CSA S832:14
(reaffirmed 2019)

Seismic risk reduction of operational and functional components (OFCs) of buildings

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CSA S832:14
June 2014

Title: *Seismic risk reduction of operational and functional components (OFCs) of buildings*

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Published in June 2014 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3

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ISBN 978-1-77139-452-9

Contents

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Preface

This is the third edition of CSA S832, *Seismic risk reduction of operational and functional components (OFCs) of buildings*. It supersedes the previous editions published in 2006 and 2001.

Earthquakes have rendered many buildings unusable due to extensive damage to their operational and functional components (OFCs) (commonly referred to as non-structural components), including building contents. The main cause of casualties and property damage in the event of an earthquake is often the failure of these OFCs. In many cases, losses associated with damage to these components are considerably greater than damage to the structural system.

National codes and guidelines are in place for the seismic design, evaluation, and upgrading of building structures in Canada. Similar documents did not exist for the OFCs of buildings prior to the publication of the first edition of CSA S832. This Standard is intended to address the need to reduce the seismic risk of OFCs and thus improve the post-earthquake functionality of buildings.

This Standard is intended to be used with the provisions of the 2015 edition of the *National Building Code of Canada* (*NBCC*).

Changes to this edition include
a) harmonization with the *National Building Code of Canada* (*NBCC*) 2015;
b) a general reorganization of contents;
c) revisions in definitions and symbols;
d) update of references;
e) revised definitions of OFC performance objectives;
f) a revised clause (Clause 5) on procedures for OFCs in new buildings;
g) new flowcharts (Figures 3 to 5) to better illustrate the various procedures described in this Standard;
h) a revised clause (Clause 7.5) on the determination of the seismic risk index, *R* and suggested mitigation priority thresholds in Annex C;
i) enriched documentation on methods and criteria to determine the seismic adequacy of OFCs in terms of drift-related effects (Annex D) and seismic force calculations (Annex F);
j) a new Clause 9.4 on the design of seismic restraints and explanatory notes on restraint of OFCs equipped with vibration isolation systems (Clause E.3);
k) update of Table 9, including new material on elevators;
l) a reorganization of contents in Annex G and addition of material on water systems and piping, information technology systems, industrial risk-generating buildings, and heritage buildings; and
m) revised sample calculations in Annexes H and I.

CSA Group received funding for the development of this Standard from the City of Montréal, the Department of National Defence, Public Works and Government Services Canada, the University of British Columbia, and Vibra-Sonic Control.

During the development of this Standard, the Technical Committee maintained a liaison with the Standing Committee on Earthquake Design (SCED) of the Canadian Commission on Building and Fire Codes.

This Standard was prepared by the Technical Committee on Seismic Risk Reduction of OFCs in Buildings, under the jurisdiction of the Strategic Steering Committee on Construction and Civil Infrastructure, and has been formally approved by the Technical Committee.

Notes:

1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
3) *This Standard was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*
4) *To submit a request for interpretation of this Standard, please send the following information to* ***inquiries@csagroup.org*** *and include "Request for interpretation" in the subject line:*
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   b) *provide an explanation of circumstances surrounding the actual field condition; and*
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   Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at ***standardsactivities.csa.ca****.*
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   a) *Standard designation (number);*
   b) *relevant clause, table, and/or figure number;*
   c) *wording of the proposed change; and*
   d) *rationale for the change.*

CSA S832:14
Seismic risk reduction of operational and functional components (OFCs) of buildings

0 Introduction

0.1
A well-designed and constructed building is expected to provide safety and comfort to its occupants when it is subjected to building use, occupancy loads, and other environmental loads such as wind, snow, rain, ice, and earthquakes.

A building is made up of components that can be divided into two groups: structural components and operational and functional components (OFCs) (see Figure 1). While OFCs are commonly referred to as non-structural components, this terminology is deliberately avoided in this Standard to acknowledge the interaction that exists between the seismic behaviour of a building's structural system and the seismic performance of all other building components (i.e., OFCs).

0.2
Structural components are those basic components that are designed and constructed to carry and transfer all loads to the ground without total or partial collapse of the building. Some OFCs can contribute to the structural integrity of a building, depending on their location, type of construction, and method of fastening, but these are not generally considered structural components.

OFCs are divided into three categories of sub-components:
a) architectural (external and internal);
b) building services (mechanical, plumbing, electrical, and telecommunications); and
c) building contents (common and specialized).

Some examples of building components and sub-components are listed in Figures 1 and 2. This Standard does not address those OFCs which are lightweight, non-hazardous, and relatively inexpensive in the context of the building and its functionality.

0.3
Most efforts to improve the seismic behaviour of buildings have been directly related to the safety and integrity of the structural system. Continuing advances in analysis and design have led to improvements to the structural system's capacity to resist earthquake effects. However, as a result of damage caused by recent earthquakes, focus has shifted to the behaviour of OFCs in overall building performance.

Risk to safety, damage to property, and loss of function and operation in a building can be significantly affected by the failure or malfunction of OFCs even if the building structural system has performed well during an earthquake. The damage resulting from these components can be considerably more than that arising from structural component failure, particularly in areas of low and moderate seismic intensity. Buildings in Canada that are designed in accordance with early codes can be vulnerable to the failure or malfunctioning of OFCs after an earthquake. In a number of cases, improvements to the overall seismic performance of the building can be achieved by improving the performance of OFCs.

1 Scope

1.1 General

1.1.1
This Standard applies to OFCs in buildings with seismic hazards as defined in Article 4.1.8.1 of the *NBCC*.

1.1.2
This Standard provides information and methodologies to identify and evaluate seismic hazards associated with OFCs and to undertake appropriate mitigation strategies and techniques. While seismic risk reduction of OFCs is affected by the structural performance of a building, this Standard does not address structural integrity (see Clause 1.3.1).

1.1.3
This Standard is intended for use by building owners, building officials, facility managers, engineers, architects, and other stakeholders for improving the safety and serviceability of OFCs subjected to earthquakes.

1.2 Application

1.2.1
This Standard identifies types of OFCs, their failure modes and consequences, and design/retrofit approaches. This Standard applies to new and existing buildings (including renovations), and to major occupancy classifications listed in Appendix A of the *NBCC* Groups A to F (namely: assembly, care or detention, industrial, residential, business and personal services, and mercantile), and post-disaster buildings.

Note: *Lifeline components in the immediate vicinity of the building and essential to its performance objective (such as transformers, back-up power generators, fuel tanks, elevators, etc.) are considered to be part of the building in the application of the Standard (see Clause 1.3.2).*

1.2.2
Special use of buildings, hazardous materials storage, and building contents and processes requiring special protective measures can require additional considerations beyond the scope of this Standard.

Note: *Examples include emergency response facilities, electric power systems, telecommunication systems, water supply, wastewater collection and treatment systems, hospitals and nursing homes, large assembly occupancies, industrial risk-generating facilities, laboratories and hazardous materials, art galleries and museums, and correctional institutions (see Annex G).*

1.2.3
Additional considerations for heritage buildings are stipulated by various heritage authorities (see Annex G).

1.3 Exclusions and limitations

1.3.1
This Standard does not address the integrity of the structural systems of buildings. Structural aspects are covered by the building codes and other publications referenced in Clause 2.