Significant Changes to the Wind Load Provisions of ASCE 7-10

An Illustrated Guide

T. Eric Stafford, P.E.

ASCE PRESS

Library of Congress Cataloging-in-Publication Data

Stafford, T. Eric.
Significant changes to the wind load provisions of ASCE 7-10 : an illustrated guide / T. Eric Stafford
p. cm.
Includes bibliographical references and index.
ISBN 978-0-7844-1116-2
1. Wind-pressure—Handbooks, manuals, etc. 2. Buildings—Standards—United States—Handbooks, manuals, etc. 3. Buildings—Aerodynamics—Handbooks, manuals, etc. 4. Gust loads—Handbooks, manuals, etc. 5. Structural engineering—Handbooks, manuals, etc. I. American Society of Civil Engineers. II. Title.
TH891.S73 2010
624.1'75021873—dc22
2010017360

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia 20191
www.asce.org

ISBN 978-0-7844-1116-2
Manufactured in the United States of America.

18 17 16 15 14 13 12 11 10 1 2 3 4 5

PREFACE

Significant Changes to the Wind Load Provisions of ASCE 7-10: An Illustrated Guide is intended to familiarize structural engineers, architects, code officials, and others in the building construction and design industry with the changes to the wind load requirements of the newest edition of *Minimum Design Loads for Buildings and Other Structures*, Standard ASCE/SEI 7-10. This reference book is organized into seven parts that generally follow the organization of the new wind chapters in ASCE 7-10. While not all changes to the wind provisions are shown in this reference, the ones that would be of most interest to or have significant impact on the industry are discussed in detail. Most of the changes addressed include the reason for the change in addition to diagrams, examples, and color photographs and illustrations to enrich the reader's understanding. This reference is best used as a companion to ASCE 7-10 and not a replacement as only a small portion of the complete text of ASCE 7-10 is shown. The commentary and opinions provided are those of the authors and do not necessarily represent the official position of ASCE.

ACKNOWLEDGEMENT

The author wishes to acknowledge the following individuals, including the anonymous reviewers, for their input and review during the development of this publication:

Daryl Boggs, CPP Inc.

Gary Chock, Martin & Chock, Inc.

Dr. Mark Powell, NOAA Hurricane Research Division

Dr. Tim Reinhold, IBHS

The author wishes to extend a thank you to Betsy Kulamer with ASCE Press for her support, guidance, and input from the beginning of this project through to its end.

TABLE OF CONTENTS

Part V – Components and Cladding

Part VI – Other Buildings and Structures

Part VII – Wind Tunnel Testing

Part 1
Reorganization

All Sections

All Sections

Modification

All Titles

At a Glance

The wind load provisions of Chapter 6 have been reorganized into 6 new chapters for clarity and to improve the usability and comprehension of the specific methods for determining wind loads on buildings and structures.

2010 Standard

Delete Chapter 6 Wind Loads and Replace with the follow reorganization:

(Only Main Section Titles Shown)

CHAPTER 26. WIND LOADS – GENERAL REQUIREMENTS

26.1 PROCEDURES
- 26.1.1 Scope.
- 26.1.2 Permitted Procedures.
  - 26.1.2.1 Main Wind Force Resisting System (MWFRS).
  - 26.1.2.2 Components and Cladding.

26.2 DEFINITIONS

26.3 SYMBOLS AND NOTATION

26.4 GENERAL
- 26.4.1 Sign Convention.
- 26.4.2 Critical Load Condition.
- 26.4.3 Wind Pressures Acting on Opposite Faces of Each Building Surface.

26.5 WIND HAZARD MAP
- 26.5.1 Basic Wind Speed.
- 26.5.2 Special Wind Regions.
- 26.5.3 Estimation of Basic Wind Speeds from Regional Climatic Data.
- 26.5.4 Limitation.

26.6 WIND DIRECTIONALITY

26.7 EXPOSURE
- 26.7.1 Wind Directions and Sectors.
- 26.7.2 Surface Roughness Categories.
- 26.7.3 Exposure Categories.
- 26.7.4 Exposure Requirements.
  - 26.7.4.1 Direction Procedure (Chapter 27)

27.4.1 Enclosed and Partially Enclosed Rigid Buildings.
27.4.2 Enclosed and Partially Enclosed Flexible Buildings.
27.4.3 Open Buildings with Monoslope, Pitched or Troughed Free Roofs.
27.4.4 Roof Overhangs.
27.4.5 Parapets.
27.4.6 Design Wind Load Cases.
27.4.7 Minimum Design Wind Loads.

Part 2: Enclosed Simple Diaphragm Buildings With $H \leq 160$ Ft

27.5 GENERAL REQUIREMENTS
27.5.1 Design Procedure
27.5.2 Conditions
27.5.3 Wind Load Parameters Specified in Chapter 26
27.5.4 Diaphragm Flexibility

27.6 WIND LOADS – MAIN WIND-FORCE RESISTING SYSTEM
27.6.1 Wall and Roof surfaces – Class 1 and 2 Buildings
27.6.2 Parapets
27.6.3 Roof Overhangs

CHAPTER 28. WIND LOADS ON BUILDINGS – MWFRS (ENVELOPE PROCEDURE)

28.1 SCOPE
28.1.1 Building Types.
28.1.2 Conditions.
28.1.3 Limitations.
28.1.4 Shielding.

Part 1: Enclosed And Partially Enclosed Low-Rise Buildings

28.2 GENERAL REQUIREMENTS
28.2.1 Wind Load Parameters Specified in Chapter 26.

28.3 VELOCITY PRESSURE
28.3.1 Velocity Pressure Exposure Coefficient.
28.3.2 Velocity Pressure.

28.4 WIND LOADS - MAIN WIND FORCE RESISTING SYSTEM
28.4.1 Design Wind Pressure for Low-Rise Buildings.
28.4.1.1 External Pressure Coefficients, GC_{pf}
28.4.2 Parapets.
28.4.3 Roof Overhangs.
28.4.4 Minimum Design Wind Loading.

CHAPTER 30. WIND LOADS – COMPONENTS AND CLADDING

30.1 SCOPE
- 30.1.1 Building Types.
- 30.1.2 Conditions.
- 30.1.3 Limitations.
- 30.1.4 Shielding.
- 30.1.5 Air Permeable Cladding.

30.2 GENERAL REQUIREMENTS
- 30.2.1 Wind Load Parameters Specified in Chapter 26.
- 30.2.2 Minimum Design Wind Pressures.
- 30.2.3 Tributary Areas Greater than 700 ft2 (65 m2).
- 30.2.4 External pressure coefficients.

30.3 VELOCITY PRESSURE
- 30.3.1 Velocity Pressure Exposure Coefficient.
- 30.3.2 Velocity Pressure.

Part 1: Low-Rise Buildings

30.4 BUILDING TYPES.
- 30.4.1 Conditions
- 30.4.2 Design Wind Pressures

Part 2: Low-Rise Buildings (Simplified)

30.5 BUILDING TYPES
- 30.5.1 Conditions.
- 30.5.2 Design Wind Pressures

Part 3: Buildings with $h > 60$ ft (18.3 m)

30.6 BUILDING TYPES
- 30.6.1 Conditions.
- 30.6.2 Design Wind Pressures

Part 4: Buildings with $h \leq 160$ ft (48.8 m) (Simplified)

30.7 BUILDING TYPES
- 30.7.1 Wind Loads – Components and Cladding
  - 30.7.1.1 Wall and Roof Surfaces
  - 30.7.1.2 Parapets
  - 30.7.1.3 Roof Overhangs

CHAPTER 31. WIND TUNNEL PROCEDURE

Analysis and Commentary

The wind load provisions of Chapter 6 in ASCE 7 have been reorganized into six chapters. Considering the reorganization and other changes discussed in this guide, the procedures and methods for wind design have undergone the most significant changes since the 1995 edition of ASCE 7 (ASCE 7-95). There have been complaints from many users about the layout and presentation of the wind load provisions in ASCE 7. While ASCE 7-98 did make some improvements to the format (introduction of the three Methods), much of the important information was buried deep within the paragraph numbering. In addition, Method 2 Analytical Procedure actually contained two different methods embedded within (Buildings of All Heights and Low-rise Buildings). While technically correct, understanding and applying the appropriate wind loads could be somewhat cumbersome.

The primary goals of the reorganization effort were to keep the section numbering smaller and to locate major subject areas as distinct chapters. Additionally, it was desired to order the wind provisions in a logical sequence for the general structural design community. Accomplishing these goals led to the creation of six distinct chapters and the relocation of the provisions into their most logical new chapter. For example, the provisions for determining MWFRS loads are in separate chapters from Components and Cladding Loads. Additionally, the different methods for determining MWFRS loads are located in the three separate chapters – Chapter 27 Directional Procedure (formerly buildings of all heights in Method 2); Chapter 28 Envelope Procedure (formerly low-rise buildings in Method 2); and Chapter 29 Other Structures and Building Appurtenances (formerly embedded in Method 2).

Each chapter was again subdivided into "parts" where appropriate for clarity. For example in Chapter 28 the analytical method for determining wind loads for low-rise buildings is identified as Part 1 and the simplified method for determining wind loads for low-rise buildings is identified as Part 2. Similar subdivisions occur in Chapters 27 and 30.

To ease the transition to the new format and to facilitate improved awareness of the provisions applicable to the various methods, each chapter and parts contain tables that specifically identify and outline the steps and provisions applicable for that respective chapter or part. The following is an example of one of the outlines presented for Part 1 in Chapter 27.

Table 27.2-1
Steps to Determine MWFRS Wind Loads
Enclosed, Partially Enclosed and Open Buildings of All Heights

Step 1: Determine risk category of building or other structure, see Table 1.4-1

Step 2: Determine the basic wind speed, V, for the applicable risk category, see Figure 26.5-1A, B or C

Step 3: Determine wind load parameters:

- Wind directionality factor, K_d, see Section 26.6 and Table 26.6-1
- Exposure category, see Section 26.7
- Topographic factor, K_{zt}, see Section 26.8 and Table 26.8-1
- Gust Effect Factor, G, see Section 26.9
- Enclosure classification, see Section 26.10
- Internal pressure coefficient, GC_{pi}, see Section 26.11 and Table 26.11-1

Step 4: Determine velocity pressure exposure coefficient, K_z or K_h, see Table 27.3-1

Step 5: Determine velocity pressure q_z or q_h Eq. 27.3-1

Step 6: Determine external pressure coefficient, C_p or C_N

- Fig. 27.4-1 for walls and flat, gable, hip, monoslope or mansard roofs
- Fig. 27.4-2 for domed roofs
- Fig. 27.4-3 for arched roofs
- Fig. 27.4-4 for monoslope roof, open building
- Fig. 27.4-5 for pitched roof, open building
- Fig. 27.4-6 for troughed roof, open building
- Fig. 27.4-7 for along-ridge/valley wind load case for monoslope, pitched or troughed roof, open building

Step 7: Calculate wind pressure, p, on each building surface

- Eq. 27.4-1 for rigid buildings
- Eq. 27.4-2 for flexible buildings
- Eq. 27.4-3 for open buildings

The following table will assist users in locating provisions between ASCE 7-10 and ASCE 7-05. The table is a cross-reference of all sections, figures, and tables in the two editions. Sections applicable to ASCE 7-05 are shown in the left column in numerical sequence so that users familiar with ASCE 7-05 may easily locate the applicable sections in ASCE 7-10.

ASCE 7-05 Section	ASCE 7-10 Section
Text	
6.1 General	26.1 Procedures
6.1.1 Scope	26.1.1 Scope
6.1.2 Allowed Procedures	26.1.2 Procedures
6.1.3 Wind Pressures Acting on Opposite Faces of Each Building Surface	26.4.3 Wind Pressures Acting on Opposite Faces of Each Building Surface
-	26.1.2.1 Main Wind Force Resisting System (MWFRS)
-	26.1.2.2 Components and Cladding
6.1.4 Minimum Design Wind Loading	-
6.1.4.1 Main Wind-Force Resisting System	27.4.7 Minimum Design Wind Loads
	28.4.4 Minimum Design Wind Loading
	29.8 Minimum Design Wind Loading
6.1.4.2 Components and Cladding	30.2.2 Minimum Design Wind Pressures
6.2 Definitions	26.2 Definitions
6.3 Symbols and Notations	26.3 Symbols and Notations
6.4 Method 1-Simplified Procedure	Chapter 28 Part 2: Enclosed Simple Diaphragm Low-Rise Buildings
	28.6 Wind Loads-Main Wind-Force Resisting System
	Chapter 30 Part 2: Low-rise Buildings (Simplified)
-	Chapter 27 Part 2 Enclosed Simple Diaphragm Buildings with $h \leq 160$ ft
-	Chapter 30 Part 4 Buildings with $h \leq 160$ ft
6.4.1 Scope	28.6.1 Scope
	30.5 Building Types
6.4.1.1 Main wind-Force Resisting System	28.6.2 Conditions
6.4.1.2 Components and Cladding	30.5.1 Conditions
6.4.2 Design Procedure	-
6.4.2.1 Main wind-Force Resisting System	28.6.3 Design Wind Loads
6.4.2.1.1 Minimum Pressures	28.6.4 Minimum Design Wind Loads
6.4.2.2 Components and Cladding	30.5.2 Design Wind Pressures
6.4.2.2.1 Minimum Pressures	30.2.3 Minimum Design Wind Pressures
6.4.3 Air Permeable Cladding	30.1.5 Air Permeable Cladding

ASCE 7-05 Section	ASCE 7-10 Section
Text	
6.5 Method 2-Analytical Procedure	Chapter 27 Wind Loads on Buildings – MWFRS (Directional Procedure)
	Chapter 28 Wind Loads on Buildings – MWFRS (Envelope Procedure)
	Chapter 29 Wind Loads on Other Structures and Building Appurtenances - MWFRS
	Chapter 30 Wind Loads - Components and Cladding
6.5.1 Scope	27.1.2 Conditions
	28.1.2 Conditions
	29.1.2 Conditions
	30.1.2 Conditions
6.5.2 Limitations	27.1.3 Limitations
	28.1.3 Limitations
	29.1.3 Limitations
	30.1.3 Limitations
6.5.2.1 Shielding	27.1.4 Shielding
	28.1.4 Shielding
	29.1.4 Shielding
	30.1.4 Shielding
6.5.2.2 Air Permeable Cladding	30.1.5 Air Permeable Cladding
6.5.3 Design Procedure	Steps to Determine Wind Loads provided for each Chapter and/or Part
6.5.4 Basic wind Speed	26.5.1 Basic Wind Speed
6.5.4.1 Special Wind Regions	26.5.2 Special Wind Regions
6.5.4.2 Estimation of Basic Wind Speeds from Regional Climatic Data	26.5.3 Estimation of Basic Wind Speeds from Regional Climatic Data
6.5.4.3 Limitation	26.5.4 Limitation
6.5.4.4 Wind Directionality Factor	26.6 Wind Directionality Factor
6.5.5 Importance Factor	-
6.5.6 Exposure	26.7 Exposure
6.5.6.1 Wind Directions and Sectors	26.7.1 Wind Directions and Sectors
6.5.6.2 Surface Roughness Categories	26.7.2 Surface Roughness Categories
6.5.6.3 Exposure Categories	26.7.3 Exposure Categories
6.5.6.4 Exposure Category for Main Wind-Force Resisting System	26.7.4 Exposure Requirements
6.5.6.4.1 Buildings and Other Structures	26.7.4.1 Directional Procedure (Chapter 27)
	26.7.4.3 Directional Procedure for Building Appurtenances and Other Structures (Chapter 29)
6.5.6.4.2 Low-Rise Buildings	26.7.4.2 Envelope Procedure (Chapter 28)

ASCE 7-05 Section	ASCE 7-10 Section
Text	
6.5.6.5 Exposure Category for Components and Cladding	26.7.4.4 Components and Cladding
6.5.6.6 Velocity Pressure Coefficient	27.3.1 Velocity Pressure Coefficient
	28.3.1 Velocity Pressure Coefficient
	29.3.1 Velocity Pressure Coefficient
	30.3.1 Velocity Pressure Coefficient
6.5.7 Topographic Effects	26.8 Topographic Effects
6.5.7.1 Wind Speed-Up over Hills, Ridges, and Escarpments	26.8.1 Wind Speed-Up over Hills, Ridges, and Escarpments
6.5.7.2 Topographic Factor	26.8.2 Topographic Factor
6.5.8 Gust Effect Factor	26.9 Gust Effects
-	26.9.1 Frequency Determination
-	26.9.2 Approximate Natural Frequency
6.5.8.1 Rigid Structures	26.9.3 Rigid Structures
6.5.8.2 Flexible or Dynamically Sensitive Structures	26.9.4 Flexible or Dynamically Sensitive Structures
6.8.3 Rational Analysis	26.9.5 Rational Analysis
6.8.4 Limitations	26.9.6 Limitations
6.5.9 Enclosure Classifications	26.10 Enclosure Classifications
6.5.9.1 General	26.10.1 General
6.5.9.2 Openings	26.10.2 Openings
6.5.9.3 Wind-Borne Debris	26.10.3 Protection of Glazed Openings
	26.10.3.1 Wind-borne Debris
6.5.9.4 Multiple Classifications	26.10.4 Multiple Classifications
6.5.10 Velocity Pressure	27.3.2 Velocity Pressure
	28.3.2 Velocity Pressure
	29.3.2 Velocity Pressure
	30.3.2 Velocity Pressure
6.5.11.1 Internal Pressure Coefficient	26.11 Internal Pressure Coefficient
	26.11.1
6.5.11.1.1 Reduction Factor for Large Volume Buildings, R_i	26.11.1.1 Reduction Factor for Large Volume Buildings, R_i
6.5.11.2 External Pressure Coefficients	28.4.1.1 External Pressure Coefficients, GC_{pf}
6.5.11.2.1 Main Wind-Force Resisting System	
6.5.11.2.2 Components and Cladding	30.2.4 External Pressure Coefficients
6.5.11.3 Force Coefficients	-
6.5.11.4 Roof Overhangs	29.7 Roof Overhangs
6.5.11.4.1 Main Wind-Force Resisting System	27.4.4 Roof Overhangs
	28.4.3 Roof Overhangs
6.5.11.4.2 Components and Cladding	30.10 Roof Overhangs

