

ASCE
STANDARD

American Society of Civil Engineers
Society of Fire Protection Engineers

**Standard Calculation
Methods for Structural
Fire Protection**



American Society of Civil Engineers
Society of Fire Protection Engineers

Standard Calculation Methods for Structural Fire Protection

This document uses both Système International (SI) and customary units.



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ABSTRACT

SEI/ASCE/SFPE Standard 29-99, *Standard Calculation Methods for Structural Fire Protection*, provides methods to calculate the fire resistance of selected structural members and barrier assemblies using structural steel, plain concrete, reinforced concrete, timber and wood, concrete masonry, and clay masonry. These methods are intended to provide architects, engineers, building officials, and others with calculation methods that will give the equivalent fire resistance that would have been achieved in the ASTM E119 standard fire test.

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STANDARDS

In April 1980, the Board of Direction approved ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by the Society. All such standards are developed by a consensus standards process managed by the Management Group F (MGF), Codes and Standards. The consensus process includes balloting by the balanced standards committee made up of Society members and nonmembers, balloting by the membership of ASCE as a whole, and balloting by the public. All standards are updated or reaffirmed by the same process at intervals not exceeding 5 years.

The following Standards have been issued:

- ANSI/ASCE 1-82 N-725 Guideline for Design and Analysis of Nuclear Safety Related Earth Structures
- ANSI/ASCE 2-91 Measurement of Oxygen Transfer in Clean Water
- ANSI/ASCE 3-91 Standard for the Structural Design of Composite Slabs and ANSI/ASCE 9-91 Standard Practice for the Construction and Inspection of Composite Slabs
- ASCE 4-98 Seismic Analysis of Safety-Related Nuclear Structures
- Building Code Requirements for Masonry Structures (ACI 530-02/ASCE 5-02/TMS 402-02) and Specifications for Masonry Structures (ACI 530.1-02/ASCE 6-02/TMS 602-02)
- SEI/ASCE 7-02 Minimum Design Loads for Buildings and Other Structures
- SEI/ASCE 8-02 Standard Specification for the Design of Cold-Formed Stainless Steel Structural Members
- ANSI/ASCE 9-91 listed with ASCE 3-91
- ASCE 10-97 Design of Latticed Steel Transmission Structures
- SEI/ASCE 11-99 Guideline for Structural Condition Assessment of Existing Buildings
- ANSI/ASCE 12-91 Guideline for the Design of Urban Subsurface Drainage
- ASCE 13-93 Standard Guidelines for Installation of Urban Subsurface Drainage
- ASCE 14-93 Standard Guidelines for Operation and Maintenance of Urban Subsurface Drainage
- ASCE 15-98 Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)
- ASCE 16-95 Standard for Load and Resistance Factor Design (LRFD) of Engineered Wood Construction
- ASCE 17-96 Air-Supported Structures
- ASCE 18-96 Standard Guidelines for In-Process Oxygen Transfer Testing
- ASCE 19-96 Structural Applications of Steel Cables for Buildings
- ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations
- ASCE 21-96 Automated People Mover Standards—Part 1
- ASCE 21-98 Automated People Mover Standards—Part 2
- ASCE 21-00 Automated People Mover Standards—Part 3
- SEI/ASCE 23-97 Specification for Structural Steel Beams with Web Openings
- SEI/ASCE 24-98 Flood Resistant Design and Construction
- ASCE 25-97 Earthquake-Actuated Automatic Gas Shut-Off Devices
- ASCE 26-97 Standard Practice for Design of Buried Precast Concrete Box Sections
- ASCE 27-00 Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction
- ASCE 28-00 Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction
- SFPE/SEI/ASCE 29-99 Standard Calculation Methods for Structural Fire Protection
- SEI/ASCE 30-00 Guideline for Condition Assessment of the Building Envelope
- SEI/ASCE 32-01 Design and Construction of Frost-Protected Shallow Foundations
- EWRI/ASCE 33-01 Comprehensive Transboundary International Water Quality Management Agreement
- EWRI/ASCE 34-01 Standard Guidelines for Artificial Recharge of Ground Water
- EWRI/ASCE 35-01 Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment
- CI/ASCE 36-01 Standard Construction Guidelines for Microtunneling
- SEI/ASCE 37-02 Design Loads on Structures During Construction
- CI/ASCE 38-02 Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data
- EWRI/ASCE 39-03 Standard Practice of the Design and Operation of Hail Suppression Projects

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FOREWORD

In April 1995, the Board of Direction approved the revision to the ASCE Rules for Standards Committees to govern the writing and maintenance of Standards developed by the Society. All such Standards are developed by a consensus standards process managed by the ASCE Codes and Standards Activities Committee (CSAC). The consensus process includes balloting by a balanced standards committee made up of Society members and nonmembers, balloting by the membership of ASCE as a whole, and balloting by the public. All Standards are updated or reaffirmed by the same process at intervals not exceeding 5 years.

