduced by up to 50% for automatic sprinlker system

Reduction due to automatic sprinker system = -40% x 12,750 = **-5,100** L/min

4) The value obtained in 2. may be increased for structures exposed within 45 metres by the fire

Separation (metres)	Condtion	Max Charge*
0m to 3.0m	1	25%
3.1m to 10.0m	2	20%
10.1m to 20.0m	3	15%
20.1m to 30.0m	4	10%
30.1m to 45.0m	5	5%
45.1m to	6	0%

Charge for separation has been modified by Technical Bulletin ISTB-2018-02 based on construction and Length-Height Factor
Lenght*Height (L * H) = Exposed wall length in feet x height of building in stories
No of Stories = 6

Exposures	Distance(m)	Length (m)	L * H	Condition		Charge
Front (north)	45.7	66	396	6	-------->	0%
Back (south)	16.8	62	372	3	-------->	15%
Side 1 (west)	11.6	22	132	3	-------->	15%
Side 2 (east)	Firewall	22	132	#N/A	-------->	0%
						30%

Increase due to separation = 30% x 12,750 = **3,825** L/min

The fire flow requirement is = **12,750**
Reduction due to Sprinkler = **-5,100**
Increase due to Separation = 3,825
11,475

The Total fire flow requirement is = 11,000 L/min
or **183.3** **L/sec**

NFPA 13

5.1 General.

5.1.1 Number of Supplies. Every automatic sprinkler system shall have at least one automatic water supply.

5.1.2 Capacity. Water supplies shall be capable of providing the required flow and pressure for the remote design area determined using the requirements and procedures as specified in Chapters 19 through 26 including hose stream allowance where applicable for the required duration.

19.2.3 Water Demand Requirements — Hydraulic Calculation Methods.

19.2.3.1 General.

19.2.3.1.1 The water demand for sprinklers shall be determined only from one of the following, at the discretion of the designer:

(1) For new systems, the density/area selected from Table 19.2.3.1.1 in accordance with the density/area method of 19.2.3.2
(2) For the evaluation or modification of existing systems, the density/area curves of Figure 19.2.3.1.1 in accordance with the density/area method of 19.2.3.2
(3) The room that creates the greatest demand in accordance with the room design method of 19.2.3.3
(4) Special design areas in accordance with 19.2.3.4

Table 19.2.3.1.1 Density/Area

Hazard	Density/Area [gpm/ft²/ft² (mm/min/m²)]
Light	0.1/1500 or 0.07/3000* (4.1/140 or 2.9/280)
Ordinary Group 1	0.15/1500 or 0.12/3000* (6.1/140 or 4.9/280)
Ordinary Group 2	0.2/1500 or 0.17/3000* (8.1/140 or 6.9/280)
Extra Group 1	0.3/2500 or 0.28/3000* (12.2/230 or 11.4/280)
Extra Group 2	0.4/2500 or 0.38/3000* (16.3/230 or 15.5/280)

*When required by 19.2.3.1.5.

19.2.4 Water Demand.

19.2.4.1* The water demand requirements shall be determined from the following:

(1) Occupancy hazard fire control approach and special design approaches of Chapter 19
(2) Storage design approaches of Chapter 20 through Chapter 25
(3) Special occupancy approaches of Chapter 26

19.2.4.2* The minimum water demand requirements for a sprinkler system shall be determined by adding the hose stream allowance to the water demand for sprinklers.

19.2.5 Water Supplies.

19.2.5.1 The minimum water supply shall be available for the minimum duration specified in Chapter 19.

19.2.6.2* Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a private fire hydrant, whichever is closer to the system riser.

19.3.3 Water Demand Requirements — Hydraulic Calculation Methods.

19.3.3.1 General.

19.3.3.1.1 The water demand for sprinklers shall be determined only from one of the following, at the discretion of the designer:

(1) Density/area curves of Figure 19.3.3.1.1 in accordance with the density/area method of 19.3.3.2
(2) The room that creates the greatest demand in accordance with the room design method of 19.3.3.3
(3) Special design areas in accordance with 19.3.3.4

19.3.3.1.2 The minimum water supply shall be available for the minimum duration specified in Table 19.3.3.1.2.

19.3.3.1.3 The lower duration values in Table 19.3.3.1.2 shall be permitted where the sprinkler system waterflow alarm device(s) and supervisory device(s) are electrically supervised and such supervision is monitored at an approved, constantly attended location.

Table 19.3.3.1.2 Hose Stream Allowance and Water Supply Duration Requirements for Hydraulically Calculated Systems

Occupancy	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
	gpm	L/min	gpm	L/min	
Light hazard	0, 50, or 100	0, 190, or 380	100	380	30
Ordinary hazard	0, 50, or 100	0, 190, or 380	250	950	60–90
Extra hazard	0, 50, or 100	0, 190, or 380	500	1900	90–120

A.19.3.3.1.5.2(10) The gypsum board (or equivalent material) used as the firestopping will compartment the concealed space and restrict the ability for fire to spread beyond 160 ft^3 (4.5 m^3) zones covering multiple joist channels.

