Importance Category and Seismic Restraint

Summary
The Ontario Building Code requires all buildings be assigned an Importance Category of ‘Low’, ‘Normal’, ‘High’ or ‘Post-disaster’. Importance Category is necessary for seismic design but can at times be overlooked because all buildings are considered Normal unless designated otherwise. The Importance Category should be included as part of the Code Data Matrix that must be part of building permit applications.

The design requirements are mostly structural but there are architectural, mechanical and electrical requirements and implications that need to be observed.

This Practice Tip describes aspects of seismic restraint and the Importance Category that architects must take into account in the design of buildings.

If the Importance Category is not taken into account at the design stages and provisions for seismic design and restraint are not incorporated in the drawings for permit and construction, revisions in order to comply with the code requirements can be a difficult and costly surprise.

Background
Seismic design is a critical factor for buildings to be available after an earthquake for emergency responders, treating victims, communications and housing the displaced. Some areas of Ontario, the Ottawa and St. Lawrence valleys for example, are among the highest seismically sensitive areas in North America.

Three things the architect should be aware of related to seismic design: the Importance Category; the Site Class assigned by a geotechnical engineer following soil tests; and, if the seismic hazard index formulae calculation \( I = F_a S_a(0.2) \) is above or below 0.35. The formulae uses both the Site Class and the Importance Category as factors.

Importance Categories
The Ontario Building Code requires all buildings be assigned an Importance Category of ‘Low’, ‘Normal’, ‘High’ or ‘Post-disaster’. The ‘Post-disaster’ category applies to buildings that need to remain operational following a disaster such as hospitals, police facilities and telephone exchanges. The ‘High’ category is for buildings that are likely to become a shelter or collecting point such as schools.

Although the requirement for the Importance Category resides in Part 4 – Structural Design of the Code, the determination of Importance Category relates to the use and occupancy of the building - traditionally under the purview of the architect and owner - not the structural engineer. To appropriately assign the Importance Category, the architect will need to use professional judgment and may need to have discussions with the owner, structural engineer and authorities having jurisdiction.
## Table 4.1.2.1.B.

### Importance Categories for Buildings

**Forming Part of Sentence 4.1.2.1.(3)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Use and Occupancy</strong></td>
<td><strong>Importance Category</strong></td>
</tr>
<tr>
<td>1.</td>
<td><strong>Buildings</strong> that represent a low direct or indirect hazard to human life in the event of failure, including:</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>• low human-occupancy buildings, where it can be shown that collapse is not likely to cause injury or other serious consequences</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• minor storage buildings</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>All buildings except those listed in Importance Categories Low, High and Post-disaster</td>
<td>Normal</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Buildings</strong> that are likely to be used as post-disaster shelters, including buildings whose primary use is:</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>• as an elementary, middle or secondary school</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• as a community centre</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manufacturing and storage facilities containing toxic, explosive or other hazardous substances in sufficient quantities to be dangerous to the public if released</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td><strong>Post-disaster buildings</strong></td>
<td>Post-disaster</td>
</tr>
</tbody>
</table>

### Low

Examples of ‘Low’ Importance Category can be low human occupancy buildings (farm buildings) with 1 person or less per 40m² of floor area and ‘Low’ hazard industrial occupancy (Group F, Division 3) warehouses where structural failure causing damage to materials or equipment does not present a direct threat to human life.

It is important for the authorities having jurisdiction to be aware of when the ‘Low’ Importance Category is being assigned, since it enables relaxations of some code requirements. In some cases this relaxation is inappropriate. An equestrian riding facility that also has provision for permanent or temporary grandstands is an Assembly use. It should not be categorized as ‘Low’ Importance category.

### Normal

All buildings not classified as ‘Low’, ‘High’ or ‘Post-disaster’.

### High

The ‘High’ Importance category applies to schools, community centers and industrial or storage facilities having hazardous or toxic materials. This category is not limited to the specific facilities noted and might also apply to a college, sports facility, arena or large place of worship. The code uses the term “likely to be used as ‘Post-Disaster’ shelters”. It should be noted that this is not the code-defined term ‘Post-disaster building’ but a lower category of Importance which will require professional judgment in order to assign a category.

### Post-disaster

This classification is reserved for ‘Post-disaster buildings’ which is defined in the Code.