The material presented in this Standard has been prepared in accordance with recognized engineering principles. This Standard should not be used without first securing competent advice with respect to its suitability for any given application. The publication of the material contained herein is not intended as a representation or warranty on the part of the American Society of Civil Engineers, or of any other person named herein, that this information is suitable for any general or particular use or promises freedom from infringement of any patent or patents. Anyone making use of this information assumes all liability from such use.

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The development of this Standard was a joint

effort between SEI and the Society of Fire Protection Engineers (SFPE). Although developed through ASCE's consensus process, SFPE contributed greatly to the development of this Standard.

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Standard Calculation Methods for Structural Fire Protection

1. STANDARD CALCULATION METHODS FOR STRUCTURAL FIRE PROTECTION

1.1 General

Building codes specify the fire resistance required for structural members and barriers in identified occupancies and classifications of construction. The fire endurance is based on the test results of the American Society for Testing and Materials (ASTM) test designation E119, *Standard Test Methods for Fire Tests of Buildings Construction and Materials*.

As an alternative to selection of tested assemblies, this Standard provides methods to calculate the fire resistance of selected structural member and barrier assemblies using structural steel, plain concrete, reinforced concrete, timber and wood, concrete masonry, and clay masonry. These methods are intended to provide architects, engineers, building officials, and others with calculation methods that will give the equivalent fire resistance that would have been achieved in the ASTM E119 standard fire test.

1.2 Scope

1.2.1

The calculation methods provided in the document are intended to produce fire resistance rating times that are equivalent to the results obtained from the standard fire test, ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*. The calculation methods of this Standard are for use as an alternative to the laboratory test results.

1.2.2

These calculation methods are applicable only to structural steel, plain concrete, reinforced concrete, timber and wood, concrete masonry, and clay masonry. Limitations of applicability are identified in the individual chapters that describe the methods for each of the materials that comprise this Standard.

1.3 Purpose and Use

1.3.1

While the fire resistance ratings calculated by the procedures specified in this Standard are equivalent substitutes for the results obtained by the ASTM E119 standard fire test, they do not necessarily describe the performance for natural fires having time-temperature relationships different from ASTM E119.

1.3.2

The fire resistance results obtained by calculation methods are for use in building fire evaluations or for building code applications. It is the responsibility of the user of this Standard to establish appropriate technical or regulatory use for the results.

1.3.3

The procedures for calculating the fire resistance ratings for structural members or assemblies for the different structural materials are organized under the following chapters:

Chapter 2. Standard Methods for Determining the Fire Resistance of Plain and Reinforced Concrete Construction

Chapter 3. Standard Methods for Determining the Fire Resistance of Timber and Wood Structural Elements

Chapter 4. Standard Calculation Methods for Determining the Fire Resistance of Masonry

Chapter 5. Standard Methods for Determining the Fire Resistance of Structural Steel Construction

1.4 Referenced Standards

1.4.1 American Concrete Institute (ACI)

ACI 318-95 Building Code Requirements for Structural Concrete

ACI 530-95/ASCE 5-95/TMS 402-95 Building Code Requirements for Masonry Structures

1.4.2 American Society for Testing and Materials (ASTM)

ASTM C33-93 Standard Specification for Concrete Aggregates

ASTM C67-94 Standard Methods of Sampling and Testing Brick and Structural Clay Tile

ASTM C140-95a Standard Methods of Sampling and Testing Concrete Masonry Units

ASTM C331-94 Standard Specification for Lightweight Aggregates for Concrete Masonry Units

ASTM C332-87 Standard Specification for Lightweight Aggregates for Insulating Concrete (Reapproved 1991)

ASTM C612-93 Standard Specification for Mineral Fiber Block and Board Thermal Insulation