ASCE 7-05 Section	ASCE 7-10 Section
Text	
6.5.11.5 Parapets	29.6 Parapets
6.5.11.1 Main Wind-Force Resisting System	27.4.5 Parapets
	28.4.2 Parapets
6.5.11.2 Components and Cladding	30.9 Parapets
6.5.12 Design Wind Loads on Enclosed and Partially Enclosed Buildings	Chapter 27 Wind Loads on Buildings – MWFRS (Directional Procedure)
	Chapter 28 Wind Loads on Buildings – MWFRS (Envelope Procedure)
	Chapter 30 Wind Loads - Components and Cladding
6.5.12.1.1 Sign Convention	26.4.1 Sign Convention
6.5.12.1.2 Critical Load Condition	26.4.2 Critical Load Condition
6.5.12.1.3 Tributary Area Greater than 700 ft^2 (65 m^2)	30.2.3 Tributary Area Greater than 700 ft^2 (65 m^2)
6.5.12.2.1 Rigid Buildings of All Heights	27.4.1 Enclosed and Partially Enclosed Rigid Buildings
6.5.12.2.2 Low-Rise Buildings	28.4.1 Design Wind Pressure for Low-Rise Buildings
6.5.12.2.3 Flexible Buildings	27.4.2 Enclosed and Partially Enclosed Flexible Buildings
6.5.12.2.4 Parapets	27.4.5 Parapets
	28.4.2 Parapets
6.5.12.3 Design Wind Load Cases	27.4.6 Design Wind Load Cases
6.5.12.4 Components and Cladding	-
6.5.12.4.1 Low-Rise Buildings and Buildings with $h \leq 60$ ft (18.3 m)	Chapter 30, Part 1: Low-rise Buildings
	30.4.2 Design Wind Pressures
6.5.12.4.2 Buildings with $h > 60$ ft (18.3 m)	Chapter 30, Part 3: Buildings with $h > 60$ ft (18.3 m)
	30.6.2 Design Wind Pressures
6.5.12.4.3 Alternative Design Wind Pressures for Components and Cladding Buildings with 60 ft (18.3 m) $< h <$ 90 ft (27.4 m)	Exception to Section 30.6.2
6.5.12.4.4 Parapets	30.9 Parapets
6.5.13 Design Wind Loads on Open Buildings with Monoslope, Pitched, or Troughed Roofs	Chapter 27 Wind Loads on Buildings – MWFRS (Directional Procedure)
6.5.13.1 General	Chapter 30 Wind Loads – Components and Cladding
6.5.13.1.1 Sign Convention	27.4.3 Open Buildings with Monoslope, Pitched, or Troughed Free Roofs
6.5.13.1.2 Critical Load Condition	
6.5.13.2 Main Wind-Force Resisting System	

ASCE 7-05 Section	ASCE 7-10 Section
Text	
6.5.13.3 Components and Cladding Elements	Chapter 30, Part 5: Open Buildings
	30.8 Building Types
	30.8.1 Conditions
	30.8.2 Design Wind Pressures
6.5.14 Design Wind Loads on Solid Freestanding Walls and Solid Signs	29.4 Design Wind Loads – Solid Freestanding Walls and Solid Signs
	29.4.1 Solid Freestanding Walls and Solid Freestanding Signs
-	29.4.2 Solid Attached Signs
6.5.15 Design Wind Loads on Other Structures	29.5 Design Wind Loads – Other Structures
6.5.15.1 Rooftop Structures and Equipment for Buildings with h ≤ 60 ft (18.3 m)	29.5.1 Rooftop Structures and Equipment for Buildings with h ≤ 60 ft (18.3 m)
	30.11 Rooftop Structures and Equipment for Buildings with h ≤ 60 ft (18.3 m)
6.6 Method 3 – Wind Tunnel Procedure	Chapter 31Wind Tunnel Procedure
6.6.1 Scope	31.1 Scope
6.6.2 Test Conditions	31.2 Test Conditions
6.6.3 Dynamic Response	31.3 Dynamic Response
-	31.4 Load Effects
-	31.4.1 Mean Recurrence Intervals of Load Effects
6.6.4 Limitations	
6.6.4.1 Limitations on Wind Speed	31.4.2 Limitations on Wind Speed
-	31.4.3 Limitations on Loads
6.6.5 Wind-Borne Debris	31.5 Wind-Borne Debris
Tables and Figures	
Figure 6-1	Figure 26.5.1A
	Figure 26.5.1B
	Figure 26.5.1C
Figure 6-2	Figure 28.6-1
Figure 6-3	Figure 30.5-1
Figure 6-4	Figure 26.8-1
Figure 6-5	Table 26.11-1
Figure 6-6	Figure 27.4-1
Figure 6-7	Figure 27.4-2
Figure 6-8	Figure 27.4-3
Figure 6-9	Figure 27.4-8
Figure 6-10	Figure 28.4-1
Figure 6-11A	Figure 30.4-1
Figure 6-11B	Figure 30.4-2A
Figure 6-11C	Figure 30.4-2B

ASCE 7-05 Section	ASCE 7-10 Section
Tables and Figures	
Figure 6-11D	Figure 30.4-2C
Figure 6-12	Figure 30.4-3
Figure 6-13	Figure 40.4-4
Figure 6-14A	Figure 30.4-5A
Figure 6-14B	Figure 30.4-5B
Figure 6-15	Figure 30.4-6
Figure 6-16	Figure 30.4-7
Figure 6-17	Figure 30.6-1
Figure 6-18A	Figure 27.4-4
Figure 6-18B	Figure 27.4-5
Figure 6-18C	Figure 27.4-6
Figure 6-18D	Figure 27.4-7
Figure 6-19A	Figure 30.8-1
Figure 6-19B	Figure 30.8-2
Figure 6-19C	Figure 30.8-3
Figure 6-20	Figure 29.4-1
Figure 6-21	Figure 29.5-1
Figure 6-22	Figure 29.5-2
Figure 6-23	Figure 29.5-3
Table 6-1	-
Table 6-2	Table 26.9-1
Table 6-3	Table 27.3-1
	Table 28.3-1
	Table 29.3-1
	Table 30.3-1
Table 6-4	Table 26.6-1

Part II
General Requirements for Determining Wind Loads

Figures 26.5-1A, 26.5-1B, 26.5-1C

Modification

Basic Wind Speeds for Hawaii

At a Glance

The entire state of Hawaii has been established as a special wind region.

2010 Standard

Notes to Figure 26.5-1A

Location	**Vmph**	**(m/s)**
Guam	195	(87)
Virgin Islands	165	(74)
American Samoa	160	(72)
Hawaii - <u>Special Wind Region Statewide</u>	130	(58)

Notes to Figure 26.5-1B

Location	**Vmph**	**(m/s)**
Guam	210	(94)
Virgin Islands	175	(78) American Samoa 170
(76)		
Hawaii - <u>Special Wind Region Statewide</u>	145	(65)

Notes to Figure 26.5-1C

Location	**Vmph**	**(m/s)**
Guam	180	(80)
Virgin Islands	150	(67)
American Samoa	150	(67)
Hawaii - <u>Special Wind Region Statewide</u>	115	(51)

Analysis and Commentary

Due to the presence of mountainous terrain and valley gorges in Hawaii, Section 26.8.2 and Figure 26.8-1, which only address the topographic speed-up influence of *isolated* 2-dimensional ridge and escarpment features and *axisymmetric* hills, do not sufficiently account for the significant effect of topographic wind speed variations caused by the highly complex three-dimensional topography in State of Hawaii. This conclusion was reached by numerous studies. The topography has speed-up effects that cannot be adequately portrayed by a single statewide value of wind speed nor at the macroscale of a national map. The State of Hawaii has addressed this issue with the development of wind maps for each local jurisdiction. These maps are based on the application of topographic effect adjustments to the basic wind speed.

These new maps for the State of Hawaii define the K_{zt} and K_d factors applicable to each region. There are also maps of the equivalent net effect wind speeds, defined as $V_{eff} = \sqrt{(K_{zt} \times K_d/0.85)}$ where V is the basic wind speed from ASCE 7 and V_{eff} is the net effective wind speed. There are also maps of Exposure Category that account for the turbulence caused by topography as well as terrain surface roughness.

The change provides explicit notification within the wind speed maps that the entire State of Hawaii is classified as a Special Wind Region and that the authority having jurisdiction should be consulted to determine the applicable basic wind speed parameters. All the special wind region maps are provided in the Hawaii State Building Code.

While the probabilistic reference wind speeds are provided for Hawaii on Figures 26.5-1A, 26.5-1B, and 26.5-1B, the intent is that the actual design wind speeds are to be further modified as determined from the authority having jurisdiction. Wind speeds are identified simply to provide the reference wind speed for each Risk Category, and to also ensure that the wind-borne debris region criteria in Section 26.10.3.1 is appropriately triggered by the net value of V_{eff}.

Unique Topography of Hawaii

Section 26.5, Figures 26.5-1A, 26.5-1B, 26.5-1C

Modification

Basic Wind Speeds

At a Glance

New wind speed maps (strength design level or Ultimate Wind Speeds) have replaced the existing map (Figure 6-1 in ASCE 7-05) that are directly applicable for determining design wind pressures using the strength design approach. Different maps are provided for different Risk Categories instead of a single map with importance factors to be applied for each Risk Category.

2010 Standard

Delete Figure 6-1 and replace with Figures 26.5-1A, 26.5-1B, and 26.5-1C

26.2 ~~6.2~~ Definitions

HURRICANE PRONE REGIONS: Areas vulnerable to hurricanes; in the United States and its territories defined as

1. The U.S. Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed for Risk Category II buildings is greater than 115 ~~90~~ mi/h, and
2. Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa.

~~**IMPORTANCE FACTOR, *I*:** A factor that accounts for the degree of hazard to human life and damage to property.~~

~~**6.5.5 Importance Factor.** An Importance Factor, *I* , for the building or other structure shall be determined from Table 6-1 based on building and structure categories listed in Table 1-1.~~

~~**Table 6-1 Importance Factor, *I* (Winds Loads)**~~

~~Category~~	~~Non-Hurricane Prone Regions and Hurricane Prone Regions with V = 85-100 mph and Alaska~~	~~Hurricane Prone Regions with V > 100 mph~~
~~I~~	~~0.87~~	~~0.77~~
~~II~~	~~1.00~~	~~1.00~~
~~III~~	~~1.15~~	~~1.15~~
~~IV~~	~~1.15~~	~~1.15~~

~~**Note:**~~
~~1. The building and structure classification categories are listed in Table 1-1.~~

26.5.1 ~~6.5.4~~ Basic Wind Speed.

The basic wind speed, *V*, used in the determination of design wind loads on buildings and other structures shall be determined from ~~as given in~~ Fig. 26.5-1 as follows, ~~6-1~~ except as provided in Sections 26.5.2 ~~6.5.4.1~~ and 26.5.3 ~~6.5.4.2~~ :~~.~~

For Risk Category II buildings and structures – use Fig. 26.5-1A.
For Risk Category III and IV buildings and structures - use Fig. 26.5-1B.
For Risk Category I buildings and structures - use Fig. 26.5-1C.

The wind shall be assumed to come from any horizontal direction. The basic wind speed shall be increased where records or experience indicate that the wind speeds are higher than those reflected in Fig. 26.5-1.

26.5.2 ~~6.5.4.1~~ Special Wind Regions.

~~The basic wind speed shall be increased where records or experience indicate that the wind speeds are higher than those reflected in Fig. 6-1.~~ Mountainous terrain, gorges, and special wind regions shown in Fig. 26.5-1 ~~6-1~~ shall be examined for unusual wind conditions. The authority having jurisdiction shall, if necessary, adjust the values given in Fig. 26.5-1 ~~6-1~~ to account for higher local wind speeds. Such adjustment shall be based on meteorological information and an estimate of the basic wind speed obtained in accordance with the provisions of Section 26.5.3 ~~6.5.4.2~~.

26.5.3 ~~6.5.4.2~~ Estimation of Basic Wind Speeds from Regional Climatic Data.

In areas outside hurricane-prone regions, regional climatic data shall only be used in lieu of the basic wind speeds given in Fig. 26.5-1 ~~6-1~~ when (1) approved extreme-value statistical-analysis procedures have been employed in reducing the data; and (2) the length of record, sampling error, averaging time, anemometer height, data quality, and terrain exposure of the anemometer have been taken into account. Reduction in basic wind speed below that of Fig. 26.5-1 ~~6-1~~ shall be permitted.

In hurricane-prone regions, wind speeds derived from simulation techniques shall only be used in lieu of the basic wind speeds given in Fig. 26.5-1 ~~6-1~~ when ~~(1)~~ approved simulation and extreme value statistical analysis procedures are used. ~~(t~~The use of regional wind speed data obtained from anemometers is not permitted to define the hurricane wind-speed risk along the Gulf and Atlantic coasts, the Caribbean, or Hawaii~~)~~. ~~and (2) the design wind speeds resulting from the study shall not be less than the resulting 500-year return period wind speed divided by √1.5.~~

In areas outside hurricane-prone regions, when the basic wind speed is estimated from regional climatic data, the basic wind speed shall not be less than the wind speed associated with the specified mean recurrence interval ~~an annual probability of 0.02 (50-year mean recurrence interval)~~, and the estimate shall be adjusted for equivalence to a 3-sec gust wind speed at 33 ft (10 m) above ground in Exposure C. The data analysis shall be performed in accordance with this chapter.

27.3.2 ~~6.5.10~~ Velocity Pressure.

Velocity pressure, q_z, evaluated at height z shall be calculated by the following equation:

$$q_z = 0.00256 K_z K_{zt} K_d V^2 \not{I} \text{ (lb/ft}^2\text{)} \qquad (27.3\text{-}1 \ \text{~~6-15~~})$$

[In SI: $q_z = 0.613 K_z K_{zt} K_d V^2 \not{I}$ (N/m^2); V in m/s]

where

K_d = ~~is the~~ wind directionality factor, see Section 26.6 ~~defined in Section 6.5.4.4,~~
K_z = ~~is the~~ velocity pressure exposure coefficient, see Section 27.3.1 ~~defined in Section 6.5.6.6~~

