Changes To Code Impacting Fire Alarm Design & Commissioning

ONTARIO FIRE COLLEGE
2010 Fire Prevention Officers’ Seminar
September 13 – 17, 2010
CHASING GOLD
CHASING GOLD

On-Going Pursuit of Life Safety Knowledge

To further protect society from the ravages of fire
Building codes, standards, and regulations have had a positive impact on life-loss from fires.
NBC

Generally life safety codes consider fire safety design for the construction of buildings. The following are the areas of focus:

- Life safety
- Property protection
- Continuity of operations
- Environmental protection
Building Code

Any version of the Building Code that was in force at any time since it was made under the provinces Building Code Act.
CHAPTER 1  
Fire Protection History Lessons Learned

1. Chapter Overview and Key Concepts
   - Primary Purpose of Fire Alarm Systems
   - Reference Infamous Canadian Fires
   - CFAA Program and Expectations
   - The Building Code
   - Building Requirements for Fire Alarm Systems
   - Governing Documents
   - Codes & Standards
   - Plans & Specifications

CCBFC

Canadian Commission on Building and Fire Codes.
Authority Having Jurisdiction

The organization, office, or individual responsible for approving an installation, a procedure, or equipment.
Building Code Application in Canada
British Columbia & Alberta

National Research Council

Canadian Commission on Building and Fire Codes

National Fire Code (NFC)
National Building Code (NBC)

Constitution Act
(Provinces and Territories Responsible for Building Regulation)

British Columbia

Public Safety and Solicitor General Office of the Fire Commissioner

Fire Services Act

Provincial codes based on the NFC and NBC

British Columbia Fire Code (BCFC)

Alberta

Municipal Affairs and Housing Safety Services Branch
Fire Discipline Agency
Building Discipline Agency

Local Government Act

Safety Codes Act

Provincial codes based on the NFC and NBC

British Columbia Building Code (BCBC)

Alberta Fire Code (AFC)

Alberta Building Code (ABC)

Canadian Commission on Building and Fire Codes

National Fire Code (NFC)
National Building Code (NBC)
New Brunswick & Nova Scotia

National Research Council

Canadian Commission on Building and Fire Codes

National Fire Code (NFC)
National Building Code (NBC)

Constitution Act
(Provinces and Territories Responsible for Building Regulation)

New Brunswick

Department of Public Safety
Office of the Fire Marshall

Fire Prevention Act

Provincial adoption or amendment of NFC

NFC

Department of Environment
(and Building Safety Advisory Committee)

New Brunswick Building Code Act
(in development)

NBC

Municipal adoption or amendment of NFC

Nova Scotia

Environment and Labour
- Fire Safety

Fire Safety Act

NBC

Provincial Adoption of NFC

Environment and Labour
- Building and Equipment Safety

Nova Scotia Building Code Act

NFC

Provincial adoption and amendment of NBC

NBC
Yukon - Northwest Territories & Nunavut

National Research Council

Canadian Commission on Building and Fire Codes

National Fire Code (NFC)  National Building Code (NBC)

Constitution Act
(Provinces and Territories Responsible for Building Regulation)

Yukon

Community Services Protective Services
Fire Marshal's Office

Community Services Consumer and Safety
Services, Building Safety

Fire Prevention Act

 Territory adoption of NFC

Northwest Territories and Nunavut

NWT - Municipal and Community Affairs
Office of the Fire Marshal
Nunavut - Community and Government Services
Protection Services and the
Office of the Fire Marshal

Fire Prevention Act
(Nunavut adopts NWT Act)

Adopted NFC

Adopted NBC

 Territory adoption of NBC

Building Standards Act

Territory adoption of NBC

National Building Code (NBC)

National Fire Code (NFC)
Code Development in Canada

• National Coordination Strategy:
  – Achieve greater harmonization among the model national and provincial codes; and
  – Create a more uniform code development process
Code Development in Canada Continues

• Work on Ontario’s 2006 Building Code began in 1998:
  – Part of a joint Federal/Provincial/Territorial Process coordinated by the Canadian Commission on Building and Fire Codes (CCBFC)
Building Code Act & the OBC
Ontario’s Building Code is different from the National Code in key areas where Ontario has its own policy priorities

