



Computational Wind Engineering Tools and Techniques

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INTRODUCTION

1.1 PURPOSE

The purpose of these Guidelines is to reduce the potential for progressive collapse in new and renovated Federal buildings. It is intended to bring a consistent level of protection in the application of progressive collapse design to Federal facilities and to bring alignment with the suite of security standards issued by the Interagency Security Committee (ISC) and the General Services Administration (GSA) in their philosophy, decision-making methodology and application. In addition, it aims to bring alignment within the industry by reducing incongruities between GSA and Department of Defense (DoD) methodologies.

To meet this purpose, these Guidelines replace the previous document "*GSA Progressive Collapse Analysis and Design Guidelines for New Federal Office Buildings and Major Modernization Projects 2003*" and provide a new, threat-dependent methodology for minimizing the potential for progressive collapse that utilizes the alternate path (AP) analysis procedures of UFC 04-023-03, *Design of Buildings to Resist Progressive Collapse* [31] and ASCE-41, *Seismic Rehabilitation of Existing Buildings* [10].

1.2 GUIDELINE PHILOSOPHY

These Guidelines address the need to save lives, prevent injury and protect Federal buildings, functions, and assets by minimizing the potential for progressive collapse. Consistent with *The Risk Management Process for Federal Facilities*, "ISC Risk Management Process" [26], these Guidelines take a flexible risk-based approach where requirements are driven by the security needs of the Federal tenant(s) and where implemented measures are commensurate with the level of risk. As such, the application of these Guidelines is dependent on the required level of protection as determined by the Facility Security Level (FSL) or facility-specific risk assessment.

1.2.1 DEFINITION OF PROGRESSIVE COLLAPSE

For the purposes of these Guidelines, progressive collapse is defined as an extent of damage or collapse that is disproportionate to the magnitude of the initiating event. Since this definition focuses on the relative consequence or magnitude of the collapse rather than the manner in which it occurs, it is often referred to in the industry as "disproportionate" rather than "progressive" collapse.

1.2.2 THREAT DEPENDENT APPROACH

This document is to be implemented in conjunction with the ISC Risk Management Process [26] and *GSA Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV*, "GSA Applicability" [18], which take a threat dependent approach for reducing potential for progressive collapse. With a threat dependent approach, reduction of progressive collapse potential can be achieved either by precluding failure of load-carrying elements or by bridging over their loss. The first approach reduces the risk of progressive collapse for a defined threat by directly limiting the initial damage through hardening of structural elements. The second approach reduces the risk of progressive collapse by limiting the propagation of the initial damage, without explicit consideration for the cause of the initial event, through implementation of these Guidelines.



Where applicable and as approved by the GSA Technical Representative, execution of threat-based hardening in lieu of these Guidelines can be applied for FSL III and IV buildings in accordance with the ISC Risk Management Process [26]. Application of this alternative design methodology, including threat, performance and approval requirements is provided in Section 7.4 of the GSA Applicability document [18].

1.3 APPLICABILITY

The applicability of these Guidelines to specific building types is discussed in Chapter 2. The requirements contained herein are an independent set of measures for meeting the provisions of the ISC Risk Management Process [26] regarding progressive collapse. Where applicable per ISC Risk Management Process [26] based on the FSL level, these Guidelines should be used by all professionals engaged in the planning and design of new facilities or building modernization projects, including in-house Government engineers, architectural/engineering (A/E) firms and professional consultants under contract to the GSA.

These Guidelines are not applicable to facilities that have already been designed for progressive collapse under either the previous GSA guidelines [27] or the UFC 04-023-03 [31] prior to issuance of this document. These facilities are considered as benchmarked to meet the provisions of the ISC Risk Management Process [26] regarding progressive collapse and these Guidelines need not be applied.

While mandatory for GSA facilities, these Guidelines may also be used and/or adopted by any agency, organization, or private entity. The material contained herein is not intended as a warranty on the part of the Government that this information is suitable for any general or particular use. The user of this information assumes all liability arising from such use. This information should not be used or relied upon for any specific application without competent professional examination and verification.

1.4 HOW TO USE THIS DOCUMENT

The intent of this document is to provide guidance to reduce and/or assess the potential for progressive collapse of Federal buildings for new or existing construction. It is to be implemented in conjunction with the ISC Risk Management Process [26] and GSA Applicability [18] documents and follows the analysis methodology and performance requirements of UFC 04-023-03 [31] for Alternate Path. It also provides guidelines for incorporating redundancy into the progressive collapse resisting system to mitigate single points of failure and provide increased robustness for extreme loading scenarios not explicitly addressed in the design.

1.5 DOCUMENT ORGANIZATION

This document is organized into four main sections: an introductory section that discusses the overall objectives and applicability of the guidelines (Chapters 1 and 2); a section that discusses the required design procedures (Chapter 3); a section that provides material specific criteria (Chapters 4 through 8); and a series of appendices that provide additional background, guidance and design examples for implementation of these guidelines (Appendix A through E).

With the exception of the first introductory section (Chapters 1 and 2) the main body of this document incorporates the general organization and content of the UFC 04-023-03 [31] as it relates to Alternate Path only. The adopted methodology has been incorporated in its entirety such that these Guidelines are

a stand-alone document and the designer need not reference the UFC 04-023-03 [31] for its application. For clarity for those familiar with the UFC methodology, any modifications to the Alternate Path procedures are indicated in the text in accordance with the legend below, including sections of the UFC that have been removed.