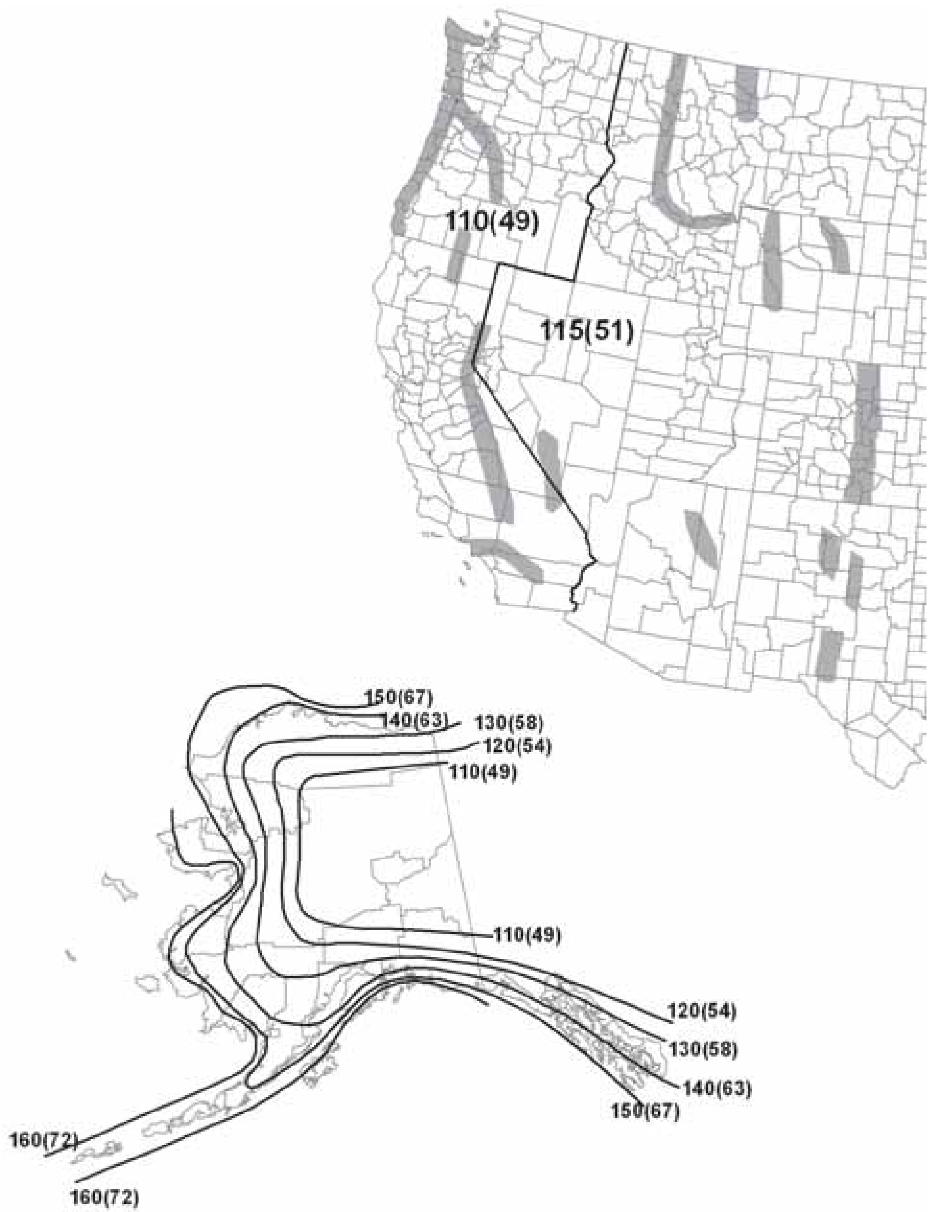


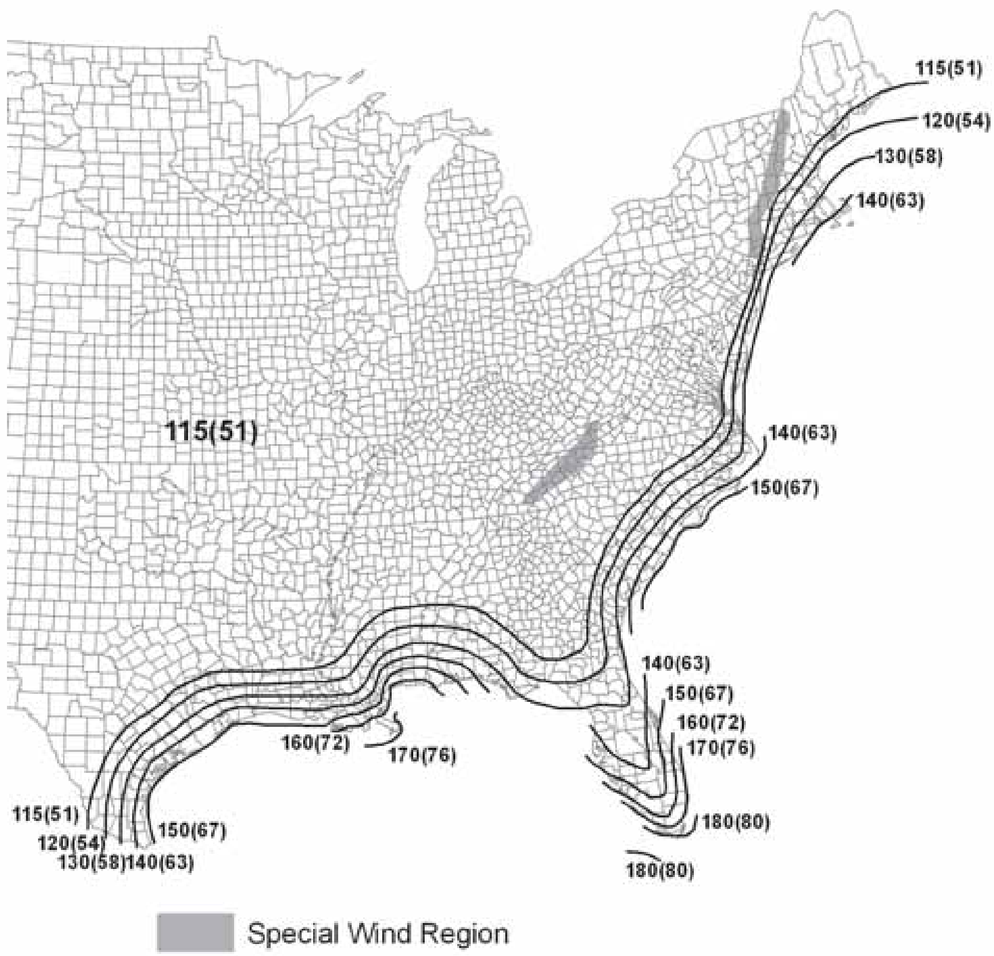
Figure 26.5-1A Basic Wind Speeds for Risk Category II Buildings and Other Structures.

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

Figure 26.5-1A
Basic Wind Speeds for Risk Category II Buildings and Other Structures

MINIMUM DESIGN LOADS



Location	Vmph	(m/s)
Guam	195	(87)
Virgin Islands	165	(74)
American Samoa	160	(72)
Hawaii – Special Wind Region Statewide	130	(58)

Figure 26.5-1A (*Continued*)

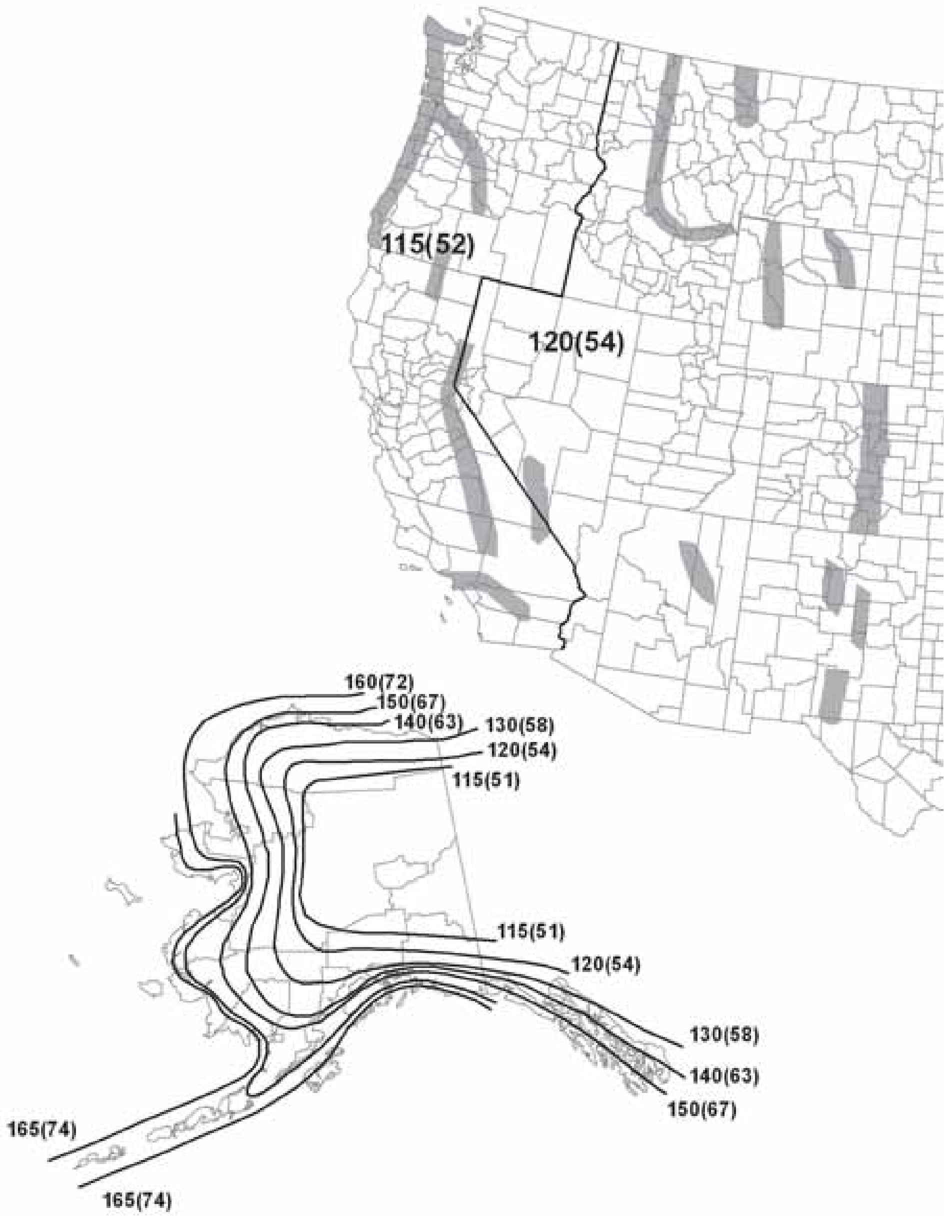
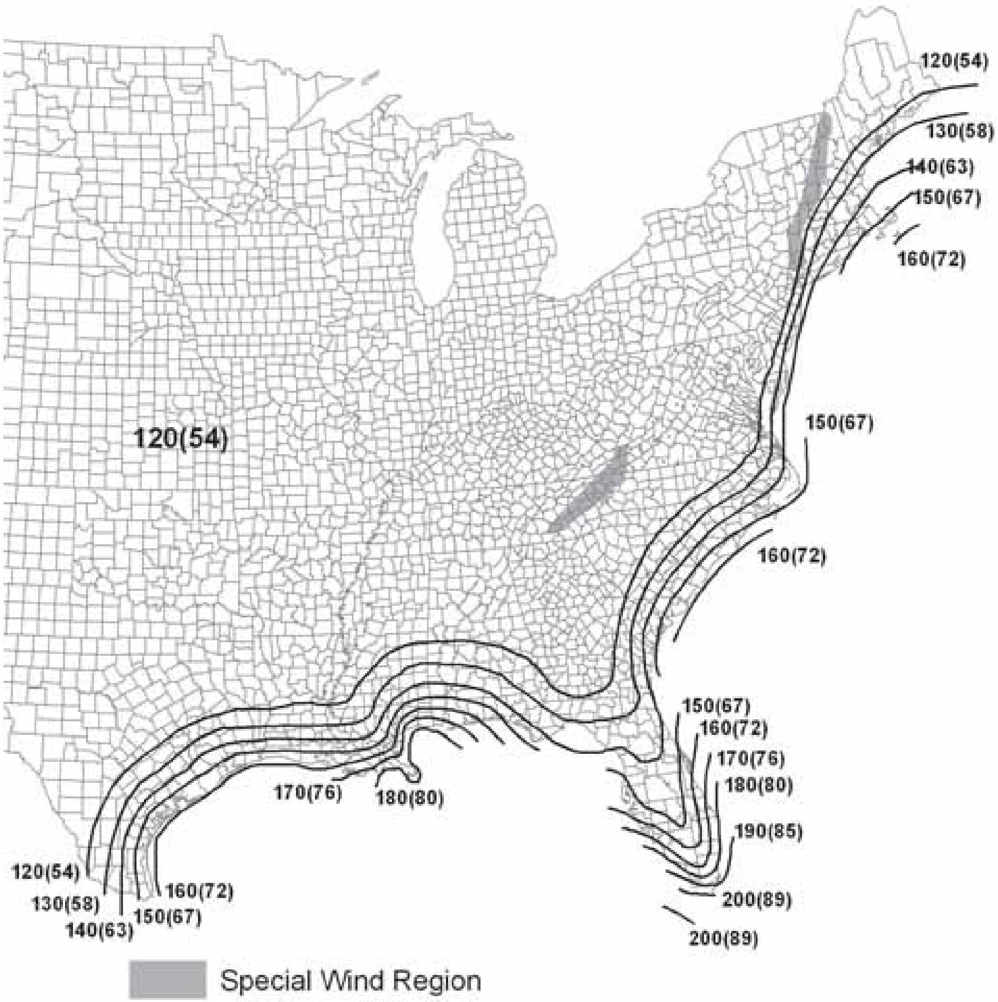


Figure 26.5-1B Basic Wind Speeds for Risk Category III and IV Buildings and Other Structures.

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (Annual Exceedance Probability = 0.000588, MRI = 1700 Years).

Figure 26.5-1B
Basic Wind Speeds for Risk Category III and IV Buildings and Other Structures



Location	Vmph	(m/s)
Guam	210	(94)
Virgin Islands	175	(78)
American Samoa	170	(76)
Hawaii – Special Wind Region Statewide	145	(65)

16

Figure 26.5-1B (*Continued*)

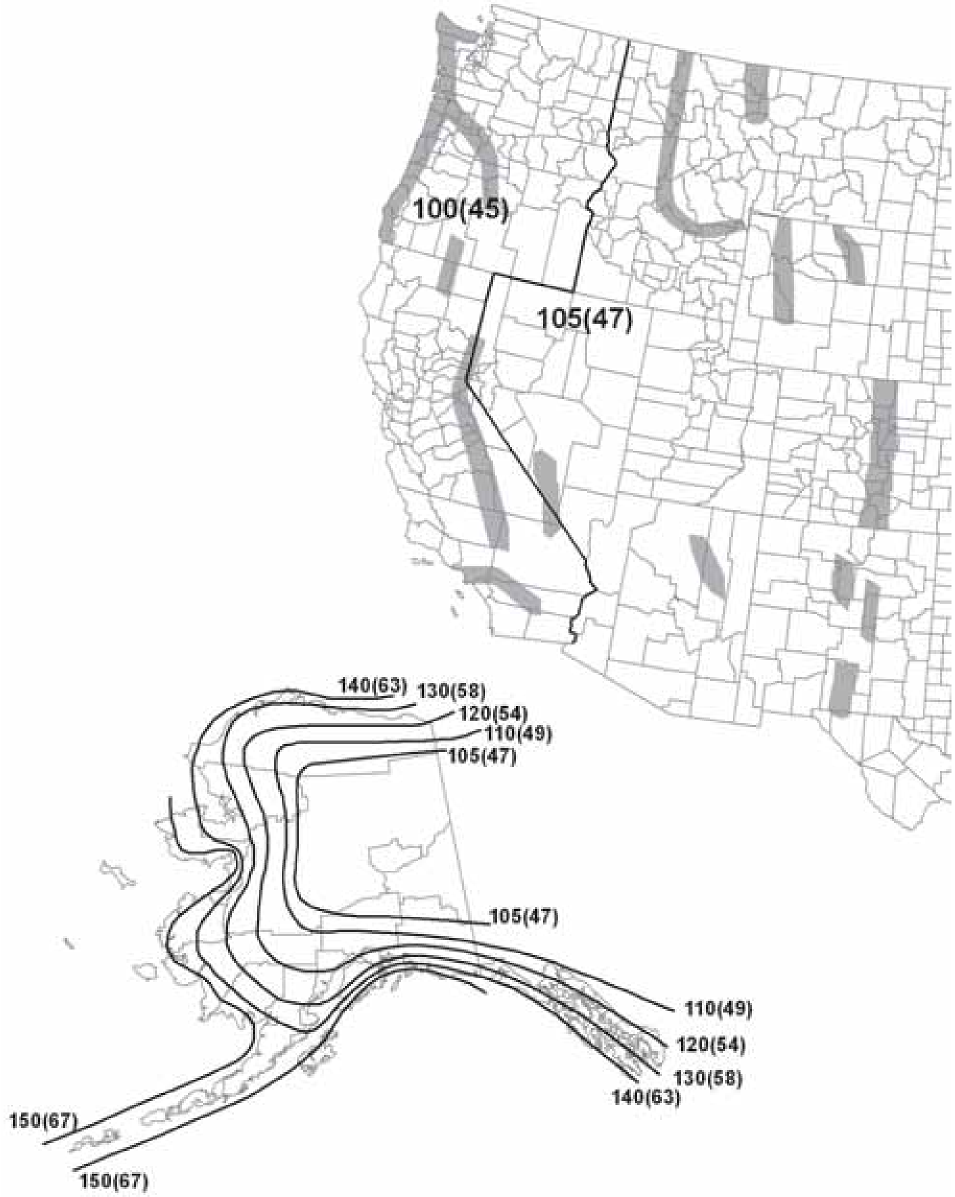
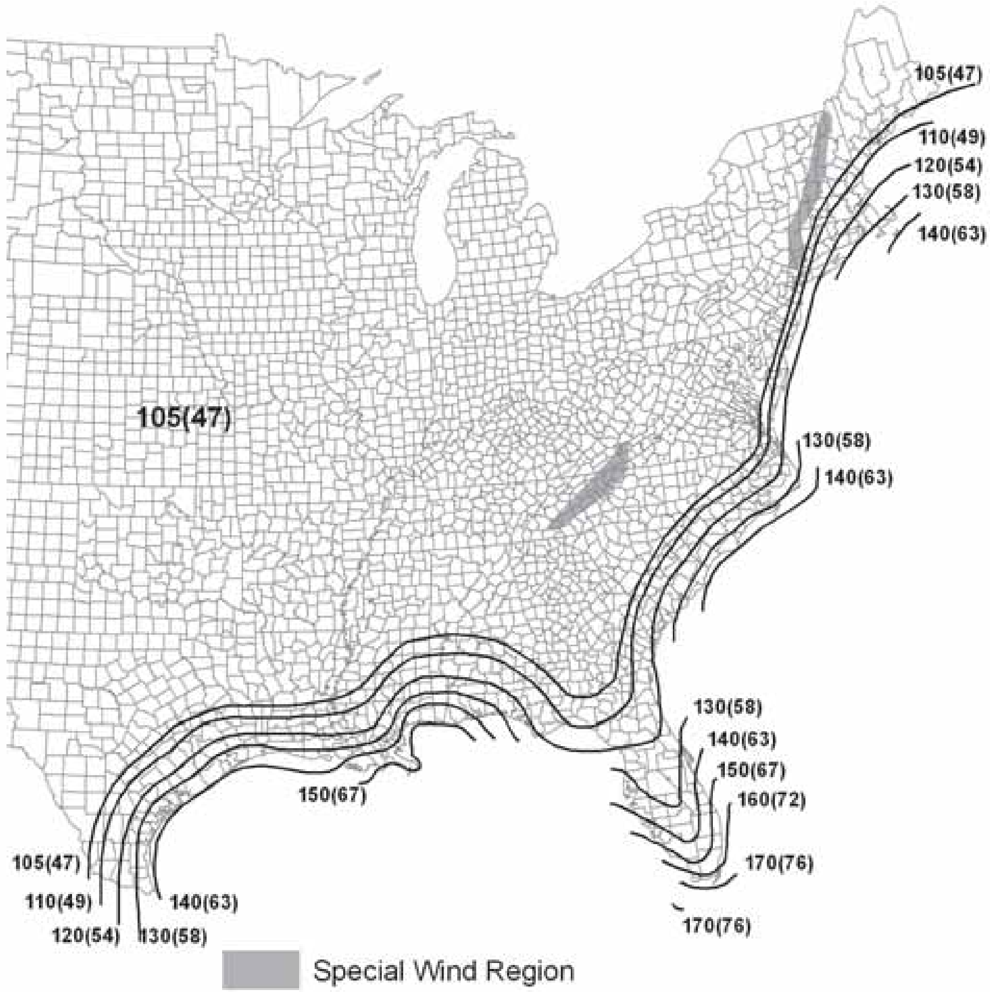


Figure 26.5-1C Basic Wind Speeds for Risk Category I Buildings and Other Structures.
Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00333, MRI = 300 Years).