- Unique Code requirements in areas such as energy efficiency, water conservation and building conservation
2006 Building Code

Objectives

Functional Statements

Acceptable Solutions

New User Documents

Intent Statements

Application Statements
The **Building Code Act, 1992** is the legislative framework governing the construction, renovation and change of use of buildings.
Ontario Building Code

- The Ontario Building Code is a compilation of regulations authorized under Section 34 of the Act and sets out detailed administrative and technical requirements.
• The Act and Code are administered by the Ministry of Municipal Affairs and Housing (MAH)
• Enforcement is a local responsibility
  – Primarily in the hand of municipalities
WHY IS IT IMPORTANT TO US?

- Protects health & safety of people
- Enables construction to happen
- It is the law
DECISION MAKERS

- Ontario Legislature (*Building Code Act*)
- MMAH (BC content & amendments)
- Local CBO (Application of *BCA* & BC)
- BCC (Disputes over application of BC)
- Ontario Courts (Disputes over compliance with *BCA*)
Building Code Act

- Holds municipalities accountable & establishes CBO as authority having jurisdiction
- Prohibits illegal building & occupancy
- Establishes the powers of municipal building officials & the rules they must operate by
- Provides remedies for concerns about official’s actions
- Specifies offenses and penalties
- Provides for the BC & very limited municipal administrative by-laws
- Establishes the BCC & BMEC
Minister’s Ruling MR-09-S-09, amends Supplementary Standards SA-1, SB-2, SB-5 and SB-10 and comes into effect on January 1, 2010. Minister’s Rulings MR-09-S-10 and MR-09-S-11 further amend SA-1 for Building Code requirements coming into effect on April 1, 2010 and January 1, 2011 respectively.
Code Amendment History

The first Ontario Building Code was issued in 1975. The 1975 and subsequent editions of the Building Code have been issued as follows:

<table>
<thead>
<tr>
<th>Building Code Edition</th>
<th>Date Filed</th>
<th>Effective Date</th>
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</table>
The following Table lists the amendments to the 2006 Building Code made since the filing of O. Reg. 350/06:

<table>
<thead>
<tr>
<th>Amendment</th>
<th>Date Filed</th>
<th>Effective Date</th>
<th>Nature of Amendment</th>
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</thead>
<tbody>
<tr>
<td>O. Reg. 423/06</td>
<td>August 29, 2006</td>
<td>December 31, 2006</td>
<td>Definition of Applicable Law</td>
</tr>
<tr>
<td>O. Reg. 137/07</td>
<td>April 2, 2007</td>
<td>April 2, 2007</td>
<td>Editorial revisions; tall stud tables A-30 to A-33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>July 1, 2007</td>
<td>Part 3 stud wall reinforcement and plumbing fixtures</td>
</tr>
<tr>
<td>O. Reg. 205/08</td>
<td>June 18, 2008</td>
<td>April 1, 2010</td>
<td>Residential fire sprinklers</td>
</tr>
<tr>
<td>O. Reg. 365/09</td>
<td>September 23, 2009</td>
<td>September 24, 2009</td>
<td>Definition of applicable law</td>
</tr>
<tr>
<td>O. Reg. 503/09</td>
<td>December 21, 2009</td>
<td>January 1, 2010</td>
<td>Housekeeping changes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>April 1, 2010</td>
<td>Residential fire sprinklers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>January 1, 2011</td>
<td>Low flow water closets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>January 1, 2012</td>
<td>Energy efficiency</td>
</tr>
</tbody>
</table>
2010 OBC Amendments

APRIL 1, O. REG. 205/08 2010 AMENDMENT

REQUIRES FULLY SPRINKLERED HIGH RISE RESIDENTIAL BUILDINGS
Fire sprinklers in residential buildings over three storeys in height

Apply to new construction, building additions, floors of existing buildings that undergo a change of major occupancy, and floor areas that undergo extensive ("gut") renovation
The new requirements do not apply to smaller residential buildings, including houses, or to the renovation of portions of floors.

Certain forms of four-storey stacked townhouses are also exempt from the new requirements where buildings have specific fire safety features such as independent exits and continuous vertical fire separations between units.
How does the requirement for Fire Sprinklers In Residential Buildings affect Fire Alarm Systems?