*Post-disaster building means a building* that is essential to the provision of services in the event of a disaster, and includes:

- (a) hospitals, emergency treatment facilities and blood banks,
- (b) telephone exchanges,
- (c) power generating stations and electrical substations,
- (d) control centres for land transportation,
- (e) public water treatment and storage facilities,
- (f) water and sewage pumping stations,
- (g) emergency response facilities,
- (h) fire, rescue and police stations,
- (i) storage facilities for vehicles or boats used for fire, rescue and police purposes, and
- (j) communications facilities, including radio and television stations.

The list covers a broad range of buildings so questions may arise for some facilities that are not specifically listed, such as: wind turbines, private versus public bus terminal or airport, a private clinic or a non-emergency treatment facility not likely considered essential to provision of services to the public in a disaster. Again,
discussion with the owner, structural engineer and authorities having jurisdiction may be required in order to appropriately assign the Importance category.

Site Class (Table 4.1.8.4. A. & B.)
A Site Class (A to F) relative to substrate type (e.g. rock, hard or soft soil) is one of three factors required for the calculation of the seismic hazard index. The Site Class is assigned by a geotechnical engineer following soil tests. A Shear Wave Velocity Test may be required by the geotechnical engineers to assign a Site Class better (higher) than can be ascertained without the test (e.g. C rather than D, or B rather than C). The shear wave test would be an additional cost over simple borehole analysis but may save the project considerable cost.

The Seismic Hazard Index
While the structural design of the building involves complex seismic restraint calculations, a reasonably simple formula is used to determine the seismic hazard index.

The seismic hazard index formula is: \( I_E F_a S_a(0.2) \) where:
- \( I_E \) Earthquake importance factor for the structure (Table 4.1.8.5.)
- \( F_a \) Acceleration-based site coefficient (Table 4.1.8.4.B)
- \( S_a(0.2) \) 5% damped spectral response acceleration (SB-1 Table 1.2, Column 17)

If the value of the seismic hazard index is equal or greater than 0.35, this triggers the need to restrain architectural elements like suspended ceilings, parapets, ornamentations, masonry veneer connectors, etc., as well as restraint for mechanical and electrical systems and equipment in all buildings [4.1.8.6.(3), 4.1.8.18.(2)].

The chart below shows some of the requirements for various seismic hazard index values which affect architectural and engineering parts of buildings.

<table>
<thead>
<tr>
<th>Value of seismic hazard index</th>
<th>Requirements</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \geq 0.2 )</td>
<td>Buildings are not permitted to have a ‘weak storey’. Examples of weak storeys are ones where an open floor area, such as a parking garage, is on a level below a level having numerous shear walls. A formal definition of what constitutes this condition is given in the Code.</td>
<td>OBC 4.1.8.10.(1)</td>
</tr>
<tr>
<td>( \geq 0.35 )</td>
<td>Elements of structures and non-structural components and equipment (categories 6 through 21 of Table 4.1.8.18) must be seismically restrained. This includes suspended ceilings, light fixtures, masonry veneer ties, access floors, machinery, fixtures, ducts, pipes, cable trays, tanks, etc.</td>
<td>4.1.8.18(2)</td>
</tr>
<tr>
<td>( \geq 0.35 )</td>
<td>Basement walls must be designed to resist earthquake lateral pressures from backfill or natural ground.</td>
<td>OBC 4.1.8.16. (4)</td>
</tr>
<tr>
<td>( \geq 0.35 )</td>
<td>The prescriptive masonry veneer tie spacing given in CSA Standard A370, cannot be used. The ties must be engineered.</td>
<td>CSA A370 10.2.2</td>
</tr>
<tr>
<td>( \geq 0.35 )</td>
<td>Unreinforced masonry is not permitted.</td>
<td>CSA S304.1 4.5.1</td>
</tr>
<tr>
<td>( \geq 0.35 )</td>
<td>Minimum amounts of reinforcement are required for all loadbearing and lateral load-resisting masonry, masonry used around stairwells and elevators and exterior cladding (excluding veneer), and certain partitions.</td>
<td>CSA S304.1 4.6.1, 10.15.2.2, 10.15.2.4</td>
</tr>
<tr>
<td>( \geq 0.75 )</td>
<td>All partitions must be reinforced.</td>
<td>CSA S304.1 4.6.1, 10.15.2.3</td>
</tr>
<tr>
<td>( \geq 0.35 )</td>
<td>Composite and multi-wythe solid walls must have grouted collar joists and ties.</td>
<td>CSA S304.1 10.7.1.3</td>
</tr>
<tr>
<td>( \geq 0.75 )</td>
<td>Ties for masonry must be placed in grout, not in the horizontal mortar joints.</td>
<td>CSA S304.1 12.2.5</td>
</tr>
<tr>
<td>≥ 0.35</td>
<td>The empirical design method for masonry cannot be used – all masonry must be engineered.</td>
<td>CSA S304.1 F.1.1(f)</td>
</tr>
<tr>
<td>≥ 0.35</td>
<td>Wood framed structures must include special requirements for shear walls and diaphragms.</td>
<td>CSA O86 9.8.1</td>
</tr>
</tbody>
</table>