NFPA 1

6.1.8.1.5 Definition — Apartment Building. A building or portion thereof containing three or more dwelling units with independent cooking and bathroom facilities. [***101***:6.1.8.1.5]

13.5 Water Supply.

13.5.1 Private fire service mains shall be installed in accordance with NFPA 13 and NFPA 24.

18.3 Water Supplies.

18.3.1* An approved water supply capable of supplying the required fire flow for fire protection shall be provided to all premises upon which facilities, buildings, or portions of buildings are hereafter constructed or moved into the jurisdiction.

The approved water supply shall be in accordance with Section 18.4.

18.3.1.1* Where no adequate or reliable water distribution system exists, approved reservoirs, pressure tanks, elevated tanks, fire department tanker shuttles, or other approved systems capable of providing the required fire flow shall be permitted.

18.4 Fire Flow Requirements for Buildings.

18.4.1* Scope.

18.4.1.1* The procedure determining fire flow requirements for buildings hereafter constructed or moved into the jurisdiction shall be in accordance with Section 18.4.

18.4.1.2 Section 18.4 shall not apply to structures other than buildings.

18.4.2 Definitions. See definitions 3.3.14.4, Fire Flow Area, and 3.3.128, Fire Flow.

18.4.3 Modifications.

18.4.3.1 Decreases in Fire Flow Requirements.

18.4.3.1.1* Fire flow requirements shall be permitted to be decreased by the AHJ for isolated buildings or a group of buildings in rural areas or suburban areas where the development of full fire flow requirements is impractical as determined by the AHJ.

18.4.3.1.2 The AHJ shall be authorized to establish conditions on fire flow reductions approved in accordance with 18.4.3.1.1 including, but not limited to, fire sprinkler protection, type of construction of the building, occupancy, development density, building size, and setbacks.

18.4.3.2 Increases in Fire Flow Requirements. The minimum required fire flow shall be permitted to be increased by the AHJ where conditions indicate an unusual susceptibility to group fires or conflagrations. An upward modification shall not be more than twice that required for the building under consideration.

18.4.4 Fire Flow Area.

18.4.4.1 General. The fire flow area shall be the total floor area of all floor levels of a building except as modified in 18.4.4.2.

18.4.4.2 Type I (443), Type I (332), and Type II (222) Construction. The fire flow area of a building constructed of Type I (443), Type I (332), and Type II (222) construction shall be the area of the three largest successive floors.

18.4.5 Fire Flow Requirements for Buildings.

18.4.5.3 Buildings Other Than One- and Two-Family Dwellings.

18.4.5.3.1* The minimum fire flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table 18.4.5.2.1.

18.4.5.3.2 Required fire flow shall be reduced by 75 percent when the building is protected throughout by an approved automatic sprinkler system. The resulting fire flow shall not be less than 1000 gpm (3785 L/min).

18.4.5.3.3 Required fire flow shall be reduced by 75 percent when the building is protected throughout by an approved automatic sprinkler system, which utilizes quick response sprinklers throughout. The resulting fire flow shall not be less than 600 gpm (2270 L/min).

18.4.5.3.4* Required fire flow for buildings protected by an approved automatic sprinkler system shall not exceed 2000 gpm (7571 L/min) for 2 hours.

18.4.5.3.5 Required fire flow for open parking structures that are not protected throughout by an approved automatic sprinkler system shall be reduced by 75 percent where all of the following conditions are met:

(1) The structure complies with the building code.
(2) The structure is of Type I or Type II construction.
(3) The structure is provided with a Class I standpipe system in accordance with NFPA 14. Class I standpipe systems of the manual dry type shall be permitted.
(4) The resulting fire flow is not less than 1000 gpm (3785 L/min).

18.4.5.4* Required Fire Flow and Automatic Sprinkler System Demand. For a building with an approved fire sprinkler system, the fire flow demand and the fire sprinkler system demand shall not be required to be added together. The water supply shall be capable of delivering the larger of the individual demands.