Figure 26.5-1C
Basic Wind Speeds for Risk Category I Buildings and Other Structures



Location	Vmph	(m/s)
Guam	180	(80)
Virgin Islands	150	(67)
American Samoa	150	(67)
Hawaii – Special Wind Region Statewide	115	(51)

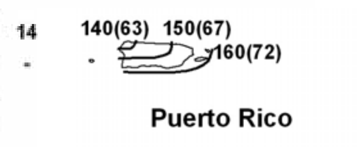


Figure 26.5-1c (*Continued*)

K_{zt} = ~~is the~~ topographic factor, see Section 26.8.2 ~~defined in Section 6.5.7.2 and~~
V = basic wind speed, see Section 26.5
q_z = velocity pressure calculated using Eq. 27.3-1 at height z
q_h = ~~is the~~ velocity pressure calculated using Eq. 27.3-1 ~~6-15~~ at mean roof height h.

The numerical coefficient 0.00256 (0.613 in SI) shall be used except where sufficient climatic data are available to justify the selection of a different value of this coefficient for a design application.

28.3.2 ~~6.5.10~~ Velocity Pressure.

Velocity pressure, q_z, evaluated at height z shall be calculated by the following equation:

$$q_z = 0.00256 K_z K_{zt} K_d V^2 \cancel{I} \text{ (lb/ft}^2\text{)} \qquad (28.3\text{-}1\ \cancel{6\text{-}15})$$

[In SI: $q_z = 0.613 K_z K_{zt} K_d V^2 \cancel{I}$ (N/m^2); V in m/s]

where

K_d = ~~is the~~ wind directionality factor defined in Section 26.6 ~~6.5.4.4,~~
K_z = ~~is the~~ velocity pressure exposure coefficient defined in Section 28.3.1 ~~6.5.6.6,~~
K_{zt} = ~~is the~~ topographic factor defined in Section 26.8.2 ~~6.5.7.2, and~~
V = basic wind speed from Section 26.5
q_h = ~~is the~~ velocity pressure q_z calculated using Eq. 28.3-1 ~~6-15~~ at mean roof height h

The numerical coefficient 0.00256 (0.613 in SI) shall be used except where sufficient climatic data are available to justify the selection of a different value of this factor for a design application.

29.3.2 ~~6.5.10~~ Velocity Pressure.

Velocity pressure, q_z, evaluated at height z shall be calculated by the following equation:

$$q_z = 0.00256 K_z K_{zt} K_d V^2 \cancel{I} \text{ (lb/ft}^2\text{)} \qquad (29.3\text{-}1\ \cancel{6\text{-}15})$$

[In SI: $q_z = 0.613 K_z K_{zt} K_d V^2 \cancel{I}$ (N/m^2); V in m/s]

where

K_d = ~~is the~~ wind directionality factor defined in Section 26.6 ~~6.5.4.4,~~
K_z = ~~is the~~ velocity pressure exposure coefficient defined in Section 29.3.1 ~~6.5.6.6,~~
K_{zt} = ~~is the~~ topographic factor defined in Section 26.8.2 ~~6.5.7.2, and~~
V = basic wind speed from Section 26.5
q_h = ~~is the~~ velocity pressure calculated using Eq. 29.3-1 ~~6-15~~ at height h

The numerical coefficient 0.00256 (0.613 in SI) shall be used except where sufficient climatic data are available to justify the selection of a different value of this factor for a design application.

30.3.2 ~~6.5.10~~ Velocity Pressure.

Velocity pressure, q_z, evaluated at height z shall be calculated by the following equation:

$$q_z = 0.00256\, K_z K_{zt} K_d V^2 \text{~~I~~} \text{ (lb/ft}^2\text{)} \qquad (30.3\text{-}1 \text{ ~~6-15~~})$$

[In SI: $q_z = 0.613\, K_z K_{zt} K_d V^2$ ~~I~~ (N/m^2); V in m/s]

where

K_d = ~~is the~~ wind directionality factor defined in Section 26.6 ~~6.5.4.4,~~
K_z = ~~is the~~ velocity pressure exposure coefficient defined in Section 30.3.1 ~~6.5.6.6,~~
K_{zt} = ~~is the~~ topographic factor defined in Section 26.8 ~~6.5.7.2, and~~
V = basic wind speed from Section 26.5
q_h = ~~is the~~ velocity pressure calculated using Eq. 30.3-1 ~~6-15~~ at height h

The numerical coefficient 0.00256 (0.613 in SI) shall be used except where sufficient climatic data are available to justify the selection of a different value of this factor for a design application.

Analysis and Commentary

The wind speed maps in ASCE 7-10 have undergone a significant revision from ASCE 7-05. The most obvious change is that the wind speed values are now represented as “Ultimate” wind speeds. However, the introduction of new maps also incorporates several other key changes. The primary impacts of the new maps can described as follows:

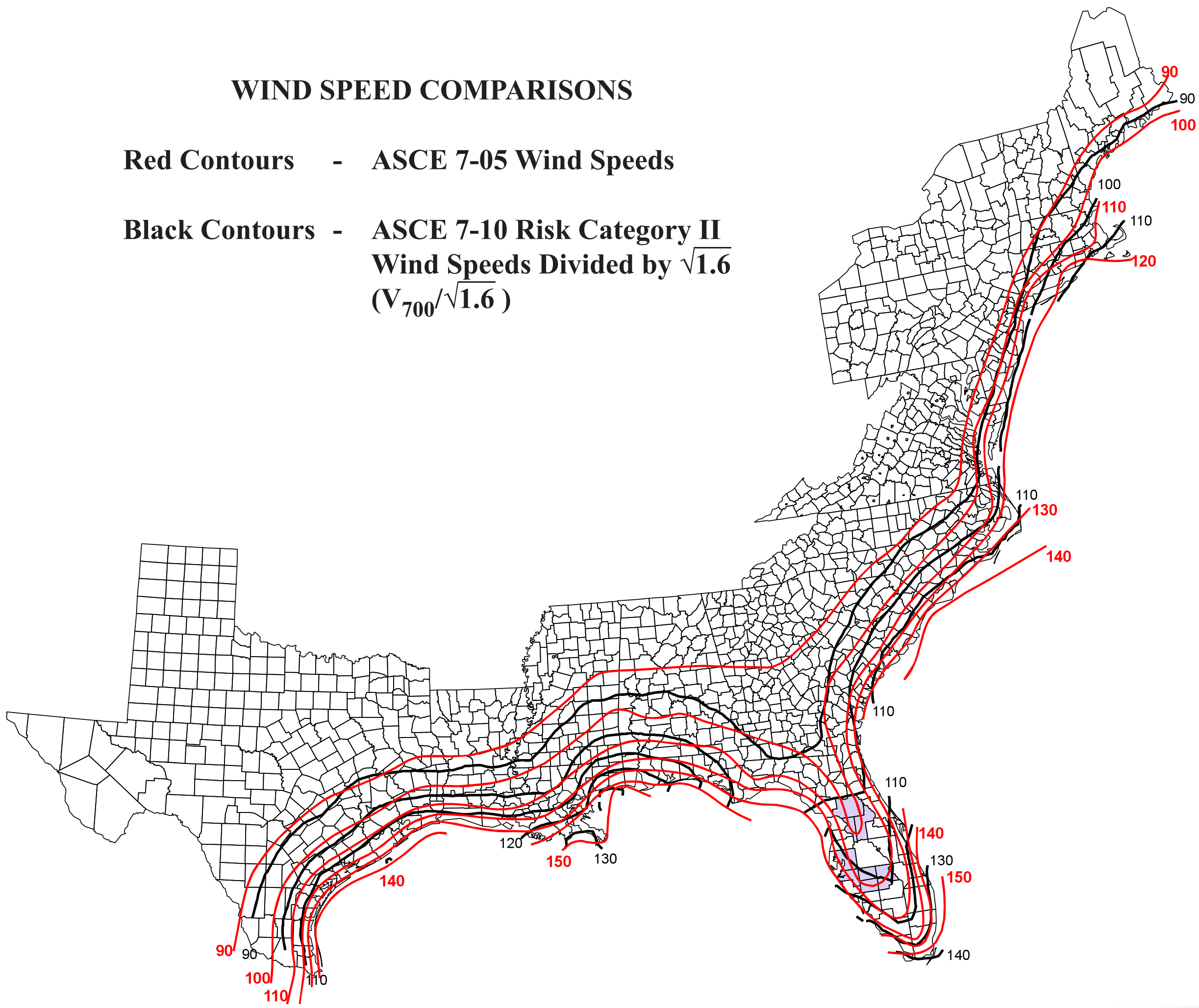
1. Strength design level wind speeds replace the ASD level wind speeds.
2. Wind speed maps are provided for each Risk Category as opposed to a single map with importance factors (300 year return period, 700 year return period, 1700 year return period)
3. Comparative hurricane wind speeds are lower than those given in ASCE 7-05.

The use of strength design level or ultimate wind speeds has been contemplated for ASCE 7 for several cycles. While the wind speeds in the maps are much higher than those in previous editions, the Load Factor on W in Section 2.3.2 is now 1.0 instead of 1.6 as established in ASCE 7-05. Therefore the actual design pressures are comparable even though the wind speeds are much higher.

Using a strength design wind speed map for wind loads brings wind design in line with that used for seismic loads in that they both essentially eliminate the use of a load factor for strength design. The use of strength design level maps also removes some confusion related to design and wind speeds for which some failure is expected. Most users of ASCE 7 have not understood that their design using the previous maps was essentially a 700 year event after multiplication by the 1.6 Load Factor for wind. The wind speeds in previous maps were roughly a 700 year event with wind speeds that are $\sqrt{1.6}$ times that shown on the maps. The new maps establish uniformity in the return period for the design-base winds by more clearly conveying that information. Additionally, most users don’t understand that buildings would not fail for wind speeds somewhat above the map values. While there is a small probability of failure just above the new map speeds, the new strength design level maps give the owner a better idea about storm intensities for which designs are performed.

Importance Factors have been used in previous editions of ASCE 7 to adjust the velocity pressure to different annual probabilities of being exceeded. For example, essential facilities and those that represent a substantial hazard to human life in the event of failure (Categories III and IV), the Importance Factor was 1.15. For non-hurricane wind speeds, this essentially doubled the return period from 50 to 100 years. However, the use of Importance Factors was an approximate means for adjusting the return period because the slope of the wind speed vs. return period curves differ. The distance inland where hurricanes can influence wind speeds increases with the return period. This situation was not adequately addressed by using Importance Factors from a table.

Figure 26.5-1A applies to Risk Category II Buildings (Occupancy Category has been changed to Risk Category in Table 1.5-1) and is associated with a return period of 700 years. Figure 26.5-1B applies to Risk Categories III and IV buildings and is associated with a return period of 1700 years. Figure 26.5.1-C applies to Risk Category I Buildings and is associated with a return period of 300 years. For serviceability, a new appendix in ASCE 7-10 provides maps of peak gust wind speeds at 33 ft above ground for Exposure C conditions for return periods of 10, 25, 50 and 100 years.



The wind speed maps in ASCE 7 haven't changed since the 1998 edition (ASCE 7-98). Since the development of the model used for the ASCE 7-98 wind speed map, significantly more hurricane data have become available which improves the modeling process. The new hurricane hazard model indicates that the hurricane wind speeds given in ASCE 7-05 (ASCE 7-98 and ASCE 7-02 included) are conservative. This conservatism is evident even though the overall rate of intense storms produced by the new model is higher compared to the rate of intense storms produced by the model used to develop the wind speed maps in ASCE 7-98 through ASCE 7-05. The new maps, when used in combination with the 1.0 load factor on wind for strength design and the 0.6 factor on wind for allowable stress design, result in a net decrease in design wind loads in Hurricane-Prone Regions. However, for parts of southern Florida, due to the re-introduction of Exposure D for coastal areas (see change discussed on Page 32) the loads are approximately the same when compared to the previous editions. For the rest of the Hurricane-Prone Region the design wind pressures are on average approximately 20% less than the loads determined from ASCE 7-05. The figure on page 29 provides a comparison of design wind speeds for Risk Category II buildings for the maps in ASCE 7-10 and ASCE 7-05. The red contours represent the ASCE 7-05 wind speeds. The black contours represent the wind speeds for Risk Category II Buildings in ASCE 7-10 that have been factored down to allowable stress design levels by dividing the wind speeds by $\sqrt{1.6}$ and locating the contours on whole numbers.

As can be seen from this figure, comparative wind speeds in ASCE 7-10 are lower than those from ASCE 7-05. This will take many users by surprise as the first thing that will be noticed about the new wind speed maps is the magnitude of the basic wind speeds. However, as discussed previously, net wind loads in the Hurricane-Prone Regions have been reduced.

Similar to the wind speed map changes that occurred in ASCE 7-95 (basic wind speeds changed from fastest-mile to 3-second gusts), the transition to the new strength design level maps will take some time and adjustment, particularly for product manufacturer's that have evaluation reports or test reports based on the un-factored load effects for wind speeds provided in ASCE 7-05 and earlier. To ease this transition, a table is provided in the commentary to ASCE 7-05 that provides conversions from the strength design-based wind speeds using ASCE 7-10 wind speed maps and the ASCE 7-05 wind speed maps. This table is reproduced here. For example, if a product was evaluated for a wind speed of 130 mph in ASCE 7-05, the comparable wind speed in ASCE 7-10 would be 164 mph. A column is also provided for correlation with the wind speed maps in ASCE 7-93 (fastest-mile).

TABLE C26.5-6
Design Wind Speeds: ASCE 7-93 to ASCE 7-10

ASCE 7-05 Design Wind Speed (3-sec gust in mph)	*ASCE 7-10 Design Wind Speed (3-sec gust in mph)*	*ASCE 7-93 Design Wind Speed (fastest mile in mph)*
85	110*	71
90	115*	76
100	126	85
105	133	90
110	139	95
120	152	104
130	164	114
140	177	123
145	183	128
150	190	133
170	215	152

* Wind speed values of 110 mph and 115 mph were rounded from the "exact" conversions of $85\sqrt{1.6}$ = 108 and $90\sqrt{1.6}$ = 114 mph, respectively.

26.7.2 Modification

Surface Roughness Categories

At a Glance

Surface Roughness D now applies to all water surfaces including water surfaces in hurricane prone regions.

2010 Standard

26.7.2 ~~6.5.6.2~~ Surface Roughness Categories.

A ground surface roughness within each 45° sector shall be determined for a distance upwind of the site as defined in Section 26.7.3 ~~6.5.6.3~~ from the categories defined in the following text, for the purpose of assigning an exposure category as defined in Section 26.7.3 ~~6.5.6.3~~.

Surface Roughness B: Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

Surface Roughness C: Open terrain with scattered obstructions having heights generally less than 30 ft (9.1 m). This category includes flat open country~~,~~ and grasslands, ~~and all water surfaces in hurricane prone regions~~.