- More Fire Alarm Sprinkler Monitoring Devices
- More Fire Alarm Annunciation
3.2.4.15. Sprinklers in Lieu of Fire Detectors
(1) *Fire detectors* required by Article 3.2.4.10. and *heat detectors* required by Sentence 3.2.4.11.(2) need not be provided within a *floor area* if the *floor area* is *sprinklered* and the sprinkler system is electrically supervised in conformance with Sentence 3.2.4.9.(2).

Fewer Detectors Installed

Less Fire Alarm Detection Annunciation
3.2.4.14. Elevator Emergency Return
(1) Except as permitted by Sentence (3), in a building having elevators that serve storeys above the first storey and that are equipped with an automatic emergency recall feature, smoke detectors shall be installed in the elevator lobbies on the recall level so that when these smoke detectors are actuated, the elevators will automatically return directly to an alternate floor level.

(2) Smoke detectors required by Sentence (1) shall be designed as part of the building fire alarm system.

(3) The alternate floor recall feature required by Sentence (1) is not required if the floor area containing the recall level is sprinklered.
(1) Where an examination referred to in Clause 3.2.4.2.(1)(a) or (b) is replaced with a new examination, the director shall give notice of the new examination to every registered person who is registered in a class of registration to which the new examination relates.

Must be qualified to design fire alarms system
2010 Amendments
Effective January 2012

Occupancy Permit

1.3.3. Occupancy of Buildings

1.3.3.1. Occupancy Permit - General

(1) Except as permitted in Sentence 1.3.3.2.(1), a person may occupy or permit to be occupied any building or part of it that has not been fully completed at the date of occupation where the chief building official or a person designated by the chief building official has issued a permit authorizing occupation of the building or part of it prior to its completion in accordance with Sentence (2).
1.3.3.2. Conditions for Residential Occupancy

(1) A person may occupy or permit to be occupied a building intended for residential occupancy that has not been fully completed at the date of occupation provided that

(a) the building
   (i) is of three or fewer storeys in building height and has a building area not exceeding 600 m²,
   (ii) has not more than 1 dwelling unit above another dwelling unit,
   (iii) has not more than 2 dwelling units sharing a common means of egress, and
   (iv) has no accommodation for tourists,
(b) the following building components and systems are complete, operational and inspected:
   (i) required exits, handrails and guards, fire alarm and detection systems, and fire separations,
   (ii) required exhaust fume barriers and self-closing devices on doors between an attached or built-in garage and a dwelling unit, and
   (iii) water supply, sewage disposal, lighting and heating systems,
(c) the following building components and systems are complete, operational, inspected and tested:
   (i) water systems,
   (ii) building drains and building sewers, and
   (iii) drainage systems and venting systems, and
(d) where applicable, the building conforms to Article 3.1.1.3. or 9.1.1.7. of Division B.

(2) Sentence (1) does not apply in respect of the occupancy of a building to which Article 1.3.3.4. applies.
OBC’s Audibility & Intelligibility Requirements
1(b) loudspeakers operated from the central alarm and control facility that are designed and located so as to be audible and the messages intelligible in all parts of the building, except that this requirement does not apply to elevator cars.

Clause (b) prescribes that the emergency voice page messages be both audible (we can hear it) and intelligible, (we can understand it) in all parts of the building; (except inside the elevator).
Scenario 2

The Degree To Which
The Occupants
Understand
The Spoken Language

Fire Alarm System Intelligibility
Initial Review Of Existing System
Determine Audibility

- A measure of loudness of a sound.
- When used with respect to fire alarm systems, audibility is regarded as the evacuation signal level above background noise.
SIGNAL LEVELS SHALL BE A MINIMUM OF 15 dBA ABOVE AMBIENT BUT NOT LESS THAN 65 dBA

(Ref: National Building Code)
Audibility Requirements

SIGNAL LEVELS SHALL BE A MAXIMUM OF 100 dBA IN A NORMALLY OCCUPIED AREA (Ref: Ontario Building Code)

DECIBELS

TOO LOUD
Busy Factory
Noisy Crowd
Library
GIS Audibility Review

Ambient SPL equal to or over 60 dBA

Evacuation SPL Readings

Areas requiring more analysis

Step One The Review
Geospatial Information System
Mapping the SPL
The CIS is not a method of measuring intelligibility itself, but is a standardized scale to which a variety of measurement methods are correlated.

