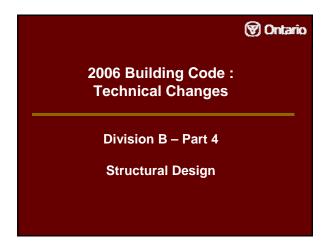
### **Ontario Notice** This presentation is intended for general information purposes only. It only identifies certain highlights of the Building Code. Code users are strongly advised to consult the official records for specific legislative and regulatory requirements, including: • The Building Code Act, 1992, as amended; and • The Building Code, including amendments not yet in Copies of these documents are available from Publications Ontario at 1-800-668-9938 or eLaws at www.e-laws.gov.on.ca (V) Ontario Part 4 & 5 This slide deck is part of a series of slide decks prepared to accompany the Ministry of Municipal and Affairs and Housing's information sessions on the 2006 Building Code. Other slide decks and locations for the Ministry's information sessions are available from the Building Code website at www.obc.mah.gov.on.ca. The complete series of slides is intended to: Provide an overview of the 2006 Building Code's new objective-based format and Introduce certain technical highlights of Ontario's 2006 Building Code (V) Ontario Overview: Agenda • The morning session:

Format and StructureHighlights of changes to Part 3Highlights of changes to Part 9

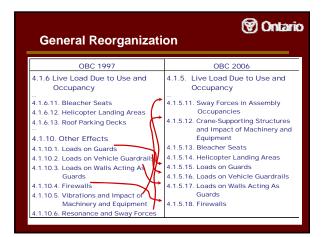
Highlights of changes to Parts 4, 5, 6, 7, 8 and 11
 Part 12: Resource Conservation (Energy and Water)

• The afternoon session:

-	
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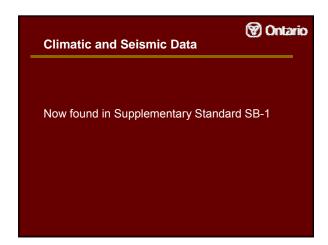


REORGANISATION OF PART 4	<b>♥</b> Ontario
•Part 4 incorporated into Division B •Relocation of articles	





Divisions A, B and C of OBC
Relocation of Issues of Structural significance
Division A • Designated Structures 1.3.1.1.
Division B     Depth of frost penetration 1.1.2.2.     Majority of design requirements Part 4
Division C  Design and Review Section 1.2.









### **MAJOR CHANGES IN DESIGN Ontario REQUIREMENTS** Design methodology · has been revised has been updated to reflect latest knowledge and data and to more closely reflect changes in other jurisdictions. • End result will not be significantly different for most designs Changes in design methodology (W) Ontario - overview 4.1.2. Specified Loads and Effects -Importance categories and factors 4.1.3. Limit States Design - Companion action format Working stress design eliminated Return period for snow and wind 4.1.6. Loads due to rain and snow - snow loads 4.1.7. Wind Loads 4.1.8. Earthquake Loads and Effects (W) Ontario Changes in design methodology 4.1.2. Specified Loads and Effects - Importance categories and factors 4.1.3. Limit States Design - Companion action format Working stress design eliminated

### Snow, Wind and Earthquake Loads Tontario 1997 Building Code Various methods of addressing loads on different types of buildings Importance factor in general load combination equation 0.8 for low importance buildings 1.0 for other buildings Snow Wind Earthquake Post-Disaster School Other No Distinction 1-in-30 year 1-in-30 year

1.2. Importance Categories	<b>₩</b> On
Use and Occupancy	Importance Category
Low or indirect hazard to human life in event of a failure	Low
Others	Normal
Post-disaster shelters Facilities housing hazardous substances	High
Post-disaster buildings	Post-disaster

4.1.2. Compila Importance Fa						<b>Intari</b> c
Harmonization of approach for wind, snow and earthquake						
Importance Category	Snow, I <sub>S</sub> Wind, I <sub>W</sub>				uake, I <sub>E</sub> 4.1.8.5.)	
portaneo category	ULS	SLS	ULS	SLS	ULS	SLS
Low	0.8	0.9	0.8	0.75	0.8	imits
Normal	1.0	0.9	1.0	0.75	1.0	
High	1.15	0.9	1.15	0.75	1.3	<b>Deflection</b>
Post-Disaster	1.25	0.9	1.25	0.75	1.5	Del
ULS = ultimate limit st	ates	SLS = s	erviceal	oility limi	t states	