- Modified or additions to text is indicated with a line in the left margin

1.6 SUMMARY OF THE PROGRESSIVE COLLAPSE DESIGN PROCEDURE

The design procedures employed by these Guidelines aim to reduce the potential for progressive collapse by bridging over the loss of a structural element, limiting the extent of damage to a localized area (Alternate Path) and providing a redundant and balanced structural system along the height of the building.

1.6.1 ALTERNATE PATH

The Alternate Path method employed by these Guidelines is based on the methodology and performance requirements presented in UFC 4-023-03 [31] and ASCE-41 [10], with modifications and additions as outlined in Chapters 3 through 8. The Alternate Path method requires that the structure be able to bridge over vertical load-bearing elements that are notionally removed one at a time at specific plan and elevation locations, as required by Chapter 2. The procedures and general requirements for the Alternate Path method are provided in Chapter 3 with specific requirements for each material given in Chapters 4 through 8.

1.6.2 REDUNDANCY REQUIREMENTS

The Redundancy Requirements outlined in Chapter 3 shall be applied in conjunction with the Alternate Path analysis. The intent of these requirements is to distribute progressive collapse resistance up the height of the building without explicitly requiring column/wall removal scenarios at each level.

1.7 REFERENCES

These Guidelines incorporate provisions from other publications by dated or undated reference. These references are cited at the appropriate places in the text and the citations for the publications are listed in Appendix A References. For dated references, subsequent amendments to, or revisions of, any of these publications apply to these Guidelines only when incorporated in it by amendment or revision. For undated references, the latest edition of the referenced publication applies (including amendments).

2 APPLICABILITY

These Guidelines apply to GSA owned (new and existing) and new GSA lease construction. If stated as a tenant specific requirement within the Program of Requirements (POR), these Guidelines may also apply to new lease acquisitions or succeeding leases that are established through full and open competition. These Guidelines do not apply to lease renewals, extensions, expansions, or superseding and succeeding leases that are established other than through full and open competition.

2.1 NEW CONSTRUCTION AND BUILDING ADDITIONS

These Guidelines shall be applied to all new construction, as required by the FSL. In accordance with the ISC Risk Management Process [26], Section 5.2.1, new additions to existing buildings shall be considered as "new construction, including new building additions". Accordingly, these Guidelines shall be applied to all new additions, as required by the FSL.

For new construction, once a facility is determined as requiring progressive collapse resistance, the methodology outlined in Chapters 3 through 8 shall be executed. The methodology provides design guidance and performance requirements for incorporating progressive collapse resistance into the new design based on the Alternate Path method provided in UFC 04-023-03 [31], with modifications, additions and commentary as included herein.

2.2 EXISTING BUILDINGS

These Guidelines shall be applied only to existing Federal buildings (leased or Government-owned) that are undergoing a major modernization and as required by the FSL. For the purposes of these Guidelines, a major modernization is defined as a major structural renovation, such as a seismic upgrade.

For existing construction, once an existing building is determined as requiring progressive collapse resistance, the same methodology outlined in Chapters 3 through 8 shall be executed to evaluate the existing structure's potential for progressive collapse. If the existing building does not meet the progressive collapse requirements and mitigation measures are recommended, the Government shall be provided with all pertinent information to make an informed risk-based decision regarding the mitigation or the acceptance of risk, including a complete understanding of the potential consequences, and the cost associated with the recommended mitigation measure.

2.3 FACILITY SECURITY LEVELS (FSL)

In accordance with the ISC Risk Management Process [26], the application of progressive collapse design is dependent on the required level of protection as determined by the number of stories and FSL, or where a FSL has not yet been determined, by a facility-specific risk assessment or facility-specific requirements as provided in the Request for Proposal (RFP) or Program of Requirements (POR).

The ISC Risk Management Process [26] defines the criteria and process for determining the FSL of a Federal facility, which categorizes facilities based on the analysis of several security-related facility factors, including its target attractiveness, as well as its value or criticality. The responsibility for making the final FSL determination, specifically as it relates to incorporation of the requirements of these



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Guidelines, rests with the Government, who must either accept the risk or fund security measures to reduce the risk.

Once a facility's FSL level has been established the applicability of these Guidelines is determined based on the Applicability flow chart and this section.

2.3.1 FSL I & II

Given the low occupancy and risk level associated with these types of facilities, progressive collapse design is not required for FSL I and II, regardless of the number of floors.

2.3.2 FSL III & IV

These Guidelines are applicable to FSL III and IV buildings with four stories or more measured from the lowest point of exterior grade to the highest point of elevation. Unoccupied floors such as mechanical penthouses or parking shall not be considered a story. FSL III and IV facilities shall implement both the Alternate Path and Redundancy design procedures. The Alternate Path method shall be applied based on vertical load bearing element removal locations identified in Section 3.2.9.

2.3.3 FSL V

These Guidelines are applicable to all FSL V buildings regardless of number of floors. FSL V facilities shall implement the Alternate Path method based on vertical load bearing element removal locations identified in Section 3.2.9. Redundancy design procedures do not need to be applied to FSL V facilities.



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