- The capability of being understood or comprehended.

<table>
<thead>
<tr>
<th></th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
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<tbody>
<tr>
<td>CIS</td>
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<td>RASTI</td>
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<td>0.90</td>
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<td>STI</td>
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<td>%ALcons</td>
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<table>
<thead>
<tr>
<th></th>
<th>POOR</th>
<th>BAD</th>
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<tbody>
<tr>
<td>CIS</td>
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<td>0.60</td>
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<tr>
<td>RASTI</td>
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Geospatial Mapping of CIS

**CIS**

- Poor: 0.65, 0.60, 0.54
- Bad: 0.47, 0.39, 0.29, 0.16, 0.00, 0.00, 0.00

**Room Dimensions**

- Room Width: 36 Feet
- Room Length: 22 Feet
- Room Height: 10 Feet
Intelligibility Testing

Step One The Review

<table>
<thead>
<tr>
<th>POOR</th>
<th>0.65</th>
<th>0.60</th>
<th>0.54</th>
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</thead>
<tbody>
<tr>
<td>CIS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analyzing Audibility

THE OCCUPANTS CANNOT HEAR THE EVACUATION ALARM SIGNALS

The Analysis

Evacuation SPL Reading

Ambient SPL Reading

Issue: Evacuation Alarm Signal is 33dBA lower than the ambient noise level

Ambient SPL equal to or over 60 dBA

Evacuation SPL Readings

Areas requiring more analysis

<table>
<thead>
<tr>
<th>Room Width</th>
<th>36 Feet</th>
</tr>
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<tbody>
<tr>
<td>Room Length</td>
<td>22 Feet</td>
</tr>
<tr>
<td>Room Height</td>
<td>10 Feet</td>
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Analyzing Intelligibility Metrics

<table>
<thead>
<tr>
<th>CIS</th>
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<tbody>
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<td>0.65</td>
<td>0.60</td>
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0.63
Analyzing Intelligibility Metrics

The CIS is not a method of measuring intelligibility itself, but is a standardized scale to which a variety of measurement methods are correlated.

- **Analysis Defined Language**

<table>
<thead>
<tr>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
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<tbody>
<tr>
<td>CIS</td>
<td>0.81</td>
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<tr>
<td>RASTI</td>
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<td>0.55</td>
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<td>STI</td>
<td>0.70</td>
<td>0.60</td>
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<td>%ALcons</td>
<td>5.0</td>
<td>6.6</td>
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</table>

<table>
<thead>
<tr>
<th>POOR</th>
<th>BAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS</td>
<td>0.65 0.60 0.54</td>
</tr>
<tr>
<td>RASTI</td>
<td>0.47 0.39 0.29</td>
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<tr>
<td>STI</td>
<td>0.16 0.00 0.00</td>
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<tr>
<td>%ALcons</td>
<td>0.00 0.05 0.00</td>
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</table>

**COMMON INTELLIGIBILITY SCALE**
Rapid Acoustic Speech Transmission Index
Speech Transmission Index
Articulation Loss Of Consonants
The creation of “phonemes,” or the sounds that make up words is created by amplitude modulation of voice frequencies.
Speech Pattern Modulations

Amplitude modulations of speech patterns are seen as the peaks and valleys of the waveform. These modulations range from 0.63 Hz to 12.5 Hz.
• How do we design emergency voice systems so that they provide intelligible speech?
• Do we need more loudspeakers at lower output or do we need fewer loudspeakers with higher output?
Ceiling Mount Speaker Layout Patterns

- **2 x Edge-to-Edge**

- Does not provide intelligible voice but is acceptable for tone only Signalling
Ceiling Mount Speaker Layout Patterns

The Design

- **1.4 x Edge-to-Edge**
- Good for rooms with low background noise and little reverberation
Ceiling Mount Speaker Layout Patterns