### **Changes in Design Methodology**

(W) Ontario

4.1.2. Specified Loads and Effects -Importance categories and factors

### 4.1.3. Limit States Design - Companion action format

Working stress design eliminated

- 4.1.6. Loads due to rain and snow snow loads
- 4.1.7. Wind Loads
- 4.1.8. Earthquake Loads and Effects

### 4.1.3.2. Companion Action **Load Format**



Form of Limit States Design Ultimate and serviceability limit states

### 1997 Building Code

- all variable loads at extreme values
- · factoring them down

### 2006 Building Code

- one principal load at extreme value
- · companion loads at largest expected value

### 4.1.3.2. Companion Action - Ultimate Limit State

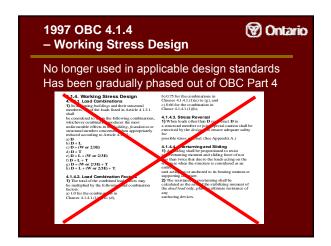


Generic Equation

$$\begin{array}{c} \Sigma\alpha_{Gi}G_{i} + \alpha_{Q1}Q_{1} + \Sigma\alpha_{CQi}Q_{i} \\ \\ \hline \\ \text{Companion Variable Loads} \\ \cdot \text{ at highest expected value} \\ \\ \text{Principal Variable Load} \\ \cdot \text{ at extreme value} \\ \end{array}$$

### 4.1.3.2. Companion Action (W) Ontario **Load Combinations Load Combination** Case Principal Loads Companion Loads 1.4**D** (1.25**D**\* or 0.9**D**\*) + 1.5**L**\* 0.5**S**\* or 0.4**W** 2 (1.25**D**\* or 0.9**D**\*) + 1.5**S** 0.5L\* or 0.4**W** (1.25**D**\* or 0.9**D**\*) + 1.4**W** | 0.5L\* or 0.5**S** 1.0**D**\* + 1.0**E**\* 0.5L\* + 0.25**S**\* snow load vs live load New Definition factors were calibrated

## Changes in Design Methodology 4.1.2. Specified Loads and Effects -Importance categories and factors 4.1.3. Limit States Design - Companion action format Working stress design eliminated Return period for snow and wind 4.1.6. Loads due to rain and snow - snow loads 4.1.7. Wind Loads 4.1.8. Earthquake Loads and Effects



### (W) Ontario **Changes in Design Methodology** 4.1.2. Specified Loads and Effects -Importance categories and factors 4.1.3. Limit States Design - Companion action Return period for snow and wind 4.1.7. Wind Loads 4.1.8. Earthquake Loads and Effects (W) Ontario Return Period - Snow and Wind 1997 Building Code Snow 1-in-30 year ground snow loadsame for all Wind 1-in-10 year for cladding, serviceability 1-in-100 year for post-disaster 1-in-30 year for other 2006 Building Code 1-in-50 year for all (W) Ontario **Changes in Design Methodology** categories and factors 4.1.3. Limit States Design - Companion action Working stress design eliminated 4.1.6. Loads due to rain and snow - snow loads 4.1.7. Wind Loads

### **Ontario** 4.1.6. Snow and Rain Load differentiation

- - · none in 1997 OBC

  - change prompted by ice storm2006 OBC to use importance factors
- Snow load **no longer** considered a live load
- Exposure factor

  - no reduction for High and Post-Disastertied to "open terrain" definition in Wind Subsection

Chang	es in Design Methodology	♥ Ontar
4.1.2.	Specified Loads and Effects -In categories and factors	nportance
4.1.3.	Limit States Design - Companio format	on action
Worki	ng stress design eliminated	
Returr	n period for snow and wind	
4.1.6.	Loads due to rain and snow - s	snow loads
4.1.7.	Wind Loads	
4.1.8.	Earthquake Loads and Effects	

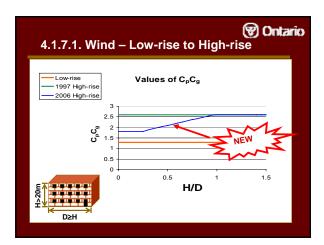
4.1.7. Wind		♥ Ontario
	1997 Building Code	2006 Building Code
Load differentiation	• return periods – 1-in-10, 1-in-30, 1-in-100 year	• 1-in-50 year • use importance factors
Cladding	• 1-in-10 year for design	• 1-in-50 year

