

Canadian Wood Council  
Conseil canadien du bois

May 2014  
*Atlantic Wood Works!  
Wood Design Seminars  
St. John's - Fredericton*

## *5- and 6-storey Wood Buildings: National Code Change Proposals and Research*

*Ineke Van Zeeland  
Manager, Codes & Standards*

## Canadian Wood Council National Federation of Associations



# Canadian Wood Council

Represents Over 1000 Manufacturers

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## Outline

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- Review of proposed changes to heights and areas requirements
- NRC/CWC/FPInnovations midrise wood construction research project
- Component Additive Method proposals and other activities

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## Division B – Subsection 3.2.2

### Building Size and Construction Relative to Occupancy

- 3.2.2.20 to 3.2.2.83
- Combustible Construction, Heavy Timber Construction and Noncombustible Construction

## 2010 NBCC Wood Construction

Occupancy Type	No. of storeys	Max. Allowable Building Area <sup>1</sup> (m <sup>2</sup> ) (unsprinklered)	Max. Allowable Building Area (m <sup>2</sup> ) (sprinklered)
Residential (Group C)	1	2400	7 200
	2	1200	3 600
	3	800	2 400
	4	-	1800

1. Facing one street, for buildings with 1hr. FRR. (Increases by 25% if facing two streets and 50% if facing 3 streets.)

Code references:

Unsprinklered – 3.2.2.51

Sprinklered – 3.2.2.50.

# 2010 NBCC Wood Construction

Occupancy Type	No. of storeys	Max. Allowable Building Area <sup>1</sup> (m <sup>2</sup> ) (unsprinklered)	Max. Allowable Building Area (m <sup>2</sup> ) (sprinklered)
Business and personal services (Group D)	1	7 200	14 400
	2	3 600	7 200
	3	2 400	4 800
	4	-	3 600

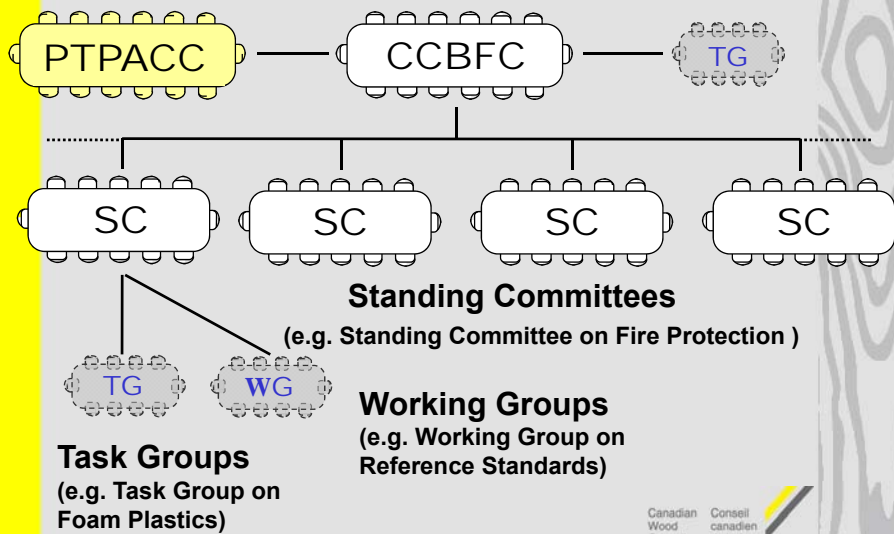
1. Facing three streets, 45-minute FRR

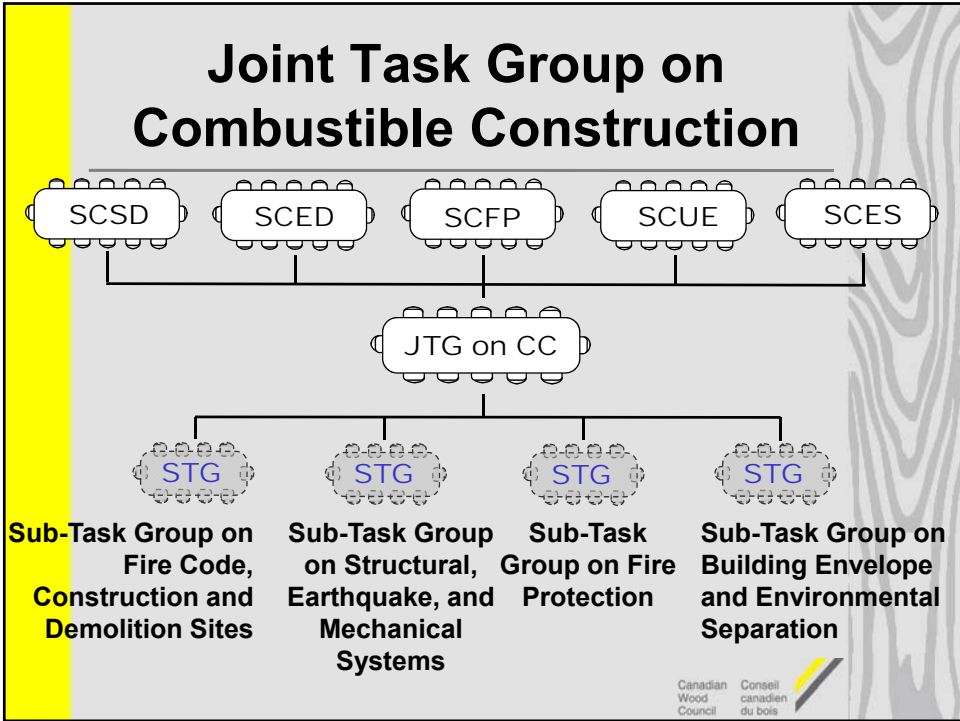
Code references:

