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ASCE/SEI

76-23

Standard for Mitigation of Disproportionate Collapse Potential in Buildings and Other Structures

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

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AMERICAN SOCIETY OF CIVIL ENGINEERS

STRUCTURAL ENGINEERING INSTITUTE

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PREFACE

Since the Ronan Point apartment building collapse in London in 1968, the structural engineering profession has engaged in serious discussion and research about causes and implications of widespread structural failure initiated by local damage. In the decades that followed, this work and additional studies of subsequent catastrophic structural failures have advanced the body of knowledge for enhancing robustness and limiting collapse when buildings are damaged. Numerous papers and several guide documents have informed structural engineers, but a single consensus perspective for mitigating disproportionate collapse has not been available.

Discussion about a standard for disproportionate collapse mitigation began when the Disproportionate Collapse Standard and Guidance Committee, met at the Structural Engineering Institute (SEI) Structures Congress in 2009. Subsequently, advocates for a standard formally proposed that SEI authorize a committee to develop a standard on the topic of disproportionate collapse mitigation. A committee was approved and met for the first time at the SEI Structures Congress in 2012. After developing a draft document and a series of ballots, the committee sent its proposed document to the American Society of Civil Engineers (ASCE) for Public Ballot in 2021. Public balloting finished in 2023, leading to the publication of this standard.

The committee endeavored to make this standard performance-based, allowing engineers maximum flexibility when finding solutions to mitigate the potential for disproportionate collapse. The standard does not dictate a course of action, nor does it prescribe solutions to resist collapse. It does not address blunders in design or construction. Guidance is given about risk assessments and avoidance, as well as characteristics that enhance collapse resistance, including the strength, ductility, deformation capacity, and robustness necessary to resist collapse without exceeding relevant limit states. These goals may be demonstrated by procedures outlined in the document, or by approved alternate rational analyses.

This standard is intended to address the same structures covered by ASCE 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. The standard is written in mandatory language, with the expectation that it could be referenced by building codes or contracts documents.

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CHAPTER 1
GENERAL

1.1 PURPOSE

The purpose of this standard is to provide principles and minimum requirements to mitigate disproportionate collapse potential of new and existing buildings and other structures.

1.2 SCOPE

This standard provides minimum requirements for planning, assessment, analysis, material selection, design and detailing, construction, and qualification testing to mitigate disproportionate collapse of new and existing buildings and other structures. This standard includes threat-specific and non-threat-specific methodologies and identifies direct design and indirect design approaches.

This standard does not prescribe requirements for blast design. This topic is addressed in other documents (e.g., ASCE 59, *Blast Protection of Buildings*).

1.2.1 Organization

This standard is organized as follows:

- Chapter 1 provides general requirements.
- Chapter 2 provides terminology used throughout this standard.
- Chapter 3 defines requirements for performing a risk assessment to mitigate disproportionate collapse.
- Chapter 4 provides design objectives, including general initiating hazard scenarios and performance objectives.
- Chapter 5 presents technical approaches to design new buildings, determine the capacity of existing buildings to resist disproportionate collapse, and develop upgrades to existing buildings to mitigate disproportionate collapse.
- Chapter 6 provides acceptance criteria for component and system performance based on the selected analysis/design approach, construction materials, and structural systems.
- Chapter 7 provides minimum requirements and intents for structural detailing of various materials expected to be used as part of a disproportionate collapse mitigation strategy.
- Chapter 8 provides minimum requirements and discussion to evaluate and enhance the robustness of existing buildings and other structures.
- Chapter 9 provides procedures and standards for the peer review of the design of structures to resist disproportionate collapse and the verification of performance of selected components and structural assemblages.

1.2.2 Applicability The provisions in this standard are applicable to buildings and other structures that are within the scope of ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures.*

1.3 BASIC REQUIREMENTS

Buildings and other structures shall be designed and constructed with adequate strength, ductility and deformation capacity, and robustness to provide resistance to disproportionate collapse. Acceptable performance shall be demonstrated using one or both of the following procedures:

1. Typical strength and robustness procedures of Section 1.3.1, and
2. Subject to the approval of the Authority Having Jurisdiction (AHJ) for individual projects, the alternative rational procedures of Section 1.3.2.

It shall be permitted to use either or both procedures for different parts of a structure and for different hazard scenarios providing the intent of this standard is met.

1.3.1 Typical Strength and Robustness Procedures Structural systems and their connections shall have adequate strength, ductility and deformation capacity, and robustness to resist disproportionate collapse in conformance with Chapters 3 through 9 of this standard, without exceeding the applicable limit states for the materials of construction.

1.3.2 Alternative Rational Procedures Structural systems and their connections shall be demonstrated by analysis or by a combination of analysis and testing to provide a reliability not less than that expected for similar systems and connections designed in accordance with the strength, ductility and deformation capacity, and robustness procedures of Section 1.3.1 when subject to initial damage identified as critical for the performance of the structure. Consideration shall be given to uncertainties in loadings, initial damage, and resistance.

1.3.2.1 Analysis Analysis shall employ rational methods based on accepted principles of engineering mechanics and shall consider all significant sources of deformation and resistance. Assumptions of stiffness, strength, damping, ductility, and other properties of components and connections incorporated in the analysis shall be based on approved test data or referenced standards. Analyses shall conform to the requirements of Chapter 5, Section 5.5, and Chapter 9 of this standard.

1.3.2.2 Testing Testing used to substantiate the performance of structural systems and connections under the influence of hazard scenarios shall accurately represent the materials, configuration, construction, loading, and boundary conditions anticipated in the structure. Testing shall comply with Chapter 9 of this standard.

1.3.2.3 Peer Review The basis, procedures, and results of analyses, testing, and calculations used to demonstrate compliance with the requirements of this standard shall be subject to an