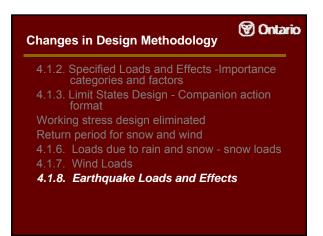
### 4.1.7.1. Wind Exposure Factor 1997 Building Code • one exposure equation • C<sub>e</sub>= (h/10)<sup>1/5</sup> 2006 Building Code • two exposure equations • open terrain → same as 1997 Building Code equation • rough terrain → extend 1 km or 10 h • intermediate terrain (h is the height of the building)













### 4.1.8. Earthquake



- Significant advances in knowledge and data lead to:
  - · updated hazard in spectral format
  - a change in return period
  - period dependant site factors
  - the delineation of overstrength and ductility
  - system restrictions
  - revised period calculations
  - defined structural irregularities
  - · dynamic analysis as the default method

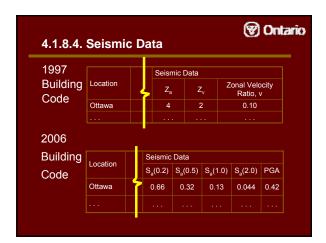
### 4.1.8. Earthquake

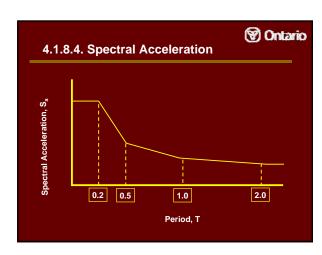


Significant advances in knowledge and data lead to:

- · updated hazard in spectral format
- · a change in return period
- period dependant site factors
- · the delineation of overstrength and ductility
- · system restrictions
- revised period calculations
- · defined structural irregularities
- · dynamic analysis as the default method

### 4.1.8.4. Spectral Acceleration 1997 Building Code • peak ground velocity and acceleration • sorted into discrete zones • amplified to obtain period-dependant forces 2006 Building Code • uniform hazard spectra at specific locations • direct representation of structural response





### 4.1.8. Detailed Spectral Acceleration Values More detailed S<sub>a</sub>(0.2) values for The Toronto area in Structural Commentary Toronto Toron

### 4.1.8. Earthquake



### Significant advances in knowledge and data lead to:

- · updated hazard in spectral format
- a change in return period
- period dependant site factors
- the delineation of overstrength and ductility
- system restrictions
- revised period calculations
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- · dynamic analysis as the default method

### (W) Ontario

### 4.1.8. Probability of Exceedance

- From 10% in 50 year probability in 1997 OBC to a probability of 2% in 50 year for 2006 OBC
- This new methodology focuses on design criteria specific to the building location as well as the building itself. It takes into account:
  - Earthquake activity
  - Ground conditions
  - Building dependent criteria. (period of vibration, discontinuity, method of construction )
- · Uniform margin of collapse.

### 4.1.8. Earthquake



### Significant advances in knowledge and data lead to:

- undated hazard in spectral format
- a change in return period
- · period dependant site factors
- the delineation of overstrength and ductility
- · system restrictions
- revised period calculations
- defined structural irregularities
- dynamic analysis as the default method

### (V) Ontario

### 4.1.8.4. Period-Dependent Site Factors

- Six 'site classes' A,B,C,D,E and F
- Used in conjunction with spectral acceleration
- Seismic response of building to ground movement.

### 4.1.8.4. Site Classification



	Average Properties in Top 30 m				
Site Ground Profile Class Name		Shear Wave Average Velocity, V <sub>s</sub> (m/s)	Standard Penetration Resistance, N <sub>60</sub>	Soil Undrained Shear Strength, su	
Α	Hard Rock	∇ <sub>s</sub> > 1500	Not applicable	Not applicable	
В	Rock	760 < V <sub>s</sub> ≤ 1500	Not applicable	Not applicable	
С	Very Dense Soil and Soft Rock	360 < V <sub>s</sub> < 760	N <sub>80</sub> > 50	s <sub>u</sub> > 100kPa	
D	Stiff Soil	180 < V <sub>s</sub> < 360	15 ≤ N <sub>80</sub> ≤ 50	50 < s <sub>u</sub> ≤ 100kPa	
	Soft Soil	V <sub>s</sub> < 180	N <sub>60</sub> < 15	s <sub>u</sub> < 50kPa	
E		Any profile with more than 3 m of soil with the following characteristics:  Plastic index. PI > 20  Moisture content w ≥ 40%, and Undrained shear strength s₁ < 25 kPa			
F	(1) Others	Site Specific Evaluation Required			