Unsprinklered – 3.2.2.58.

Sprinklered – 3.2.2.57. & 3.2.2.59.

# National Code Process





# JTG on CC and STGs

## Stakeholders

- Regulators, industry reps, general interest groups
- Fire services (CAFC, IAFC, various municipal FS)
- OFM, RBQ, Building and Safety Standards Branch BC
- Construction material industry groups (CWC, CSCC, CCMPA)
- List of 65 concerns addressed








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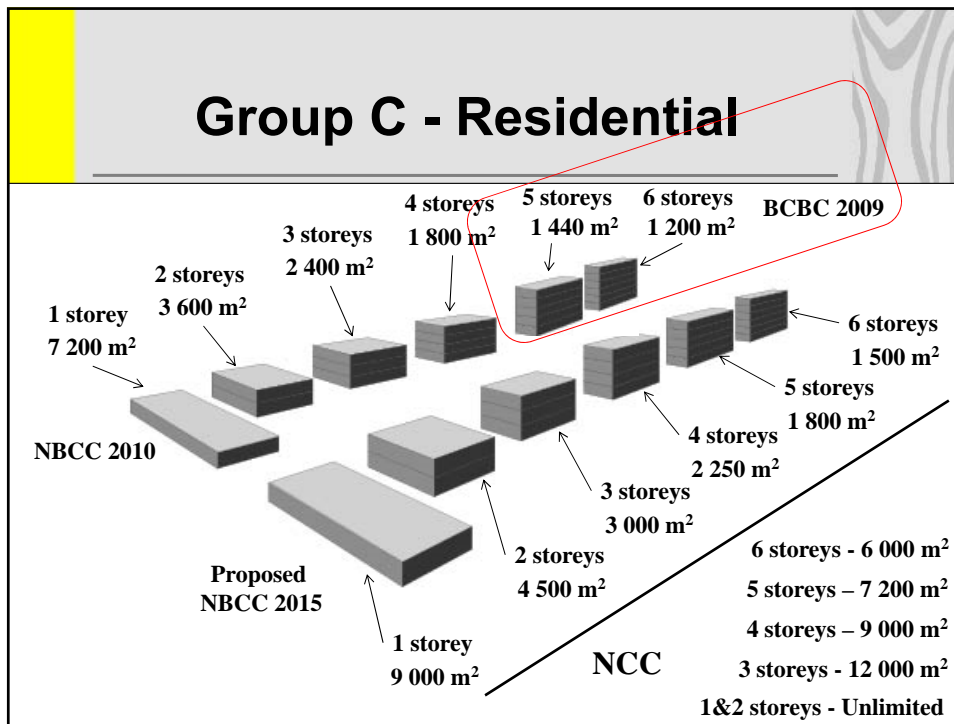
# National Code Change Proposals

The screenshot shows the National Research Council Canada website. The main heading is "National Code Change Proposals". Below it, the website header includes the Government of Canada logo and navigation links. The main content area features a sidebar on the left with links like "Current Issue", "About Construction Innovation", and "Order Codes and Guides". The main content area has a breadcrumb trail: "Home > Publications > Construction Innovation > Building Regulations for Market Access > Fall 2013 public review on proposed Code changes". The main heading is "Fall 2013 public review on proposed Code changes". Below this is a graphic of a book cover and a paragraph of text: "The Canadian Commission on Building and Fire Codes (CCBFC) will be conducting its annual public review of proposed changes to the 2010 National Model Construction Codes from October 15 to December 13, 2013 on the National Codes website. The purpose of this public review is to provide Code users and stakeholders with a detailed look at changes being considered for inclusion in the 2015 editions of the National Model Construction Codes and seek comment on each one as to whether it should be approved, altered, or rejected. An explanation of the proposed changes, as well as instructions on how to submit comments, will be provided on the website. The proposed changes in this public review cover a variety of topics, including: mid-rise combustible construction; component additive method for determining fire resistance; hot works hazard reduction; laboratory hazards and dangerous goods storage; stairs, ramps and handrails; accessibility; water use efficiency; ground motions (seismicity design data); energy efficiency for buildings (building envelope; lighting; heating, ventilating and air-conditioning; service water heating); air sound transmission; and exterior insulation and finish systems. Following the review, CCBFC Standing Committees will consider all comments and make final recommendations on each proposed change. Subject to approval by the CCBFC, the final changes will be published by NRC in the 2015 editions of the National Model Construction Codes. Please mark your calendars and check the National Codes website to ensure you don't miss this window of opportunity. Alternatively, subscribe to the National Codes Web feed to receive an alert when the public review is launched." Below this is a section for "For more information" with contact details for Anne Gribbon, Secretary to the CCBFC, at [anne.gribbon@nrc-nrc.gc.ca](mailto:anne.gribbon@nrc-nrc.gc.ca) or 613-993-5569.