Table 18.4.5.2.1 Minimum Required Fire Flow and Flow Duration for Buildings

Fire Flow Area ft² (× 0.0929 for m²)					Fire Flow gpm† (× 3.785 for L/min)	Flow Duration (hours)
I(443), I(332), II(222)*	**II(111), III(211)***	**IV(2HH), V(111)***	**II(000), III(200)***	**V(000)***		
0–22,700	0–12,700	0–8200	0–5900	0–3600	1500	2
22,701–30,200	12,701–17,000	8201–10,900	5901–7900	3601–4800	1750	
30,201–38,700	17,001–21,800	10,901–12,900	7901–9800	4801–6200	2000	
38,701–48,300	21,801–24,200	12,901–17,400	9801–12,600	6201–7700	2250	
48,301–59,000	24,201–33,200	17,401–21,300	12,601–15,400	7701–9400	2500	
59,001–70,900	33,201–39,700	21,301–25,500	15,401–18,400	9401–11,300	2750	
70,901–83,700	39,701–47,100	25,501–30,100	18,401–21,800	11,301–13,400	3000	3
83,701–97,700	47,101–54,900	30,101–35,200	21,801–25,900	13,401–15,600	3250	
97,701–112,700	54,901–63,400	35,201–40,600	25,901–29,300	15,601–18,000	3500	
112,701–128,700	63,401–72,400	40,601–46,400	29,301–33,500	18,001–20,600	3750	
128,701–145,900	72,401–82,100	46,401–52,500	33,501–37,900	20,601–23,300	4000	4
145,901–164,200	82,101–92,400	52,501–59,100	37,901–42,700	23,301–26,300	4250	
164,201–183,400	92,401–103,100	59,101–66,000	42,701–47,700	26,301–29,300	4500	
183,401–203,700	103,101–114,600	66,001–73,300	47,701–53,000	29,301–32,600	4750	
203,701–225,200	114,601–126,700	73,301–81,100	53,001–58,600	32,601–36,000	5000	
225,201–247,700	126,701–139,400	81,101–89,200	58,601–65,400	36,001–39,600	5250	
247,701–271,200	139,401–152,600	89,201–97,700	65,401–70,600	39,601–43,400	5500	
271,201–295,900	152,601–166,500	97,701–106,500	70,601–77,000	43,401–47,400	5750	
Greater than 295,900	Greater than 166,500	106,501–115,800	77,001–83,700	47,401–51,500	6000	
		115,801–125,500	83,701–90,600	51,501–55,700	6250	
		125,501–135,500	90,601–97,900	55,701–60,200	6500	
		135,501–145,800	97,901–106,800	60,201–64,800	6750	
		145,801–156,700	106,801–113,200	64,801–69,600	7000	
		156,701–167,900	113,201–121,300	69,601–74,600	7250	
		167,901–179,400	121,301–129,600	74,601–79,800	7500	
		179,401–191,400	129,601–138,300	79,801–85,100	7750	
		Greater than 191,400	Greater than 138,300	Greater than 85,100	8000	

*Types of construction are based on NFPA 220.

†Measured at 20 psi (139.9 kPa).

NFPA 220

Table 4.1.1 Fire Resistance Ratings for Type I through Type V Construction (hr)

Construction Element	Type I		Type II			Type III		Type IV	Type V	
	442	332	222	111	000	211	200	2HH	111	000
Exterior Bearing Walls[a]										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0[b]	2	2	2	1	0[b]
Supporting one floor only	4	3	2	1	0[b]	2	2	2	1	0[b]
Supporting a roof only	4	3	1	1	0[b]	2	2	2	1	0[b]
Interior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting roofs only	3	2	1	1	0	1	0	1	1	0
Columns										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	3	2	2	1	0	1	0	H	1	0
Supporting roofs only	3	2	1	1	0	1	0	H	1	0
Beams, Girders, Trusses, and Arches										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	2	2	2	1	0	1	0	H	1	0
Supporting roofs only	2	2	1	1	0	1	0	H	1	0
Floor-Ceiling Assemblies	2	2	2	1	0	1	0	H	1	0
Roof-Ceiling Assemblies	2	1½	1	1	0	1	0	H	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0
Exterior Nonbearing Walls[c]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]

H: heavy timber members *(see text for requirements)*.
[a]See *NFPA 5000*, 7.3.2.1.
[b]See *NFPA 5000*, Section 7.3.
[c]See 4.3.2.12, 4.4.2.3, and 4.5.6.8.
[**5000:**Table 7.2.1.1]

NFPA 220

4.4 Type III (211 or 200) Construction.

4.4.1 Type III Construction. Type III (211 or 200) construction shall be that type in which exterior walls and structural

elements that are portions of exterior walls are of approved noncombustible or limited-combustible materials, and in which fire walls, interior structural elements, walls, arches, floors, and roofs are entirely or partially of wood of smaller dimensions than required for Type IV construction or are of approved noncombustible, limited-combustible, or other approved combustible materials. [**5000:**7.2.4.1]

4.6 Type V (111 or 000) Construction. Type V (111 or 000) construction shall be that type in which structural elements, walls, arches, floors, and roofs are entirely or partially of wood or other approved material. [**5000:**7.2.6]