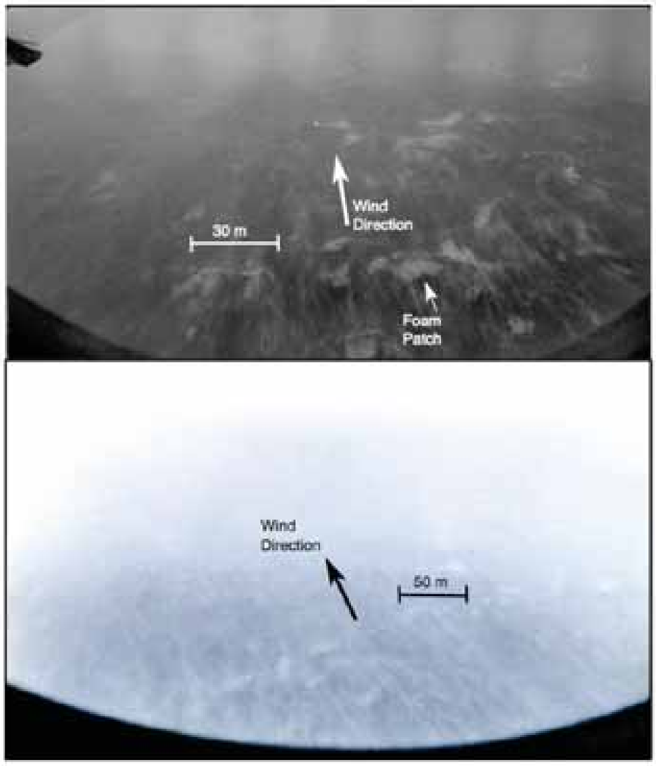
Surface Roughness D: Flat, unobstructed areas and water surfaces ~~outside hurricane prone regions~~. This category includes smooth mud flats, salt flats, and unbroken ice.

Analysis and Commentary

Prior to ASCE 7-98, Exposure Category D was usually assumed for wind blowing over open water including coastal areas of hurricane prone regions. However, ASCE 7-98 first introduced the concept of using Exposure Category C for coastal areas in hurricane prone regions, based on research that, at the time, indicated that the roughness of the ocean increases with increasing wind speed. That roughness was determined to approach that Exposure Category C, and subsequently, ASCE 7 was revised to reflect the research findings.

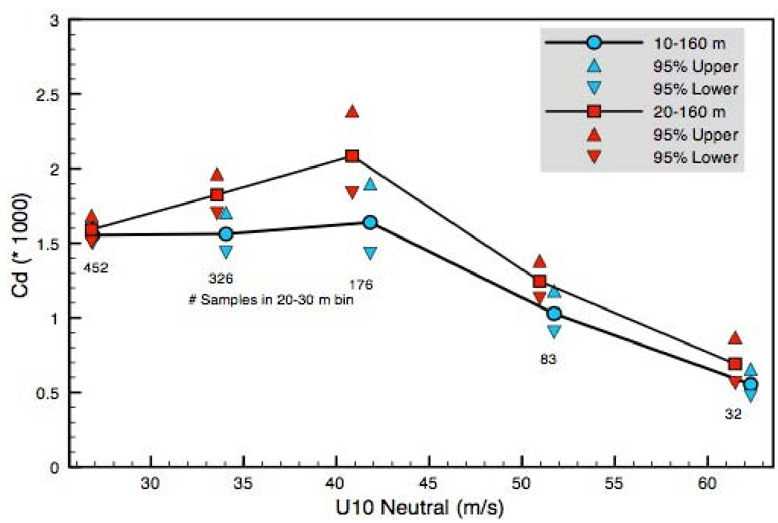
Newer research has shown that the roughness of the ocean in high winds in hurricanes does not continue to increase with increasing wind speed. The studies showed that the sea surface drag coefficient, and thus the aerodynamic roughness of the ocean, actually reaches a maximum at wind speeds of 60 to 80 mph. Additionally, there was some evidence that the surface drag coefficient may decrease at higher wind speeds, reflecting a "frothing" of the water surface and subsequent smoothing. The use of Surface Roughness D is now required for all water surfaces including coastal areas in hurricane prone regions.

The following photographs depict this smoothing of the sea surface as wind speed increase. These photos were taken from the window of a NOAA P3 research aircraft flying below the eyewall of Hurricane Ella. The top photograph was taken from an altitude of approximately 820 ft (250 m) with flight-level wind speeds of 103 mph (46 m/s). The lower photograph was taken at an altitude of approximately 1480 ft (450 m) with flight-level wind speeds of 123 mph (55 m/s).



Courtesy M. D. Powell, NOAA

The following figure shows the change in drag coefficient (Cd) with wind speed. The blue and red symbols are based on different height layers of wind data and the triangles represent the error bars.



LIVE GRAPH
Click here to view

Courtesy M. D. Powell, NOAA

26.7.3 Modification

Exposure Categories

At a Glance

The definitions of Exposure Categories have been revised for consistency and clarity.

2010 Standard

26.7.3 ~~6.5.6.3~~ Exposure Categories.

Exposure B: For buildings with a mean roof height of less than or equal to 30 ft (9.1 m), Exposure B shall apply where the ground surface roughness ~~condition~~, as defined by Surface Roughness B, prevails in the upwind direction for a distance ~~of at least~~ greater than 1,500 ft (457 m). For buildings with a mean roof height greater than 30 ft (9.1 m), Exposure B shall apply where Surface Roughness B prevails in the upwind direction for a distance C ~~of at least~~ greater than 2,600 ft (792 m) or 20 times the height of the building, whichever is greater.

> ~~**EXCEPTION:** For buildings whose mean roof height is less than or equal to 30 ft, the upwind distance may be reduced to 1,500 ft.~~

Exposure C: Exposure C shall apply for all cases where Exposures B or D do not apply.

Exposure D: Exposure D shall apply where the ground surface roughness, as defined by Surface Roughness D, prevails in the upwind direction for a distance greater than 5,000 ft (1,524 m) or 20 times the building height, whichever is greater. ~~Exposure D shall extend into downwind areas of Surface Roughness B or C for a distance of 600 feet (200 m) or 20 times the height of the building, whichever is greater.~~ Exposure D shall also apply where the ground surface roughness immediately upwind of the site is B or C, and the site is within a distance of 600 ft (183 m) or 20 times the building height, whichever is greater, from an exposure D condition as defined in the previous sentence.

For a site located in the transition zone between exposure categories, the category resulting in the largest wind forces shall be used.

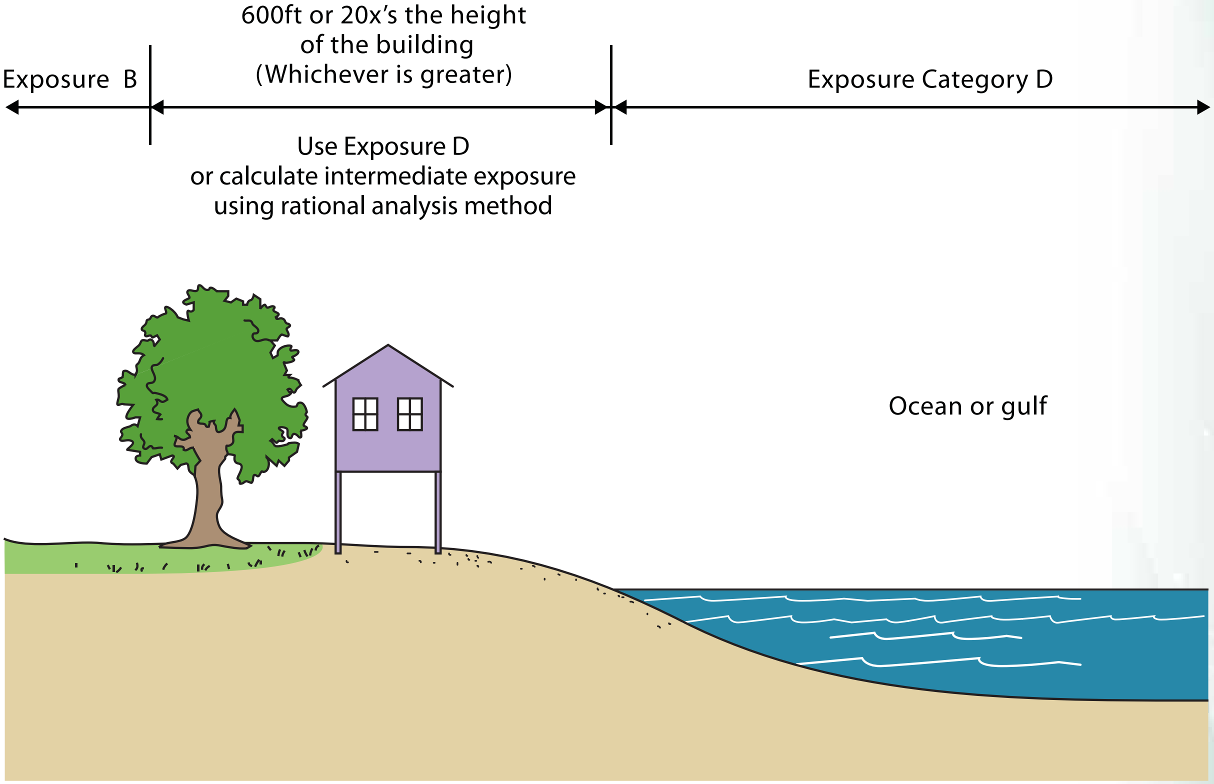
> **EXCEPTION:** An intermediate exposure between the preceding categories is permitted in a transition zone provided that it is determined by a rational analysis method defined in the recognized literature.

Analysis and Commentary

Primarily, the changes to the Exposure Category definitions are editorial in nature and intend to facilitate improved understanding of the applicable Exposure Category for a site. The exception shown in the previous edition of ASCE 7 for Exposure Category B, technically was not an exception to the definition of Exposure Category B, but rather, an exception to one sentence in particular within the definition. Therefore, the intent of the exception has been relocated to the body of the definition for Exposure Category B. The technical aspects of the definition are unchanged.

The second sentence of Exposure Category D in previous editions of ASCE 7 has often been confusing related to the use of the term “downwind.” The term “upwind” is used in other sections of ASCE 7, but the term “downwind” only appears in this definition. Much of the confusion pertaining to the use of the term “downwind” has to do with the actual starting point for describing the distance downwind. The intent is that Exposure Category D continues to extend for 600 feet or 20 times the building height, whichever is greater, from the point Exposure Category D ends, into Exposure Categories B or C, as applicable. Simply put, Exposure Category D transitions to Exposure Categories B or C over a distance of 600 feet or 20 times the height of the building, whichever is greater. Within this transition zone, the designer is required to use Exposure Category D or calculate an intermediate Exposure Category using a rational analysis method defined in the recognized literature. The change to this section preserves the original intent but revises the language to incorporate the term “upwind” within the description.

The following figure shows the intent of this language.



Exposure Category D Extending Into
Exposure Category B Areas

26.2, 26.10.3 Modification

Protection of Glazed Openings

At a Glance

The definition of Wind-borne Debris Regions has been revised to correspond appropriately to the new ultimate wind speed maps in ASCE 7-10. Much of the language has been relocated for clarity.

2010 Standard

Section 26.2 (formerly Section 6.2)

GLAZING, IMPACT RESISTANT: Glazing that has been shown by testing ~~in accordance with ASTM E1886 and ASTM E1996 or other approved test methods~~ to withstand the impact of ~~wind-borne~~ test missiles ~~likely to be generated in wind-borne debris regions during design winds~~. See Section 26.10.3.2.

~~**IMPACT RESISTANT COVERING:** A covering designed to protect glazing, which has been shown by testing withstood the impact of test missiles. when tested in accordance with ASTM E1886 and ASTM E1996 or other approved test methods to withstand the impact of wind-borne missiles likely to be generated in wind-borne debris regions during design winds.~~

IMPACT PROTECTIVE SYSTEM: Construction that has been shown by testing to withstand the impact of test missiles and that is applied, attached, or locked over exterior glazing. See Section 26.10.3.2.

WIND-BORNE DEBRIS REGIONS: Areas within hurricane prone regions ~~located:~~ where impact protection is required for glazed openings. See Section 26.10.3.

1. ~~Within 1 mile of the coastal mean high water line where the basic wind speed is equal to or greater than 110 mi/h and in Hawaii, or~~
2. ~~In areas where the basic wind speed is equal to or greater than 120 mi/h.~~

26.10.3 ~~6.5.9.3 Wind-Borne Debris~~ Protection of Glazed Openings.

Glazed openings in Risk Category II, III, or IV buildings located in hurricane-prone regions shall be protected as specified in this Section ~~Glazing in buildings located in wind-borne debris regions shall be protected~~

26.10.3.1 Wind-borne Debris Regions.

Glazed openings shall be protected in accordance with Section 26.10.3.2 in the following locations:

1. Within 1 mile of the coastal mean high water line where the basic wind speed is equal to or greater than 130 mi/h (58 m/s), or
2. In areas where the basic wind speed is equal to or greater than 140 mi/h (63 m/s).

For Risk Category II buildings and structures and Risk Category III buildings and structures, except health care facilities, the wind-borne debris region shall be based on Figure 26.5-1A. For Risk Category III health care facilities and Risk Category IV buildings and structures the wind-borne debris region shall be based on Figure 26.5.1-B. Risk Categories shall be determined in accordance with Section 1.5.

Exceptions:

1. Glazing in Category II, III, or IV buildings located over 60 ft (18.3 m) above the ground and over 30 ft (9.2 m) above aggregate surface roofs located within 1,500 ft (458 m) of the building shall be permitted to be unprotected.
2. Glazing in Category I buildings shall be permitted to be unprotected.

26.10.3.2 Protection Requirements for Glazed Openings.

Glazing in buildings requiring protection shall be protected with an impact protective system impact-resistant covering or shall be impact-resistant glazing. according to the requirements specified in ASTM E1886 and ASTM E1996 or other approved test methods and performance criteria. The levels of impact resistance shall be a function of Missile Levels and Wind Zones specified in ASTM E1886 and ASTM E1996.

Impact protective systems and impact resistant glazing shall be subjected to missile test and cyclic pressure differential tests in accordance with ASTM E1996 as applicable. Testing to demonstrate compliance with ASTM E1996 shall be in accordance with ASTM E1886. Impact resistant glazing and impact protective systems shall comply with the pass/fail criteria of Section 7 of ASTM E1996 based on the missile required by Table 3 or Table 4 of ASTM E1996.

EXCEPTION: Other testing methods and/or performance criteria are permitted to be used when approved.

Glazing and impact protective systems in buildings and structures, classified as Risk Category IV in accordance with Section 1.5, shall comply with the "enhanced protection" requirements of Table 3 of ASTM E1996. Glazing and impact protective systems in all other structures shall comply with the "basic protection" requirements of Table 3 of ASTM E1996.

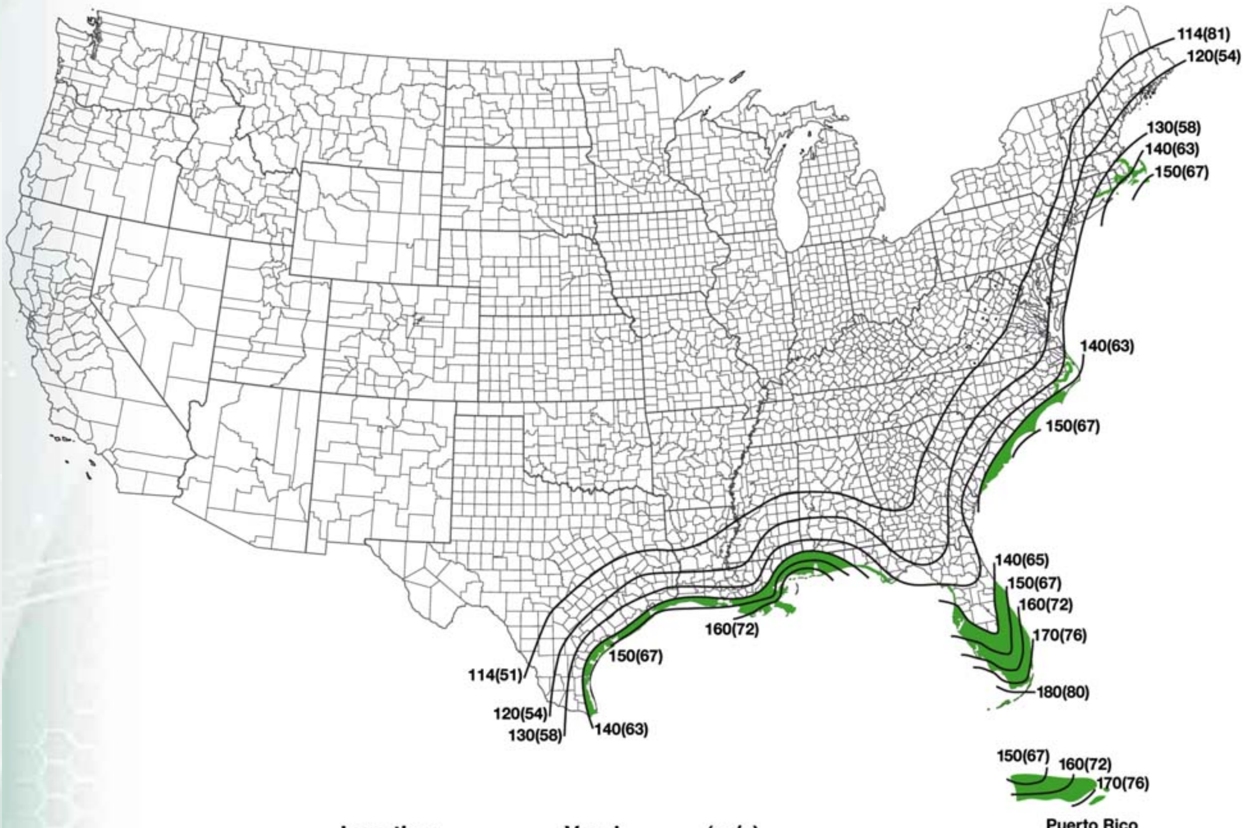
User Note: The wind zones that are specified in ASTM E1996 for use in determining the applicable missile size for the impact test, have to be adjusted for use with the wind speed maps of ASCE 7-10 and the corresponding wind-borne debris regions, see Section C26.10.3.2.