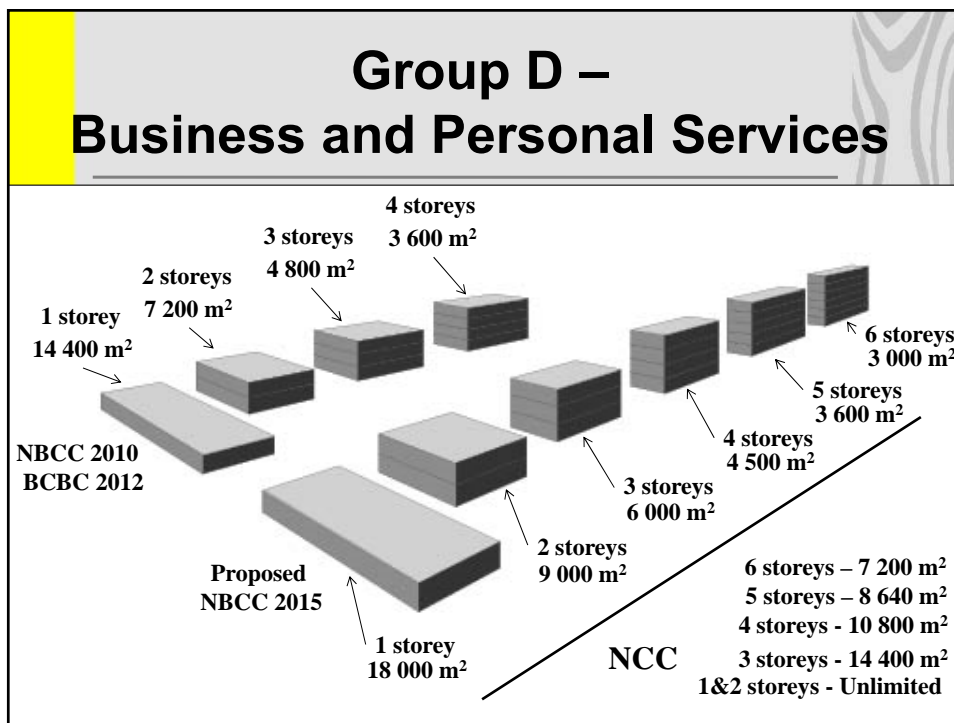
# National Code Change Proposals

- [www.nationalcodes.nrc.gc.ca](http://www.nationalcodes.nrc.gc.ca)
- October 15 – December 23, 2013
- Much more than just 5- and 6-storey combustible construction

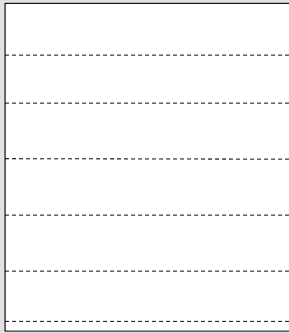
## Group C - Residential



## Group D – Business and Personal Services

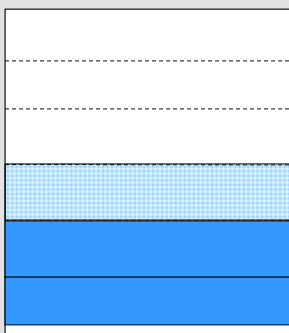


## Mixed Uses Major Occupancies - Group C



- Not permitted:**
- Group A, Divisions 1 and 3
  - Group B
  - Group F, Divisions 1, 2 and 3 (except storage garages)

## Mixed Uses Major Occupancies - Group C

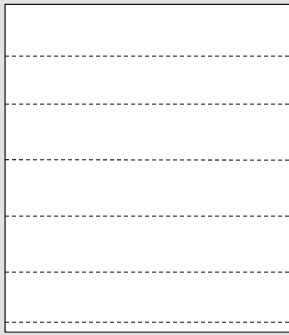


- Permitted on 1<sup>st</sup> and 2<sup>nd</sup> storey:**
- Group A, Division 2
  - Group E
  - Storage garages (also permitted on 3<sup>rd</sup> storey)

- Increased fire-resistance rating for separation between some major occupancies



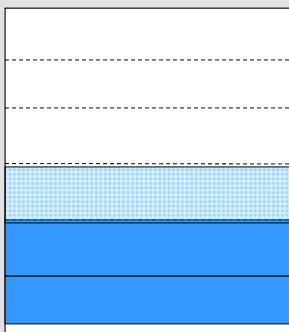
## Mixed Uses Major Occupancies - Group D