### Part 9 Buildings

Schools, community centres, other assembly occupancies and F1, high hazard industrial (all ‘High’ Importance Category buildings) are excluded from design under Part 9, but some ‘Post-disaster’ buildings can fall within the limitations of Part 9. All buildings that fall under the definition of ‘Post-disaster’ building must be designed to Part 4 of the Code [A. 1.1.2.2.(2)].

Part 9 also has some individual clauses related to seismic design and restraint, such as masonry reinforcement and restraint of water heaters based on seismic spectral response acceleration for the location of the building [9.20.1.2. & 9.31.6.2 (3)].

### Renovations

For renovation projects, a soils report and determination of Site Class by a geotechnical engineer may not be available. With some restrictions, OBC seismic design requirements are not applicable for renovation projects.

OBC, Div. B, Section 11.5 deals with compliance alternatives (‘C.A.’), a term defined as “a substitute for a requirement in another Part of Division B that is listed in Part 10 or 11 of Division B and ‘C.A.’ has a corresponding meaning.” [Div. A, 1.4.1.2.(1)(c)].

Various C.A.’s are listed in Tables 11.5.1.1.A. to 11.5.1.1.F, corresponding to occupancies A, B, C, D/E, and F respectively. C.A.’s No. A77, B78, C88, DE81, and F82 all state that the requirements under Div. B, 4.1.8. Earthquake Loads and Effects, do not apply, i.e., the seismic design requirements of the Code do not apply to renovations.

Having said this, since seismic requirements are in Div. B, Part 4 of the Code, the application of the C.A. is somewhat restricted because Div. B, 11.5.1.1.(1) allows C.A.’s to be substituted for requirements found in Parts 3, 4, 6, or 8 only if the Chief Building Official’s approval is obtained. Note that Div. B, 11.5.1.1.(2) allows C.A.’s to be substituted for Part 9 and 12 requirements without having to seek the CBO’s approval.

It is expected that building officials would generally accept that seismic design requirements for a renovation would be not applicable.

### Building Code Data Matrix

The OAA template for the Building Code Data Matrix now includes a section indicating the Importance Category and the seismic hazard index calculation. This information should be included as part of building permit applications. If the Importance Category is not identified on the drawings, the determination and designation of a classification may not be clear because according to the wording of the OBC, the ‘Normal’ category applies unless another category has been assigned.

### Procedures

1. Become familiar with Importance Categories and seismic design requirements.
2. In the code review of the building, determine if the Importance Category of the building is ‘Low’, ‘Normal’, ‘High’ or ‘Post-disaster’. Discuss with the client, confirm, and document.
3. In cases where the classification is not clear, discuss with the Building Department, document the discussions and most importantly, the decisions and agreements.
4. A geotechnical report should be provided by the owner. The report should include the Site Class and the factors for the seismic hazard index calculations. This information should appear on structural engineering drawings.
5. Determine if the seismic hazard index is above or below 0.35 and if seismic restraints for non-structural elements are required.
6. Include the Importance Category and seismic hazard index information in the Code Data Matrix on the drawings.
7. Where the architect is responsible for the coordination of consultants, distribute the information to all consultants so that they can provide appropriate seismic design and restraints where required.

**Attachments**
Excerpt - Building Code Data Matrix - Importance Category and Seismic Hazard Index
Seismic Hazard Index Calculation Examples

**References**
Practice Tip PT.3 – *Building Code Data Matrix*

---

*The OAA does not provide legal, insurance or accounting advice. Readers are advised to consult their own legal, accounting or insurance representatives to obtain suitable professional advice in those regards.*