Analysis and Commentary

The primary changes to the wind-borne debris provisions in ASCE 7 can be described in two parts: 1) accomplish relative coordination with the new ultimate wind speed maps that are now the basis for determining design wind speeds; 2) provide clarification for explicit coordination with ASTM E1886 and ASTM E1996 for testing glazing and impact protective systems.

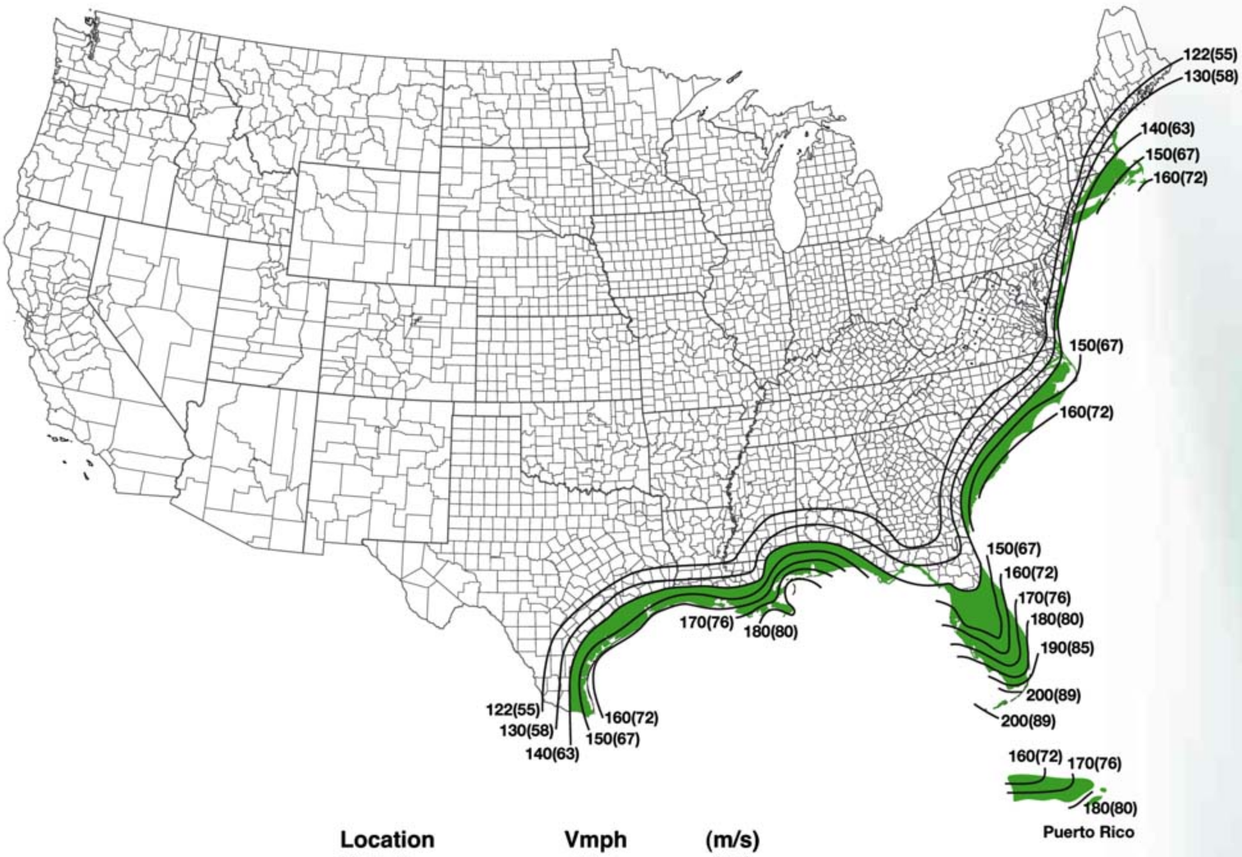
The language that triggers the Wind-borne Debris Region (WBDR) has been relocated to Section 26.10.3.1. The language is still similar but includes a couple of key changes. The appropriate map for the category of building under consideration is to be used for determining the application of the WBDR requirements. For Risk Category II buildings and Risk Category III buildings except health care facilities, the WBDR triggers are to be based on the wind speed map for Risk Category II buildings, Figure 26.5.1-A. For Risk Category IV buildings and Risk Category III health care facilities, the WBDR triggers are to be based on the wind speed map for Risk Category III and IV buildings, Figure 26.5.1-B. Using the Risk Category III and IV wind speed map substantially increases the WBDR for these buildings and structures as compared with the provisions of ASCE 7-05 except around Jacksonville, Florida and the “big bend” region of Florida. Using the appropriate risk based map for the appropriate occupancy category provides a means for achieving a more risk consistent approach for defining WBDR, particularly with regards to life safety. The types of buildings and structures included in Risk Category III suggest that life safety is most important for health care facilities. Therefore, the expanded WBDR in Figure 26.5.1-B applies to Risk Category III health care facilities.

The following maps depict an approximate representation of the areas that correspond to the new WBDR for the applicable Risk Categories.



Location	Vmph	(m/s)
Hawaii	130	(58)
Guam	195	(87)
Virgin Islands	165	(72)
American Samoa	160	(72)

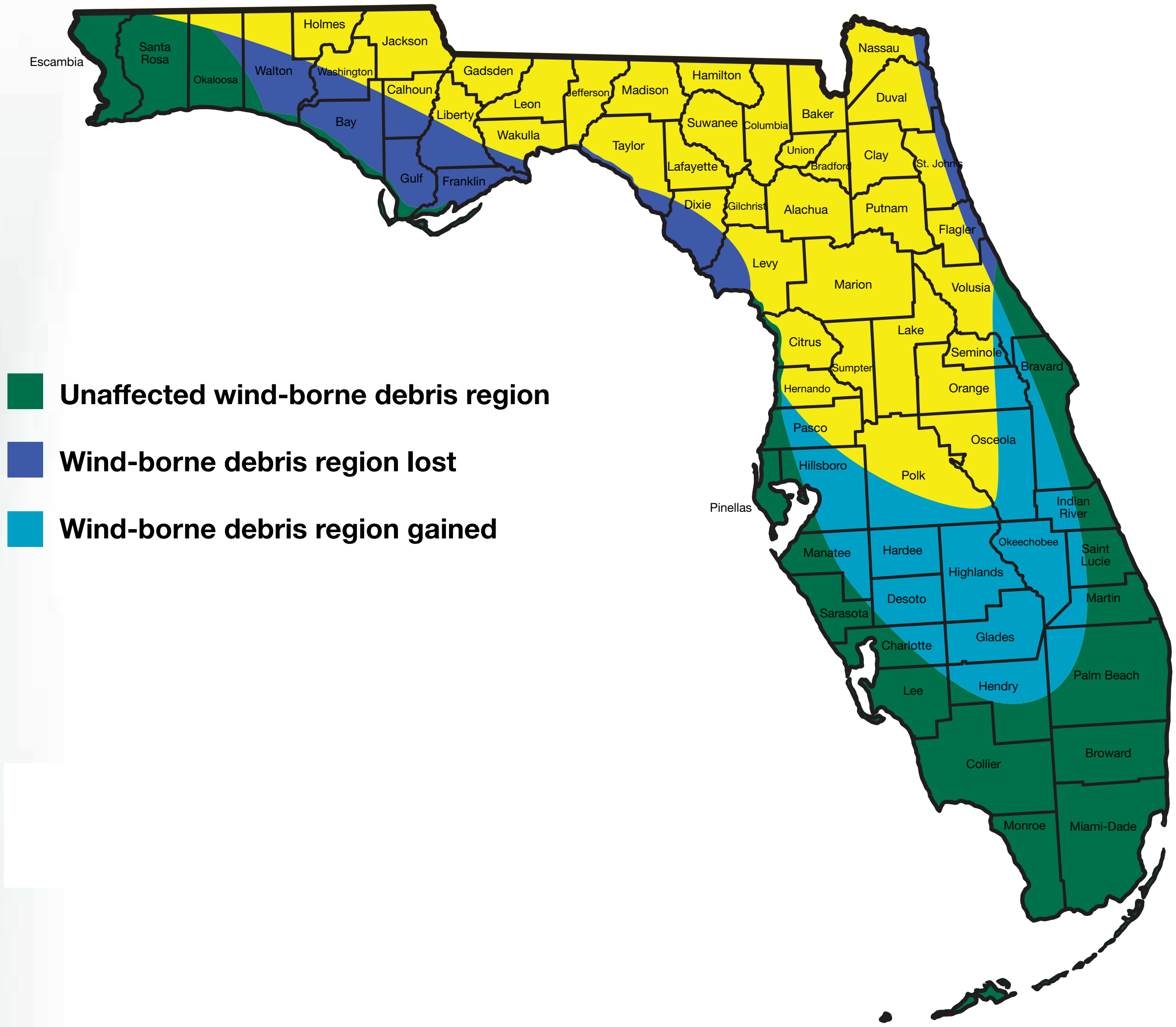
WBDR for Risk Category II and Risk Category III buildings excluding health care facilities V ≥ 140 mph; and within 1 mile of the coastal mean high water line where V ≥ 130 mph



Location	Vmph	(m/s)
Hawaii	145	(65)
Guam	210	(94)
Virgin Islands	175	(78)
American Samoa	170	(76)

WBDR for Risk Category IV and Risk Category III buildings health care facilities V ≥ 140 mph; and within 1 mile of the coastal mean high water line where V ≥ 130 mph

For Risk Category II buildings, there is a notable change in the geographic area that is now designated as a WBDR. The WBDR contained in the previous editions of ASCE 7 (1998, 2002, and 2005) were based on judgment and essentially applied the region to a strip of the coast along most of the Gulf of Mexico and Atlantic coast regions where the risk of a direct strike of a Category 3 or larger hurricane was high. The new criteria continue that judgment based definition by including the coastal areas that are approximately consistent with those given in prior editions of ASCE 7 for Risk Category II. A straight translation of the 110 and 120 mph wind speeds from ASCE 7-05 to the 700 year return period maps in ASCE 7-10 would yield triggers of 140 mph and 150 mph respectively. This would have eliminated the WBDR along most of the Texas coast and substantially reduce the region in other areas that are considered to be in a WBDR in ASCE 7-05. This is a result of the changes in the hurricane simulation model that reduces the magnitude of wind speeds for long return periods. However, while the applicability of the WBDR has essentially been shifted by 10 mph, the applicable region for Risk Category II and Risk Category III buildings excluding health care facilities has been substantially narrowed and eliminated in some places as compared to the regions applicable in ASCE 7-05 and prior editions. Significant reductions in the WBDR occur around Jacksonville, Florida, the Florida panhandle, and along the coast of North Carolina. The following figure depicts the impact of the changes for the State of Florida.



Impacts on WBDR for the State of Florida

Definitions applicable to protection of glazed openings in WBDR have been modified slightly for consistency with ASTM E1886 and ASTM E1996. Neither ASTM E1886 nor ASTM E1996 define “impact resistant glazing” or “impact resistant covering.” However, both standards define “impact protective system” as “Construction applied, attached, or locked over an exterior glazed opening system to protect that system from wind-borne debris during high wind events.” Therefore “impact resistant covering” has been replaced with the term “impact protective system.”

New language has also been added to Section 26.10.3.2 that provides explicit provisions for complying with ASTM E1886 and ASTM E1996 including pass/fail criteria. The new criteria specifically require that the pass/fail criteria of Section 7 of ASTM E1996 be used to evaluate the performance of the tested assemblies. ASTM E1996 also specifies the type and weight of missiles to be used based on the applicable wind zone and whether or not basic protection or enhanced protection is desired. ASCE 7 now specifically requires Risk Category IV structures to comply with the enhanced protection requirements of ASTM E1996. For all other structures, the basic protection requirements of ASTM E1996 are applicable. Enhanced protection in ASTM E1996 requires the use of a larger test missile travelling at faster speeds than basic protection.

The wind speeds for the various wind zones specified in ASTM E1996 are based on the wind speeds contained in ASCE 7-05. Therefore, for correlation with the strength design based wind speed maps in ASCE 7-10, the wind zones in ASTM E1996 will have to be converted and adjusted for consistency with the new WBDR designations in ASCE 7-10. The appropriate adjustment is shown below.

Modify Section 6.2.2 of ASTM E1996 as follows:

6.2.2 Unless otherwise specified, select the wind zone based on the basic wind speed as follows:
6.2.2.1 Wind Zone 1 - 130 mph ≤ basic wind speed < 140 mph, and Hawaii.
6.2.2.2 Wind Zone 2 - 140 mph ≤ basic wind speed < 150 mph at greater than 1.6 km (one mile from the coastline. The coastline shall be measured from the mean high water mark.
6.2.2.3 Wind Zone 3 - 150 mph (58 m/s) ≤ basic wind speed ≤ 160 mph (63 m/s), or 140 mph (54 m/s) ≤ basic wind speed ≤ 160 mph (63 m/2) and within 1.6 km (one mile) of the coastline. The coastline shall be measured from the mean high water mark.
6.2.2.4 Wind Zone 4 - basic wind speed > 160 mph (63 m/s).

26.9.1 Addition

Frequency Determination

At a Glance

New provisions have been added to enable designers to calculate an approximate low-bound natural frequency appropriate for wind design.

2010 Standard

26.9 ~~6.5.8~~ GUST EFFECTS ~~Factor~~

26.9.1 Gust-Effect Factor. The gust-effect factor for a rigid building or other structure is permitted to be taken as 0.85.

26.9.2 Frequency Determination.

To determine whether a building or structure is rigid or flexible as defined in Section 26.2, the fundamental natural frequency, n_1, shall be established using the structural properties and deformational characteristics of the resisting elements in a properly substantiated analysis. Low-Rise Buildings, as defined in 26.2, are permitted to be considered rigid.

26.9.2.1 Limitations for Approximate Natural Frequency

As an alternative to performing an analysis to determine n_1, the approximate building natural frequency, n_a, shall be permitted to be calculated in accordance with Section 26.9.3 for structural steel, concrete, or masonry buildings meeting the following requirements:

1. The building height is less than or equal to 300 ft (91 m), and
2. The building height is less than 4 times its effective length, L_{eff}.

The effective length, L_{eff}, in the direction under consideration shall be determined from the following equation:

$$L_{eff} = \frac{\sum_{i=1}^{n} h_i L_i}{\sum_{i=1}^{n} h_i} \qquad (26.9\text{-}1)$$

The summations are over the height of the building where

h_i is the height above grade of level i
L_i is the building length at level i parallel to the wind direction

26.9.3 Approximate Natural Frequency. The approximate lower-bound natural frequency (n_a), in hertz, of concrete or structural steel buildings meeting the conditions of Section 26.9.2.1, is permitted to be determined from one of the following equations:

For structural steel moment-resisting-frame buildings:

$$n_a = 22.2/h^{0.8} \qquad (26.9\text{-}2)$$

For concrete moment-resisting frame buildings:

$$n_a = 43.5/h^{0.9} \qquad (26.9\text{-}3)$$

For those structural steel and concrete buildings with other lateral-force-resisting systems:

$$n_a = 75/h \qquad (26.9\text{-}4)$$

For concrete or masonry shear wall buildings, it is also permitted to use

$$n_a = 385(C_w)^{0.5}/h \qquad (26.9\text{-}5)$$

where

$$C_w = \frac{100}{A_B}\sum_{i=1}^{n}\left(\frac{h}{h_i}\right)^2 \frac{A_i}{\left[1+0.83\left(\frac{h_i}{D_i}\right)^2\right]}$$

where

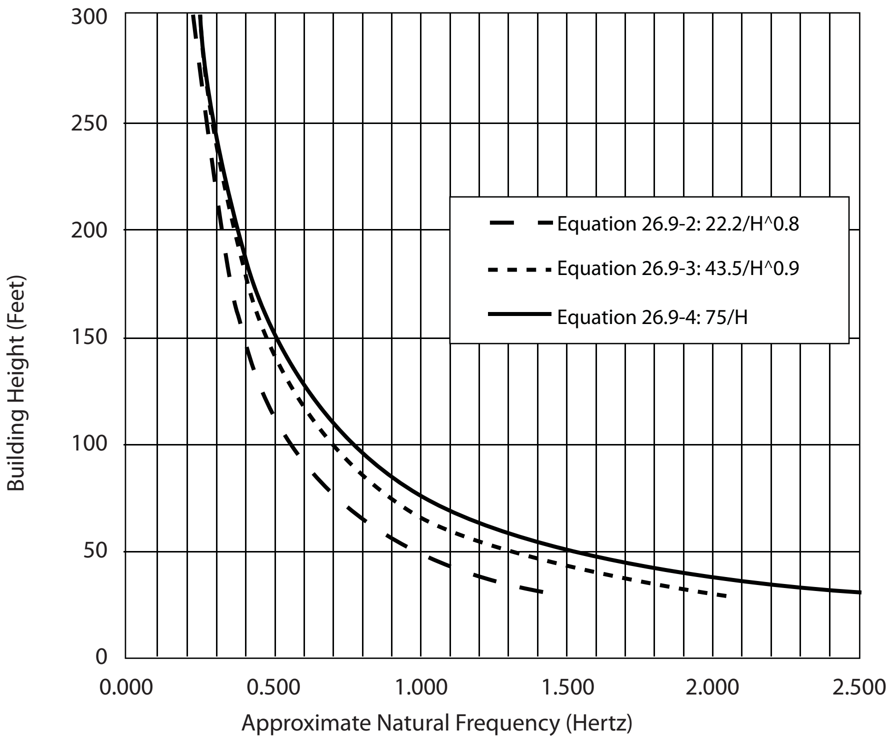
- h = building height (ft)
- n = number of shear walls in the building effective in resisting lateral forces in the direction under consideration
- A_B = base area of the structure (ft^2)
- A_i = horizontal cross-section area of shear wall "i" (ft^2)
- D_i = length of shear wall "i" (ft)
- h_i = height of shear wall "i" (ft)

Analysis and Commentary

ASCE 7 defines a Flexible Building as one in which the fundamental natural frequency is less than 1 Hz. A Rigid Building is one in which the fundamental natural frequency is greater than or equal to 1 Hz. However, the standard has historically not addressed specific methods or approximations that would be permitted to be used. There is concern that unconservative values may be inadvertently being used by designers. Empirical relationships exist for earthquake design for the building period (T_a = 0.1N where N is the number of stories). However, these expressions are based on recommendations for earthquake design with inherent bias toward higher estimates of fundamental frequencies. For wind design, these values may be unconservative because an estimated frequency higher than the actual frequency would yield lower values of the gust effect factor, which would ultimately lead to lower design wind pressures. Gust energy in the wind is smaller at frequencies above 1 Hz. Therefore, new language has been added to permit the calculation of an appropriate approximate lower-bound natural frequency of buildings for wind design.