### Not permitted:

- Group A, Divisions 1 and 3
- Group B
- Group F, Division 1

## Mixed Uses Major Occupancies - Group D

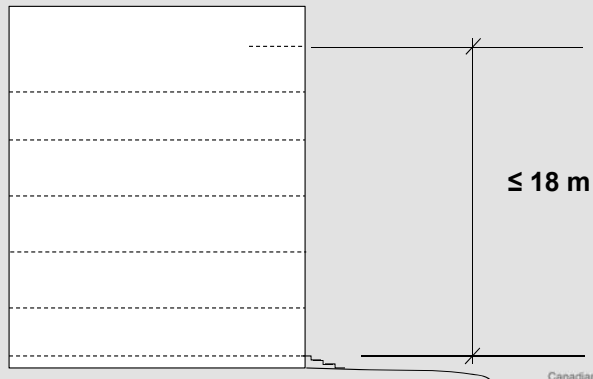


### Permitted on 1<sup>st</sup> and 2<sup>nd</sup> storey:

- Group A, Division 2
- Group E
- Group F, Divisions 2 and 3 (storage garages also permitted on 3<sup>rd</sup> storey)

## Height Limit

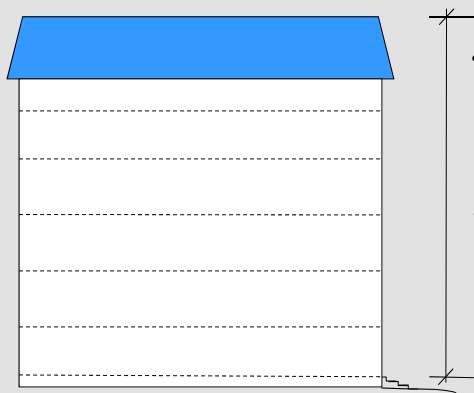
Limit height of uppermost floor level to 18 m above 1<sup>st</sup> floor.



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## Roof

- 1-h fire-resistance rating

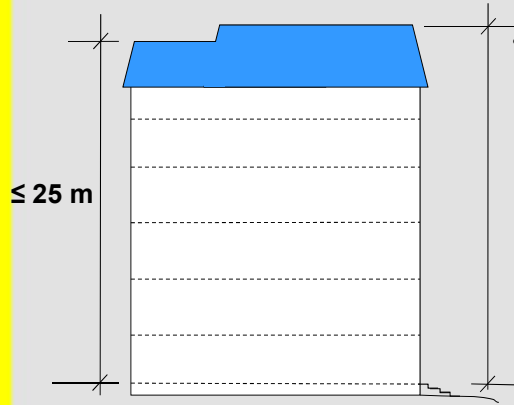


- If height  $\leq 25\text{ m}$ , combustible roof construction and roof covering (Class A, B or C)
- If height  $> 25\text{ m}$ , noncombustible or FRTW roof construction and Class A roof covering

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# Roof

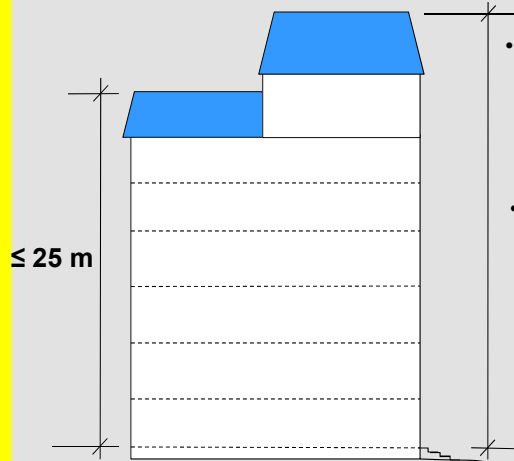
- 1-h fire-resistance rating



- If height  $\leq 25$  m, whole roof: combustible roof construction and Class A,B,C roof covering
- If height  $> 25$  m, whole roof: noncombustible or FRTW roof construction and Class A roof covering

# Roof

- 1-h fire-resistance rating



- If height  $> 25$  m: noncombustible or FRTW roof construction and Class A roof covering
- If height  $\leq 25$  m: combustible roof construction and Class A,B,C roof covering

## Sprinklers

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For 5- and 6-storey Group C:

- NFPA 13 required, as well as additional sprinklering of exterior balconies and decks  
(balconies or decks exceeding 610 mm)