### (W) Ontario 4.1.8. Earthquake Significant advances in knowledge and data lead to: the delineation of overstrength and ductility (W) Ontario 4.1.8.9. Ductility and Overstrength •Force modification factors revised. **Ontario** 4.1.8. Earthquake Significant advances in knowledge and data lead to: · system restrictions defined structural irregularities

### 4.1.8.10 System Restrictions 2006 OBC will restrict certain types of building form. •Force resisting system •Spectral acceleration •Soil properties •Importance category

### 4.1.8. Earthquake Significant advances in knowledge and data lead to: updated hazard in spectral format a change in return period period-dependant site factors the delineation of overstrength and ductility system restrictions revised period calculations defined structural irregularities dynamic analysis as the default method

4.1.8.11. Period C	(V) Ontario alculations
Revised     Braced frames and	l shear wall added
0.1996 C. 2006  C. 20	Frequency = $\frac{1}{Period}$

### 4.1.8. Earthquake



### Significant advances in knowledge and data lead to:

- undated hazard in spectral format
- a change in return period
- period-dependant site factors
- the delineation of overstrength and ductility
- · system restrictions
- revised period calculations
- · defined structural irregularities
- · dynamic analysis as the default method

<b>8</b> (	)ntario
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### 4.1.8.6. Structural Irregularities

Restrictions and special requirements:

- Irregular structures generally not permitted
- If they are, then design forces are increased
- dynamic analysis must be used

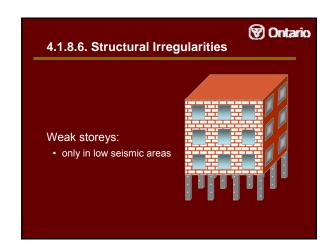


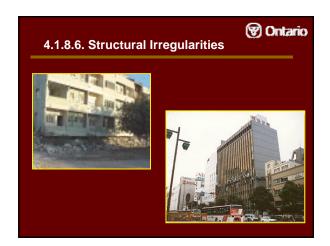
### (W) Ontario

### 4.1.8.6. Structural Irregularities

- Regular buildings perform better than irregular ones
- Triggers based on period, seismicity, importance

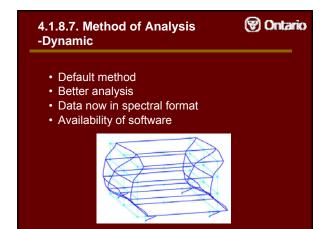
Туре	Irregularity Type and Definition	Notes
1	Vertical Stiffness Irregularity	(2) (3)
2	Weight (mass) Irregularity	(2)
3	Vertical Geometric Irregularity	(2) (3) (4)
4	In-plane Discontinuity in vertical lateral force-resisting element	(2) (3) (4)
5	Out-of-Plane Offsets	(2) (3)
6	Discontinuity in Capacity - Weak Storey	(3)
7	Torsional Sensitivity - to be considered when diaphragms are not flexible	(2) (3) (5)
8	Non-orthogonal Systems	(6)

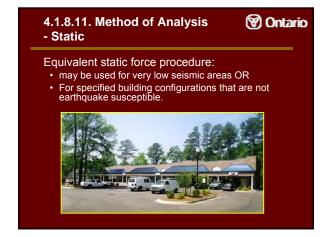






# 4.1.8. Earthquake Significant advances in knowledge and data lead to: updated hazard in spectral format a change in return period period-dependant site factors the delineation of overstrength and ductility system restrictions revised period calculations defined structural irregularities dynamic analysis as the default method



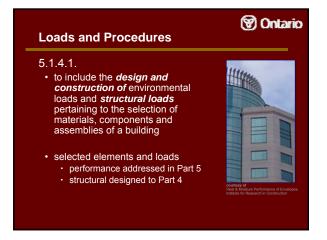


### (W) Ontario Part 4 changes - summary •Wind, Snow and Earthquake – loads •Revised Design Codes for Steel, reinforced concrete, masonry and wood •Companion Action now used for design. •Earthquake design rewritten (V) Ontario Overview: Agenda • The morning session: • Highlights of changes to Part 3 • Highlights of changes to Part 9 • The afternoon session: • Highlights of changes to Parts 4, 5, 6, 7, 8 and 11 • Part 12: Resource Conservation (Energy and Water) (W) Ontario **Building Code 2006: Technical Changes** Division B - Part 5 **Environmental Separation**

### (V) Ontario Outline Scope and Application Loads and Procedures Performance Requirements Sound Transmission Referenced Standards (V) Ontario Outline Scope and Application Performance Requirements **Sound Transmission** Referenced Standards (Contario **Scope and Application** Expansion • 5.1.1. Scope · control of condensation transfer of heat, air and moisture · airborne sound transmission



### Outline Scope and Application Loads and Procedures Performance Requirements Sound Transmission Referenced Standards



### **Loads and Procedures**



Resistance to Loads Sentence 5.1.4.1.(1)

- Design
  - of all environmental separator elements
    assemblies exposed to the exterior
- to resist or accommodate all expected
  - environmental loads and effects
  - · structural loads and effects





### **Loads and Procedures**



### Resistance to Loads

### All Across Part 5

- · Refers to Part 4 for
  - those elements and loads identified in Part 4 (5.2.2.1.)