New Section 26.9.2 adds a generic description of the appropriate analytical calculation of fundamental natural frequency. The equations in new Section 26.9.3 are derived from the commentary and are applicable to structural steel, concrete, and masonry buildings up to 300 feet in height meeting the physical limitations of Section 26.9.2.1. The relationship between building height and approximate natural frequency using these equations is shown in the following figure.

LIVE GRAPH
Click here to view



Equations for Approximate Natural Frequency n_a vs. Building Height

The use of a gust effect factor, G, of 0.85 for rigid buildings is maintained. Additionally, buildings meeting the definition of Low-rise Buildings in Section 26.2 are permitted to be considered rigid. For a building to be defined as a Low-rise Building, the mean roof height has to be less than 60 ft and cannot exceed the least horizontal dimension. Due to these geometric limitations, Low-rise Buildings will almost always have a fundamental natural frequency that exceeds 1 Hz.

26.10.3.1 Clarification

Protection of Glazed Openings and Roof Aggregate

At a Glance

New language has been added to clarify that the exception regarding wind-borne debris applies to all roofs with gravel or stone.

2010 Standard

26.10.3.1 ~~6.5.9.3~~ Wind-borne Debris Regions.

Glazed openings shall be protected in accordance with Section 26.10.3.2 in the following locations:

1. Within 1 mile of the coastal mean high water line where the basic wind speed is equal to or greater than 130 mi/h (58 m/s), or
2. In areas where the basic wind speed is equal to or greater than 140 mi/h (63 m/s).

For Risk Category II buildings and structures and Risk Category III buildings and structures, except health care facilities, the wind-borne debris region shall be based on Figure 26.5-1A. For Risk Category III health care facilities and Risk Category IV buildings and structures the wind-borne debris region shall be based on Figure 26.5-1B. Risk Categories shall be determined in accordance with Section 1.5.

Exception:

Glazing located over 60 ft (18.3 m) above the ground and over 30 ft (9.2 m) above aggregate surface roofs, including roofs with gravel or stone ballast, located within 1,500 ft (458 m) of the building shall be permitted to be unprotected.

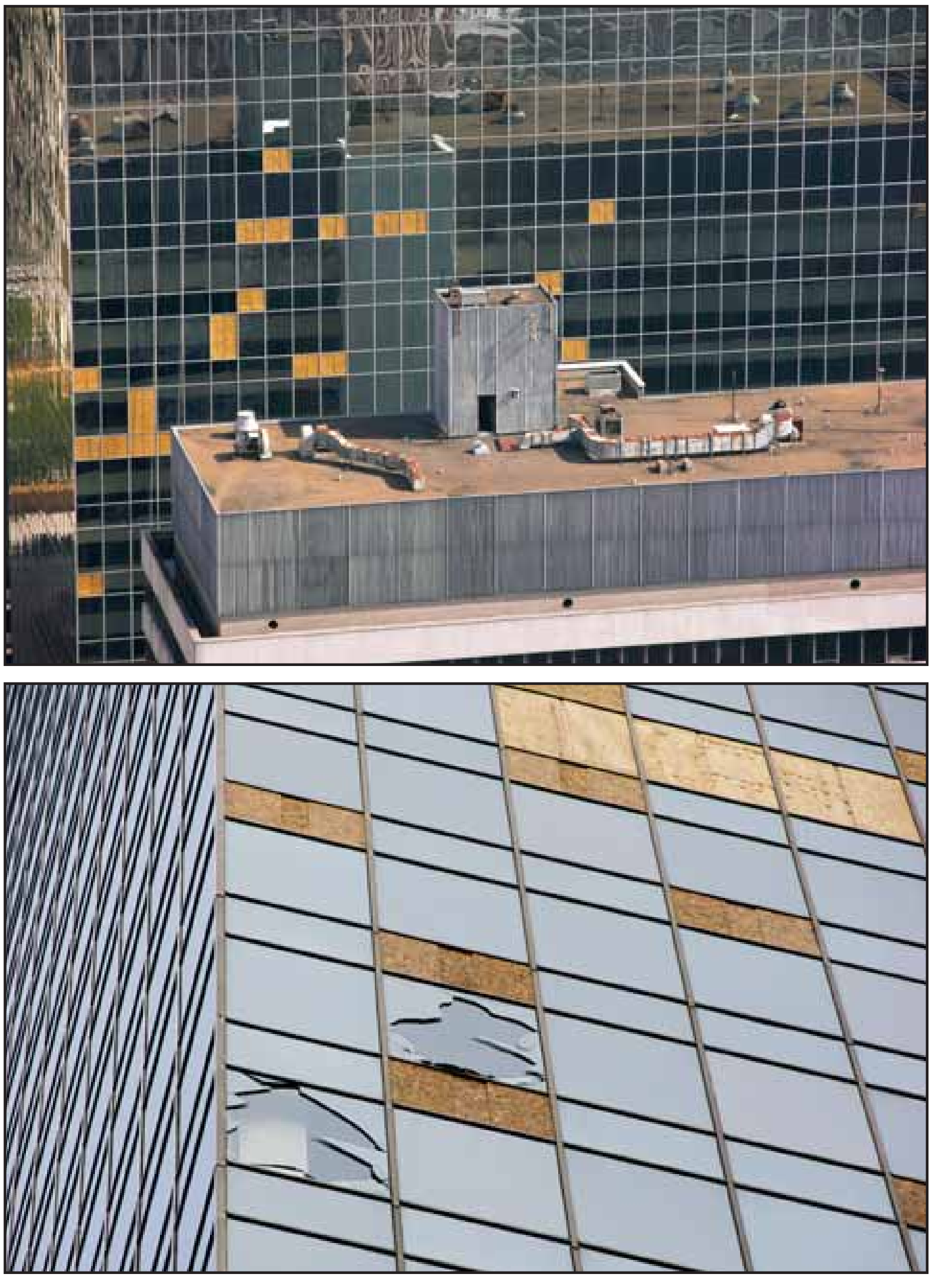
C26.10 ~~C6.5.9~~ (fourth paragraph)

Prior to the 2002 edition of the standard, glazing in the lower 60 ft (18.3 m) of Category II, III, or IV buildings sited in wind-borne debris regions was required to be protected with an ~~impact-resistant covering~~ impact protective system, or be impact resistant glazing, or the area ~~covered by~~ of the glazing was assumed to be open. Recognizing that glazing higher than 60 ft (18.3 m) above grade may be broken by wind-borne debris when a debris source is present, a new provision was added in 2002. With that new provision, aggregate surfaced roofs on buildings within 1,500 ft (457 m) of the new building need to be evaluated. For example, ~~loose~~ roof aggregate, including gravel or stone used as ballast that is not protected by a ~~an extremely~~ sufficiently high parapet should be considered as a debris source. Accordingly, the glazing in the new building, from 30 ft (9.1 m) above the source building to grade would need to be protected with an impact protective system, or be impact resistant glazing ~~or assumed to be open~~. If loose roof aggregate is proposed for the new building, it too should be considered as a debris source because aggregate can be blown off the roof and be propelled into glazing on the leeward side of the building. Although other types of wind-borne debris can impact glazing higher than 60 ft above grade, at these higher elevations, loose roof aggregate has been the predominate debris source in previous wind events. The requirement for protection 30 ft (9.1 m) above the debris source is to account for debris that can be lifted during flight. The following references provide further information regarding debris damage to glazing:

Analysis and Commentary

The change to the exception for wind-borne debris protection on tall buildings is required primarily to clarify its intent. The exception permits unprotected glazing above 60 feet provided that the glazing is located 30 feet above aggregate-surfaced roofs that are within 1500 feet of the glazing. The language in the exception has been modified by adding the term "including roofs with gravel or stone." The language is now clear that any type of surfacing that could become a debris source applies to this exception.

Aggregate surfaced roofs are often interpreted as a built up roof with aggregate embedded in a flood coat of tar of bitumen. Technically, only some of the aggregate is embedded in the flood coat. Consequently, the commentary has been revised to remove the term loose so as to be clear aggregate surfaced roofs that are not fully embedded in a flood coat of bitumen are also included.



Glazing damage due to roof aggregate from adjacent building in Hurricane Ike

Part III
Analytical Methods for Determining Wind Loads (MWFRS)

27.4.4, 28.4.2, Modification

Roof Overhangs

At a Glance

The determination and application of MWFRS wind loads on roof overhangs has been revised to provide a more accurate description of how the loads are to be applied.

2010 Standard

~~**6.5.11.4 Roof Overhangs.**~~
~~**6.5.11.4.1 Main Wind-Force Resisting System.**~~
27.4.4 Roof Overhangs.

~~overhangs shall be designed for a positive~~ The positive external pressure on the bottom surface of windward roof overhangs shall be determined using ~~corresponding to~~ $C_p = 0.8$ and combined with the top surface pressures determined from using ~~Figs. 6-6 and 6-10~~ Figure 27.4.1-1.

28.4.3 Roof Overhangs.

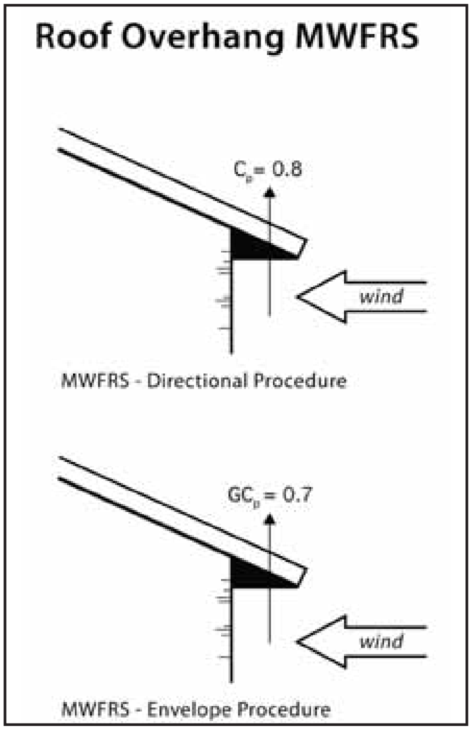
The positive external pressure on the bottom surface of windward roof overhangs shall be determined using $GC_p = 0.7$ in combination with the top surface pressures determined from using Figure 28.4.1.

Analysis and Commentary

There has been considerable confusion in the past regarding the determination and application of loads on roof overhangs and soffits (underside of the roof overhang) for the MWFRS and Components and Cladding. The hurricanes of 2004 provided fresh evidence of the importance of properly designing soffits. Many buildings appeared to suffer minimal damage other than loss of the soffit material. However, due to wind and wind driven rain, there was often significant damage on the inside to gypsum ceilings and walls when soffits were damaged or removed.

For MWFRS, the provisions were pretty clear for the Directional Procedure (Rigid Buildings of All Heights method) – use $C_p = 0.8$ in combination with pressures on the top of the roof. However, for the Envelope Procedure (Low-rise Buildings method), the provisions were a little confusing since this method uses combined gust and pressure coefficients, GC_p , and roof overhang coefficient was given as a C_p value. For clarity, the default Gust Factor ($G = 0.85$) was multiplied by $C_p = 0.8$ to yield a $GC_p = 0.7$ for better compatibility with Figure 28.4.1.

The following figures depict the application of overhang loads for MWFRS.



27.4.7, 28.4.4, 28.6.4

Modification

Minimum Design Wind Loads

At a Glance

The minimum design lateral wind load for the vertical projection of the roof has been reduced to half of the minimum design wind load for the vertical projection of the wall.

2010 Standard

~~**6.1.4 Minimum Design Wind Loading.** The design wind load, determined by any one of the procedures specified in Section 6.1.2, shall be not less than specified in this section.~~

<u>27.4.7</u> ~~6.1.4.1~~ Minimum Design Wind Loads.

The wind load to be used in the design of the MWFRS for an enclosed or partially enclosed building ~~or other structure~~ shall not be less than <u>16</u> ~~10~~ lb/ft^2 (<u>0.77</u> ~~0.48~~ kN/m^2) multiplied by the <u>wall</u> area of the building ~~or structure~~ <u>and 8 lb/ft^2 (0.38 kN/m^2) multiplied by the roof area of the building</u> projected onto a vertical plane normal to the assumed wind direction. <u>Wall and roof loads shall be applied simultaneously.</u> The design wind force for open buildings ~~and other structures~~ shall be not less than <u>16</u> ~~10~~ lb/ft^2 (0.48 kN/m^2) multiplied by the area A_f.

<u>28.4.4 Minimum Design Wind Loads.</u>

<u>The wind load to be used in the design of the MWFRS for an enclosed or partially enclosed building shall not be less than 16 lb/ft^2 (0.48 kN/m^2) multiplied by the wall area of the building and 8 lb/ft^2 (0.38 kN/m^2) multiplied by the roof area of the building projected onto a vertical plane normal to the assumed wind direction.</u>

<u>28.6.4</u> ~~6.4.2.1.1~~ Minimum Design Wind Loads.

The load effects of the design wind pressures from Section <u>28.6.3</u> ~~6.4.2.1~~ shall not be less than a minimum load defined by assuming the pressures, p_s, for Zones <u>A and C</u> ~~A, B, C, and D all~~ equal to +<u>16</u> ~~10~~ psf, <u>Zones B and D equal to +8 psf</u> while assuming p_s, for Zones E, F, G, and H <u>are</u> ~~all~~ equal ~~to~~ 0 psf.

Analysis and Commentary

The merits of the minimum design wind load of 10 psf projected on a vertical plane for the MWFRS has been under much debate during the last two update cycles for ASCE 7. The 10 psf minimum has a particular impact on low-rise buildings. For these buildings, the 10 psf minimum effectively over-rides the lateral design provisions of the Directional Procedure (Figure 27.4-1) and the Envelope Procedure (Figure 28.4-1). This floor on minimum lateral loads essentially requires the same lateral resistance in low wind areas as in the highest hurricane prone areas for many buildings. From a risk perspective, the ASCE WTC (Wind Task Committee) felt this floor to be unwarranted.