## Exterior Walls

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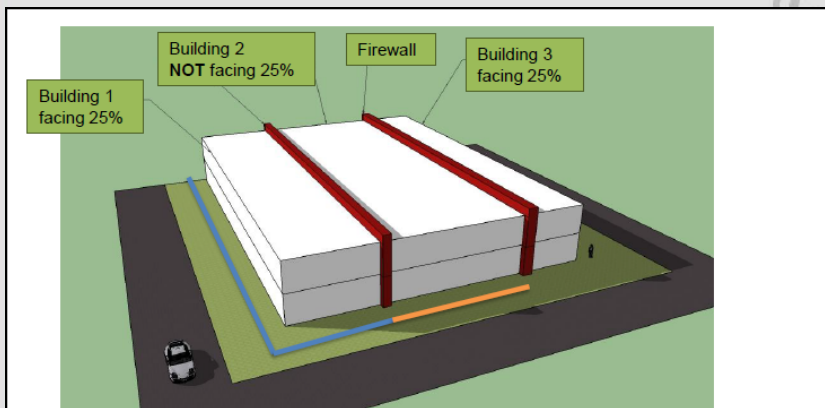
Cladding:

- noncombustible cladding, or
- cladding which passes the requirements when tested in accordance with *CAN/ULC-S134 "Standard Method of Fire Test of Exterior Wall Assemblies"*
- 10% permitted to combustible cladding

## Firefighting Access

- Require 25% of the perimeter to be within 15 m of a street or access route

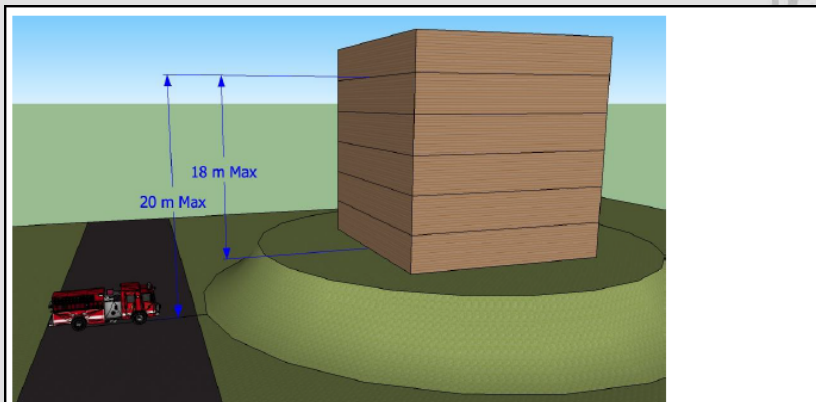
## Firefighting Access



## Firefighting Access

- Street or access route to have elevation not more than 2 m below the floor of the first storey

## Firefighting Access



(Not to scale)

## Additional Fire Protection Features

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- More fire blocking in all (including sprinklered) combustible concealed spaces (unless filled with noncombustible insulation with max. 50 mm gap)
- Double duration of emergency power supply for lighting and fire alarm systems (1 hr.)

## Construction and Demolition Sites (National Fire Code)

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- Fencing, boarding or barricades
- Access control when site unattended
- Required water supply available when combustible material arrives on site
- Unobstructed clearance around hydrants

## Construction and Demolition Sites (National Fire Code)

- Minimum clearance (3 m) maintained between exits and waste containers
- Smoking area requirements
- Minimum clearances between roofing kettles and exits, means of egress and exposed combustible materials
- Site identification
- Construction access - stairway

## Additional Changes

### Earthquake design

- Reduce risk of sway-storey seismic behaviour, which could lead to building collapse
- Improved safety factor for lateral earthquake force





## Building Envelope

- Additional guidance for design to reduce risk of:
  - inadequate design features for increased wind loading for higher buildings
  - potential detrimental effects of moisture for higher building

## Mid-rise Research



## Wood Building Research

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- National Research Council of Canada
- Canadian Wood Council
- FPInnovations
- Province of British Columbia
- Province of Ontario
- Province of Quebec



## Wood Building Research

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- Building Envelope: Control of Heat, Air, Moisture and Precipitation (HAMP)
- Acoustics: STC Ratings, Sound Flanking
- Fire: Encapsulation, Fire Resistance and Exterior Walls



## Building Envelope: HAMP

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- Identify envelope details, climate locations and loads;
- Water penetration lab experiments
- Hygrothermal modeling and analysis

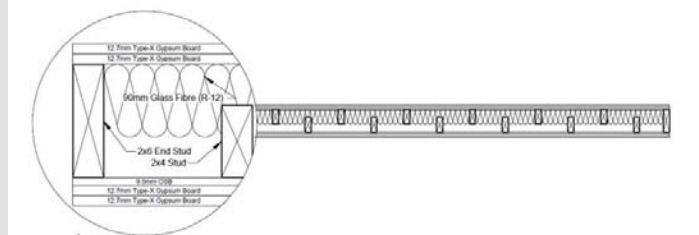
## Building Envelope: HAMP

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- Assess whether alternate wood-based building envelope solutions developed
  - Meet NBC 2010 Part 5 requirements
  - Meet NECB 2011 - maximum envelope overall heat transmission requirements

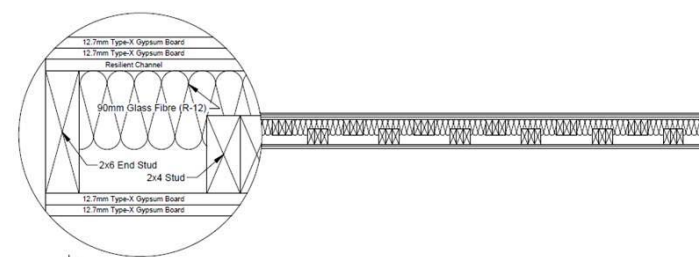
## Acoustics: STC Ratings

- Light-frame wood wall assemblies - staggered studs
- e.g.



