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Proposed Change 1900

Code Reference(s):	NBC20 Div.B 4.1.8.15.(8) (first printing)
Subject:	Earthquake Design — Other
Title:	Clarification of the Use of the Importance Factor in the Determination of Design Forces
Description:	This proposed change clarifies the use of the earthquake importance factor in the calculation of design forces according to Sentence 4.1.8.15.(8).

This change could potentially affect the following topic areas:

- | | |
|--|---|
| <input type="checkbox"/> Division A | <input checked="" type="checkbox"/> Division B |
| <input type="checkbox"/> Division C | <input checked="" type="checkbox"/> Design and Construction |
| <input type="checkbox"/> Building operations | <input type="checkbox"/> Housing |
| <input type="checkbox"/> Small Buildings | <input checked="" type="checkbox"/> Large Buildings |
| <input type="checkbox"/> Fire Protection | <input type="checkbox"/> Occupant safety in use |
| <input type="checkbox"/> Accessibility | <input checked="" type="checkbox"/> Structural Requirements |
| <input type="checkbox"/> Building Envelope | <input type="checkbox"/> Energy Efficiency |
| <input type="checkbox"/> Heating, Ventilating and Air Conditioning | <input type="checkbox"/> Plumbing |
| | <input type="checkbox"/> Construction and Demolition Sites |

Problem

In Sentence 4.1.8.15.(8) of Division B of the NBC, it is not explicitly clear whether the earthquake importance factor must be applied in the calculation of the design forces associated with the lateral capacity of the seismic force resisting system (SFRS). Omission of the importance factor in the calculation of the elastic force level (with $R_dR_o = 1.0$) or the upper limit on the design forces (with $R_dR_o = 1.3$) for High Importance Category buildings and post-disaster buildings will result in unconservative designs, leading to buildings that are very likely to perform below the expected performance level. This could increase the risk to life safety and risk of injury for building occupants beyond the risk levels that are currently acceptable in the NBC for a design-level earthquake event.

Justification

The capacity-protected non-yielding components of an SFRS are designed to remain essentially elastic. In order to ensure that this is the case, the appropriate importance factors must be applied in determining the elastic force level in non-yielding components in High Importance Category buildings and post-disaster buildings.

If the importance factors are not used, such components are likely to be under-designed and may become the weakest link in the structure. This could result in brittle failure of such components, leading to premature collapse of the structure.

PROPOSED CHANGE

[4.1.8.15.] 4.1.8.15. Design Provisions

- [1] 8)** The design forces associated with the lateral capacity of the SFRS need not exceed the forces determined in accordance with Sentence 4.1.8.7.(1) with R_dR_o taken as 1.0, unless otherwise provided by the applicable referenced design standards for elements, in which case the design forces associated with the lateral capacity of the SFRS need not exceed the forces determined in accordance with Sentence 4.1.8.7.(1) with R_dR_o taken as less than or equal to 1.3. (See Note A-4.1.8.15.(8).)

Note A-4.1.8.15.(8) Design Forces in Elements.

The earthquake importance factor, I_E , of 1.3 for High Importance Category buildings or 1.5 for post-disaster buildings must be applied when designing for the elastic force level using $R_dR_o = 1.0$ or for the upper limit on the design forces using $R_dR_o = 1.3$. Similarly, an I_E of 0.8 may be applied for Low Importance Category buildings. Additional information on the design forces in elements can be found in the Commentary entitled Design for Seismic Effects in the "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)".

Impact analysis

The proposed change is a clarification and does not add any new requirements. The impact would be neutral in terms of cost and positive in terms of facilitating the correct application of the Code.

Enforcement implications

The proposed change is a clarification. It would help enforcement staff to properly understand Sentence 4.1.8.15.(8) and its application. No difficulties are expected to result from the proposed change.

Who is affected

Owners, designers, contractors and enforcement professionals dealing with the construction of High Importance Category buildings and post-disaster buildings.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[4.1.8.15.] 4.1.8.15. ([1] 8) no attributions