  - air pressure on air barrier systems (5.4.1.2 (4))
  - wind-uplift on roofing (5.2.2.2.)
  - hydrostatic pressure on waterproofing (5.8.2.2.(5))



### **Loads and Procedures**

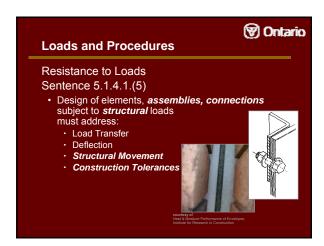


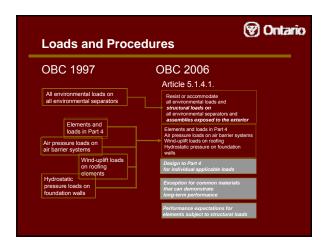
Resistance to Loads

For elements and loads not addressed in Sentence 5.1.4.1.(3)

Sentence 5.1.4.1.(4)

- a) determine structural loads and design according to Subsection 5.2.2. (Part 4), or
- b) for **common** materials, components, assemblies and their installation be based on proven past performance over several years



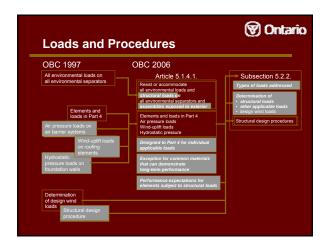


### Loads and Procedures Resistance to Deterioration addressed in Article 5.1.4.2. Design and construction of assemblies exposed to exterior must be in accordance with good practice such as CSA S478, "Guideline on Durability in Buildings" Standard

### 

### Loads and Procedures Determination of Wind Load Article 5.2.2.2. Required: for all elements subject to wind load where those elements are required to be designed to resist that load Specified Load Specified Load 100% according to 4.1.7.1. based on reference velocity pressure gust effect factor Exception smaller loads allowed – if based on test or analysis





### Loads and Procedures Why not just reference Part 4? Simple reference to Part 4: • considers only direct consequences, such as structural failure and damage • addresses only structural safety and structural sufficiency Requirements in Part 5 + reference to Part 4: • considers indirect consequences from damage or failures, such as inadequate performance of environmental separators • addresses structural and health objectives



## Loads and Procedures Intent – Part 5 – Indoor Conditions • displacements of the structural system as a whole or in part, • component buckling, or • failure of required environmental separator elements • ... • air infiltration and exfiltration • negative effects on thermal comfort • in in infiltration elements • in in infiltration and exfiltration

### Outline Scope and Application Loads and Procedures Performance Requirements Sound Transmission Referenced Standards



### 5.4. Air Leakage OBC 2006 Control of Air Leakage • materials to resist the transfer of air • means to permit venting Performance Target • provide & maintain acceptable conditions • minimize condensation & precipitation ingress • avoid ice damming • not compromise operation of building services Design Parameters • air permeance of material to resist air leakage



### Outline Scope and Application Loads and Procedures Performance Requirements Sound Transmission Referenced Standards

### (W) Ontario 5.9. Sound Transmission 3.3.4.6. Requirements Moved to 5.9 · Airborne sound only · Between dwelling units • STC Rating ≥ 50 Between dwelling units and elevator shafts STC Rating ≥ 55 Compliance ASTM E 336 STC measurement (V) Ontario **Outline** Scope and Application Loads and Procedures Performance Requirements **Sound Transmission** Referenced Standards **Ontario** 5.10. Referenced Standards OBC 2006 – Referenced Standards any material installed to fulfill Part 5 for which a standard is listed has to comply with that standard • more materials referenced · exceptions and additional specific requirements kept ANCSA A3001

# Summary - Assemblies exposed to the exterior now addressed - Structural loads on building envelope elements better addressed - Part 5 is becoming more performance-based - Sound transmission requirements moved to Part 5 - New single table of referenced standards Further Information Purther Information Purther Information