## Acoustics: STC Ratings

- Light-frame wood wall assemblies - triple-studs, staggered
- e.g.



## Acoustics: STC Ratings

- Cross-laminated Timber (CLT) wall and floor assemblies

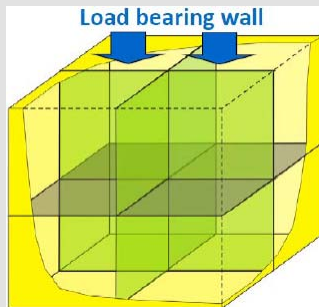


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## Acoustics: Sound Flanking

- Light-frame wood assemblies



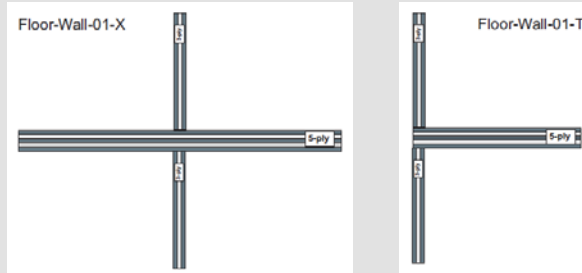
Schematic of NRC-IRC  
Flanking Sound  
Transmission Facility

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## Acoustics: Sound Flanking

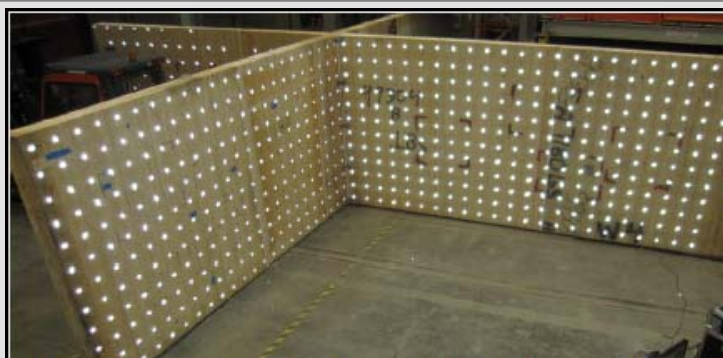
- Cross-laminated Timber (CLT)



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## Acoustics: Sound Flanking



Junctions of 3-ply and 5-ply walls:

- 5 T-Junctions
- 4 Cross-Junctions

## Acoustics: Sound Flanking



Walls (3-ply, 5-ply) with floors (5-ply, 7-ply):

- 3 T-Junctions
- 6 Cross-Junctions

## Acoustics



NATIONAL RESEARCH COUNCIL CANADA

**RR-331**

**Guide to Calculating Airborne  
Sound Transmission in Buildings**

David Quirt, Berndt Zeltner, Stefan Schoenwald,  
Ivan Sabourin, Trevor Nightingale

October 2013

 National Research Council Canada / Conseil national de recherches Canada

 Canada

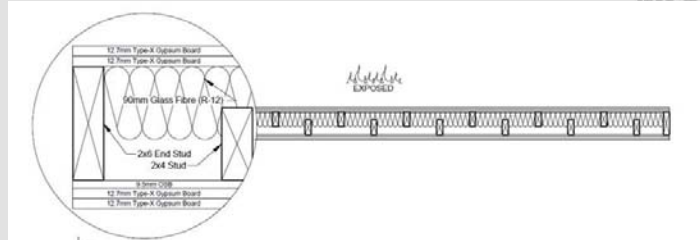
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- Guidance document
- SoundPATHS tool

## Fire: Fire-Resistance Ratings

Full-scale standard fire tests: *CAN/ULC-S101*  
(total of 5 tests)

- Light-frame wood wall assemblies - staggered single studs, wood shear panel
- e.g.



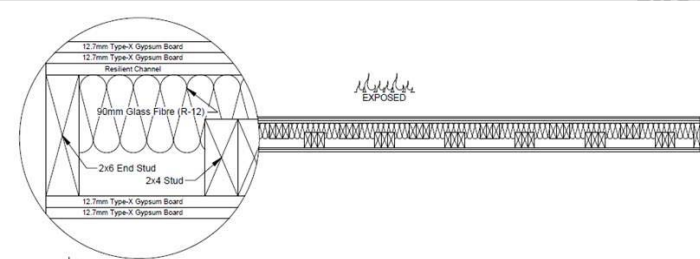
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## Fire: Fire-Resistance Ratings

Full-scale standard fire tests: *CAN/ULC-S101*  
(total of 5 tests)

- Light-frame wood wall assemblies - triple-studs, staggered
- e.g.