• **Edge-to-Edge**

• Preferred layout for typical applications

![Diagram of Edge-to-Edge layout pattern]
Ceiling Mount Speaker Layout Patterns

- **Minimum Overlap**
- Preferred layout for high reverberation and/or high ceilings
Ceiling Mount Speaker Layout Patterns

- **Full Overlap**
- For the worst areas, full overlap provides excellent intelligibility however acoustic modeling is recommended to determine speaker interaction.
### SPL Variation by Layout Pattern

#### Sound Pressure Level by Layout Pattern

<table>
<thead>
<tr>
<th>SPEAKER LAYOUT PATTERN</th>
<th>INCREASE IN SPL OVER A SINGLE SPEAKER</th>
<th>VARIATION IN COVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2X Edge to Edge</td>
<td>0.2 dB</td>
<td>-10.4 dB</td>
</tr>
<tr>
<td>1.4X Edge to Edge</td>
<td>0.4 dB</td>
<td>- 6.8 dB</td>
</tr>
<tr>
<td>Edge to Edge</td>
<td>0.7 dB</td>
<td>- 4.4 dB</td>
</tr>
<tr>
<td>Minimum Overlap</td>
<td>2.0 dB</td>
<td>- 2.0 dB</td>
</tr>
<tr>
<td>Full Overlap</td>
<td>5.2 dB</td>
<td>- 1.4 dB</td>
</tr>
</tbody>
</table>

**The Design**
Wall Mount Speaker Coverage

The Design
Coverage patterns for wall mount speakers are similar for distributed overhead systems.

The Design

Wall Mount Speaker Coverage

Coverage Width

Room Depth

-6dB On Axis

52° off axis

Critical Polar Angle

Wall
Wall Mount Speaker Coverage

The Design

Edge to Edge

Minimum Overlap

Full Overlap
Intelligibility Modeling

The Design

<table>
<thead>
<tr>
<th>Room Dimension</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor</td>
<td>Gypsum over 2 x 4 - 16&quot; o.c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling</td>
<td>Gypsum over 2 x 4 - 16&quot; o.c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall 1</td>
<td>Linear Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall 2</td>
<td>Gypsum over 2 x 4 - 16&quot; o.c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall 3</td>
<td>Linear Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall 4</td>
<td>Linear Wood</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speaker</th>
<th>TrueAlert ceiling mounted speaker</th>
</tr>
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<tbody>
<tr>
<td>Placement</td>
<td>Edge to Edge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Listener Height</th>
<th>5</th>
<th>Feet</th>
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</thead>
<tbody>
<tr>
<td>Ambient Noise</td>
<td>55</td>
<td>dB</td>
</tr>
<tr>
<td>Required Signal to Noise Ratio</td>
<td>15</td>
<td>dB</td>
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</table>

Reverberation Time

Required Speakers

Speaker Wattage

Total Audio Power

Calculate
### Intelligibility Modeling Automation

#### The Design

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Room Width</td>
<td>36 Feet</td>
</tr>
<tr>
<td>Room Length</td>
<td>22 Feet</td>
</tr>
<tr>
<td>Room Height</td>
<td>10 Feet</td>
</tr>
<tr>
<td># Speakers Required</td>
<td>24</td>
</tr>
<tr>
<td>Speaker Tap Setting</td>
<td>0.25 Watt</td>
</tr>
<tr>
<td>Total Power Required</td>
<td>6 Watt</td>
</tr>
<tr>
<td># of Columns (X)</td>
<td>4</td>
</tr>
<tr>
<td># of Rows (Y)</td>
<td>6</td>
</tr>
<tr>
<td>First Speaker X Coord.</td>
<td>2.8 Feet</td>
</tr>
<tr>
<td>First Speaker Y Coord.</td>
<td>3 Feet</td>
</tr>
<tr>
<td>Column Spacing</td>
<td>5.5 Feet</td>
</tr>
<tr>
<td>Row Spacing</td>
<td>6 Feet</td>
</tr>
</tbody>
</table>

![Diagram showing speaker placement and power requirements](image)
SPL Distribution Modeling

The Design

Resolution Slide Bar
dB Legend

SPL Distribution Button

X and Y Coordinates with SPL Reading

SPL91
SPL89
SPL86

Calculation has finished. You may click on the text below to review results.