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# Fire: Exterior Walls

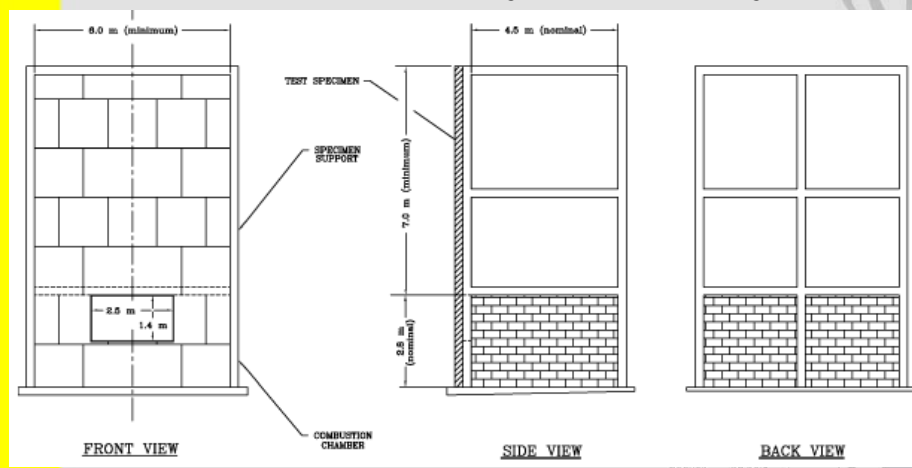
## CAN/ULC-S134 Testing



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## Combustible Components for Exterior Walls (3.1.5.5)

CAN/ULC-S134 – typical facility:



# Midrise Research CAN/ULC-S134

	Sheathing	Wall Construction	Insulation
1	12.7 mm Gypsum Sheathing	Untreated wood 2 x 6, 400 mm o.c.	Spray Polyurethane Foam
2		Simulated CLT + 2 x 6, 600 mm o.c. furring	XPS Foam Insulation
3	15.9 mm FRTW Plywood	Simulated CLT + 2 x 6, 600 mm o.c. furring	XPS Foam Insulation
4		Untreated wood 2 x 6, 400 mm o.c.	Spray Polyurethane Foam

# Fire: Encapsulation

- Intermediate-scale fire testing  
- horizontal furnace



- Large-scale fire testing -
  - Light-frame wood
  - Cross-laminated timber
  - Light-frame steel





**Fire: Encapsulation**

- Large-scale fire testing:

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## **Fire Resistance Ratings Wood-frame Construction**

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### **Component Additive Method (CAM)**

- **NBCC 2010, Division B,  
Appendix D-2.3 for Framed Walls,  
Floors and Roofs**
- **Last revised for 1995 NBCC**
- **National Codes Public Consultation  
proposals**

## **Fire Resistance Ratings Wood-frame Construction**

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### **CAM values proposed for:**

- **Double layers of gypsum board  
(walls and floors)**
- **Wood I-joists, more wood truss  
types**
- **Additional insulation  
types/locations and floor toppings**
- **Use of resilient metal channels**

## 2010 Component Additive Method (CAM) Wood Wall Assemblies

Membrane		Members		Insulation		Total FRR* ‡
Description	Assigned time (min)	Description	Assigned time (min)	Description	Assigned time (min)	
12.7 mm Type X Gypsum Board	25	Wood Studs @ 400 mm o.c.	20	MFI (Loadbearing & Nonloadbearing)	15	60
				GFI (Nonloadbearing Only)	5	50
				None (Loadbearing & Nonloadbearing) & GFI (Loadbearing)	0	45
		Wood Studs @ 600 mm o.c.	15	MFI (Loadbearing & Nonloadbearing)	15	55
				GFI (Nonloadbearing Only)	5	45
				None (Loadbearing & Nonloadbearing) & GFI (Loadbearing)	0	40
15.9 mm Type X Gypsum Board	40	Wood Studs @ 400 mm o.c.	20	MFI (Loadbearing & Nonloadbearing)	15	75
				GFI (Nonloadbearing Only)	5	65
				None (Loadbearing & Nonloadbearing) & GFI (Loadbearing)	0	60
		Wood Studs @ 600 mm o.c.	15	MFI (Loadbearing & Nonloadbearing)	15	70
				GFI (Nonloadbearing Only)	5	60
				None (Loadbearing & Nonloadbearing) & GFI (Loadbearing)	0	55

- \* for this to be applicable:
- must meet minimum fastener penetration requirements
  - all edges of GB must be supported, except for 15.9 mm Type X installed horizontally where horizontal joints can be unsupported if framing @ 400 mm o.c. maximum

‡ applicable to exterior wall assemblies requiring FRR from inside that have GB on interior and exterior sheathing + cladding with mineral fibre insulation with area density of  $\geq 1.22 \text{ kg/m}^2$

## 2015 Component Additive Method (CAM) Wood Wall Assemblies

Membrane		Members		Insulation		Total FRR*
Description	Assigned time (min)	Description	Assigned time (min)	Description	Assigned time (min)	
<b>Loadbearing</b> 2 layers of 12.7 mm Type X Gypsum Board	50	Wood Studs @ 400 mm o.c.	20	RFI	15	85
				CFI – dry-blown	10	80
				None & GFI	0	70
		Wood Studs @ 600 mm o.c.	15	RFI	15	80
				CFI – dry-blown	10	75
				None & GFI	0	65
<b>Non-loadbearing</b> 2 layers of 12.7 mm Type X Gypsum Board	80	Wood Studs @ 400 mm o.c.	20	RFI	15	115
				GFI	5	105
				None	0	100
		Wood Studs @ 600 mm o.c.	15	RFI	15	110
				GFI	5	100
				None	0	95

- \* for this to be applicable:
- must meet minimum fastener penetration requirements
  - all edges of GB must be supported, except for 15.9 mm Type X installed horizontally where horizontal joints can be unsupported if framing @ 400 mm o.c. maximum

Also, resilient metal channels are permitted to be installed at max. spacing of 400 mm o.c. with no effect on the rating of the wall assembly.

# 2010 Component Additive Method (CAM)

## Wood Floor Assemblies

Membrane		Members		Total FRR*
Description	Assigned time (min)	Description	Assigned time (min)	
1 layer of 12.7 mm Type X Gypsum Board	25	Wood Joists @ 400 mm o.c. maximum	10	35
		Wood Trusses @ 600 mm o.c. maximum	5	30
1 layer of 15.9 mm Type X Gypsum Board	40	Wood Joists @ 400 mm o.c. maximum	10	50
		Wood Trusses @ 600 mm o.c. maximum	5	45

\*for this to be applicable:

- must have also minimum subfloor + flooring combination
- all edges of GB must be supported
- must meet minimum fastener penetration requirements;
- mineral fibre insulation of rock or slag does not affect FRR in wood floors as long as held in by resilient channels or furring channels

# 2015 Component Additive Method (CAM)

## Wood Floor Assemblies

Description	Membrane		Members		Insulation		Topping		Total FRR*
	Resilient Metal Channels	Assigned time (min)	Description	Assigned time (min)	Description	Assigned time (min)	Description	Assigned time (min)	
2 layers of 12.7 mm Type X Gypsum Board	Spaced ≤ 400 mm o.c. (or direct applied to members ≤ 400 mm o.c.)	50	Wood Joists, Trusses, I-joists @ 600 mm o.c. maximum	10	RFI or CFI (wet-sprayed)	5	None or Gypsum-concrete	0	65
					None or GFI	0	Concrete	5	70
2 layers of 12.7 mm Type X Gypsum Board	Spaced ≤ 600 mm o.c. (or direct applied)	45	Wood Joists, Trusses, I-joists @ 600 mm o.c. maximum	10	RFI or CFI (wet-sprayed)	5	None or Gypsum-concrete	0	60
					None or GFI	0	Concrete	5	65
2 layer of 15.9 mm Type X Gypsum Board	Spaced ≤ 600 mm o.c. (or direct applied)	60	Wood Joists, Trusses, I-joists @ 600 mm o.c. maximum	10	RFI or CFI (wet-sprayed)	5	None or Gypsum-concrete	0	75
					None or GFI	0	Concrete	5	80
2 layer of 15.9 mm Type X Gypsum Board	Spaced ≤ 600 mm o.c. (or direct applied)	60	Wood Joists, Trusses, I-joists @ 600 mm o.c. maximum	10	RFI or CFI (wet-sprayed)	5	None or Gypsum-concrete	0	70
					None or GFI	0	Concrete	5	75

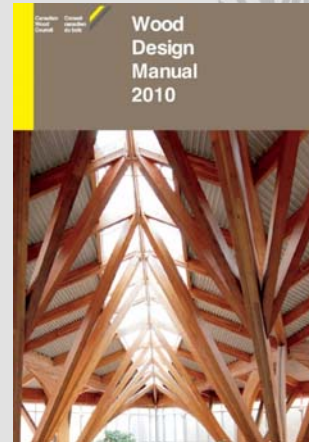
\*for this to be applicable:

- must have minimum subfloor
- all edges of GB must be supported
- must meet minimum fastener penetration requirements

# Fire Resistance Ratings Massive Timber

## CSA O86 - 2014 edition

- Annex B:  
“Fire resistance of large cross-section wood elements”
- Informative



## Additional Activities

- Fire Protection Research Foundation (NFPA) – Fire Safety Challenges of Tall Wood Buildings Report (November 2013)
- CWC - Heights & Areas Historic Fact-finding Report (2014)
- FPInnovations Tall Wood Building Guide (Spring 2014)
- 2<sup>nd</sup> Ed. of FPInnovations CLT Handbook Fire Chapter (Spring 2014)
- NSERC NEWBuildS - PROJECT T3–3–C7: FIRE BEHAVIOUR OF CROSS LAMINATED TIMBER PANELS



# Technical Information and Tools



[www.cwc.ca](http://www.cwc.ca)

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