The following example shows a comparison of wind speeds above which the lateral design provisions of the Directional Procedure and the Envelope Procedure would govern. For example, consider a building with the following characteristics:

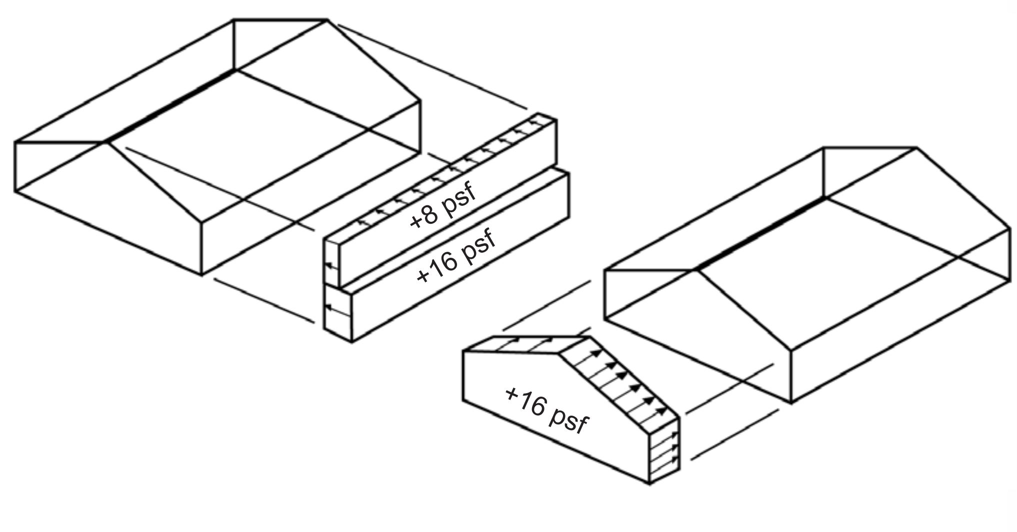
Exposure B
L = 60 ft
B = 60 ft
H_{wall} = 8 ft
Roof angle = 10 degrees

If the building was designed by the Directional Procedure, all designs where the wind speed was less than 158 mph (ultimate wind speeds), the minimum design wind load would govern. This essentially requires a building located where the wind speed is 115 mph to have the same lateral resistance as a building located where the wind speed is 158 mph. If the building was designed by the Envelope Procedure, all designs where the wind speed was less than 174 mph, the minimum design wind load would govern. This requires all buildings to have the same lateral resistance as required in the highest hurricane-prone areas.

A more reasonable approach is to reduce the minimum lateral load on the vertical projection of the roof to half the minimum lateral load on the wall. This approach still maintains a minimum lateral resistance but reduces the impact more consistent with the risk.

Note: At first glance, it appears that the minimum design wind load for walls has been increased from 10 psf to 16 psf. This increase is due to the new ultimate wind maps that are now in ASCE 7. See the discussion on the changes to the wind maps on page 19. As a result of this update, the load factor on wind for strength design is 1.0 and wind loads for allowable stress design are multiplied by 0.6. For equivalence to ASCE 7-05, the minimum design wind load of 16 psf is multiplied by 0.6 for allowable stress design: 16 psf x 0.6 = 9.6 psf ≈ 10 psf. On the vertical projection of the roof a similar calculation yields: 8 psf x 0.6 = 4.8 psf ≈ 5 psf.

The following figure depicts the application of the minimum design wind load on a building.



Minimum Design Wind Load

Figure 28.4-1 Modification

External MWFRS Pressure Coefficients – Envelope Procedure (Low-rise Buildings)

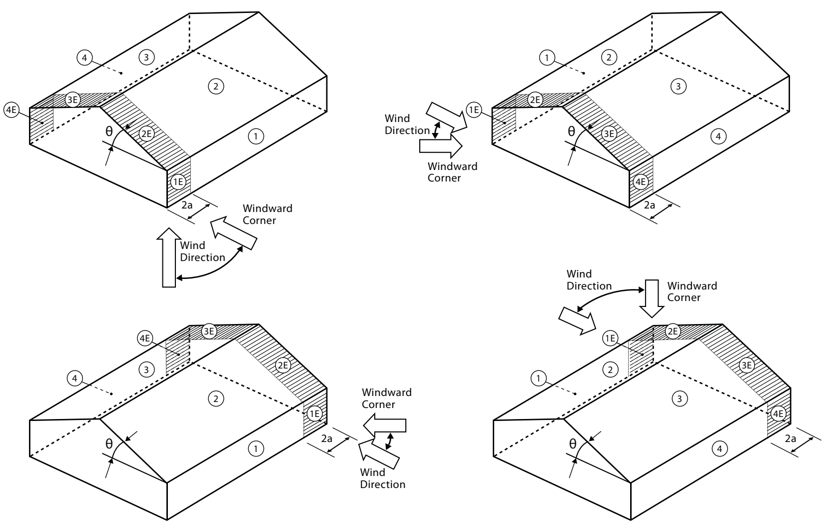
At a Glance

The application of the external pressure coefficients, GC_{pf}, for the low-rise method has been revised for clarity and to reduce instances of misapplication of the coefficients due to inappropriate interpretation of the footnotes.

2010 Standard

Replace Figure 6-10 with the following new Figure 28.4-1

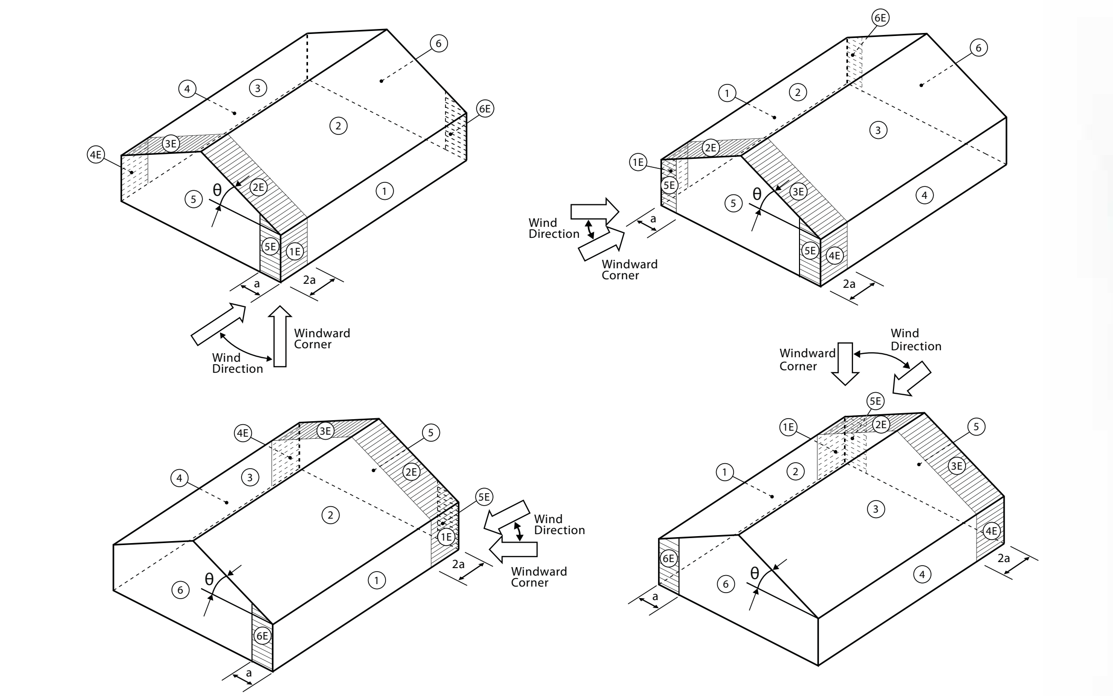
Main Wind Force Resisting System – Part 1 ~~Method 2~~		$h \leq 60$ ft.
Figure 28.4-1 ~~6-10~~	External Pressure Coefficients, GC_{pf}	Low-rise Walls & Roofs
Enclosed, Partially Enclosed Buildings		



Load Case A

Roof Angle θ (degrees)	LOAD CASE A							
	Building Surface							
	1	2	3	4	1E	2E	3E	4E
0-5	0.40	-0.69	-0.37	-0.29	0.61	-1.07	-0.53	-0.43
20	0.53	-0.69	-0.48	-0.43	0.80	-1.07	-0.69	-0.64
30-45	0.56	0.21	-0.43	-0.37	0.69	0.27	-0.53	-0.48
90	0.56	0.56	-0.37	-0.37	0.69	0.69	-0.48	-0.48

Figure 28.4-1 | External MWFRS Pressure Coefficients – Envelope Procedure (Low-rise Buildings)



Load Case B

Roof Angle θ (degrees)	LOAD CASE B											
	Building Surface											
	1	2	3	4	5	6	1E	2E	3E	4E	5E	6E
0-90	-0.45	-0.69	-0.37	-0.45	0.40	-0.29	-0.48	-1.07	-0.53	-0.48	0.61	-0.43

Notes:

1. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
2. For values of θ other than those shown, linear interpolation is permitted.
3. The building must be designed for all wind directions using the 8 loading patterns shown. The load patterns are applied to each building corner in turn as the ~~Reference~~ Windward Corner.
4. Combinations of external and internal pressures (see ~~Figure 6-5~~ Table 26.11.1) shall be evaluated as required to obtain the most severe loadings.
5. For the torsional load cases shown below, the pressures in zones designated with a "T" (1T, 2T, 3T, 4T, 5T, 6T) shall be 25% of the full design wind pressures (zones 1, 2, 3, 4, 5, 6).

   Exception: One story buildings with h less than or equal to 30 ft (9.1m), buildings two stories or less framed with light frame construction, and buildings two stories or less designed with flexible diaphragms need not be designed for the torsional load cases.

   Torsional loading shall apply to all eight basic load patterns using the figures below applied at each ~~reference~~ windward corner.
6. For purposes of designing a building's MWFRS, ~~Except for moment resisting frames,~~ the total horizontal shear shall not be less than that determined by neglecting the wind forces on the roof ~~surfaces~~.

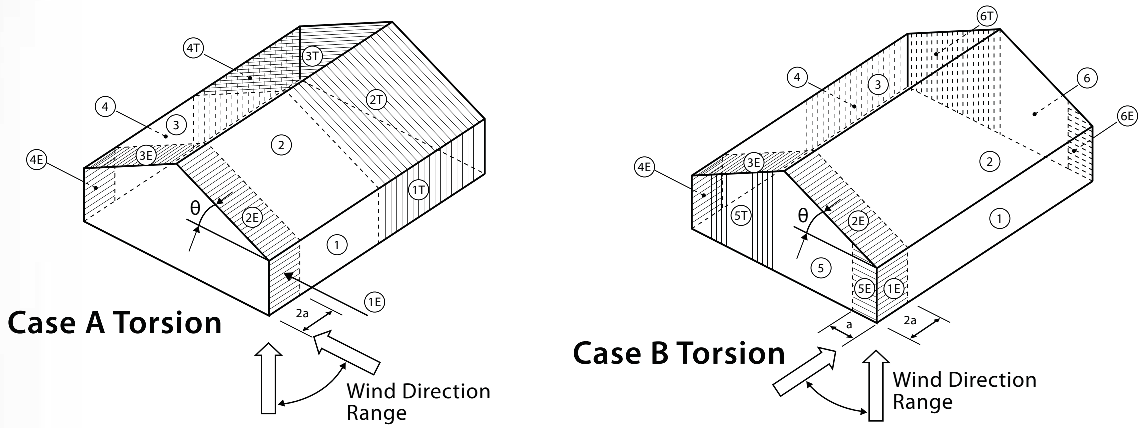
   Exception: This provision does not apply to buildings using moment frames for the MWRFS.
7. ~~For the design of the MWFRS providing lateral resistance in a direction parallel to a ridge line or f~~ For flat roofs, use θ = 0° and locate the zone 2/3 and zone 2E/3E boundary at the mid-~~length~~ width of the building.

8. The roof pressure coefficient GC_{pf}, when negative in Zone 2 ~~or~~ and 2E, shall be applied in Zone 2/2E for a distance from the edge of roof equal to 0.5 times the horizontal dimension of the building parallel to the direction of the MWFRS being designed or 2.5 times the eave height at the windward wall, whichever is less; the remainder of Zone 2/2E extending to the ridge line shall use the pressure coefficient GC_{pf} for Zone 3/3E.
9. Notation:

    a: 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

    h: Mean roof height, in feet (meters), except that eave height shall be used for $\theta \leq 10°$.

    θ: Angle of plane of roof from horizontal, in degrees.



Tranverse Direction **Longitudinal Direction**

Torsional Load Cases

Analysis and Commentary

Since the inclusion of this method in the 1995 edition of ASCE 7, there have been several attempts to clarify its application of the external pressure coefficients on a building. This method has been used in the metal building industry since the early 1980's. It is also the primary method by which single-family dwellings are designed for wind loads. The net pressure coefficients, GC_{pf}, applicable to this method represent "pseudo" loading conditions that, when applied to the building, envelope the desired structural actions (bending moment, shear, thrust) independent of the wind direction. Therefore, to capture all the appropriate structural actions, the building must be designed for all wind directions by considering each corner of the building as the windward corner.

In the 2002 edition of ASCE 7, the two figures previously represented by this method, were replaced with 8 figures with the goal to more accurately represent the rotation of the loading conditions required to envelope the MWFRS load effects. Additionally, the phrase "Direction of MWFRS Being Designed" was added to the figures to clarify how the end zones were to be applied relative to the direction of the framing. However, the existing bottom 4 sketches in combination with Note 7, was routinely misinterpreted. This misinterpretation resulted in loads for low slope roofs that were generally consistent with the original requirements, but failed to adequately reproduce the appropriate loads for higher sloped roofs at the ends of the roof and overestimated the loads for the middle portion of the roof.

The end zones are intended to be applied in the direction of the main framing. For a metal building this would be in direction of the moment frames or generally the transverse direction. For a light-framed simple diaphragm building that includes trusses and a wood structural panel roof deck, this would be in the direction of the roof trusses, or again, the transverse direction. While the footnotes were often misinterpreted, the end zones are not intended to be applied perpendicular to the main framing. Only when the main framing is spanning in the longitudinal direction would the end zones be applied in that direction. The revised bottom 4 figures are now identified as Load Case B with its own set of coefficients which removes the need to rely on the footnotes for this load case that has been misinterpreted.

This issue is critical particularly for determining roof-to-wall (rtw) loads for light-framed roofs such as trusses or rafters. For Load Case A where the wind direction is generally the transverse direction, or perpendicular to ridge, the net pressure coefficients decrease on the windward roof slope as the slope increases and ultimately become a positive or inward pressure coefficients as the roof slope exceeds approximately 25 degrees. This greatly reduces the rtw loads in this direction. For example, consider a building with a 30 degree roof slope. The applicable roof pressure coefficients are:

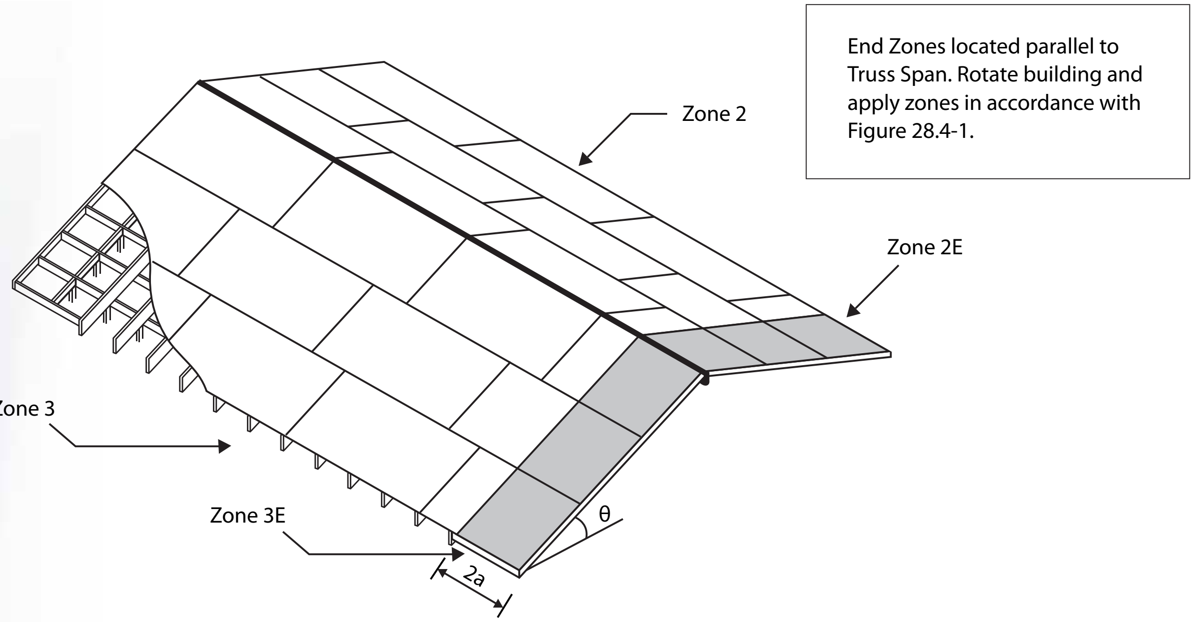
Load Case A:	Zone 2 = 0.21	(windward interior zone)
	Zone 3 = -0.43	(leeward interior zone)
	Zone 2E = 0.27	(windward end zone)
	Zone 3E = -0.53	(leeward end zone)

However, ASCE 7-10 now clarifies that Load Case B has to be considered which includes a single set of coefficients applicable for all roof slopes. The roof pressure coefficients for Load Case B are identical to those in Load Case A for a roof slope of 0-5 degrees.

Load Case B:	Zone 2 = -0.69	(windward interior zone)
	Zone 3 = -0.37	(leeward interior zone)
	Zone 2E = -1.07	(windward end zone)
	Zone 3E = -0.53	(leeward end zone)

Therefore, trusses located in the end zone or the dimension “2a”, would have to be designed using the coefficients for Zones 2E and 3E of Load Case B, and trusses located in the interior zones would have to be designed using the coefficients for Zones 2 and 3 of Load Case B.

A proper interpretation of ASCE 7-02 and ASCE 7-05 would be that the loads on the roof are not permitted to be less than those determined by applying the loads in the transverse direction and using the net pressure coefficients associated with assuming the roof slope to be 0 degrees.



Application of GC_{pf} to Light-Frame Trussed Roof Building

Part IV
Simplified Methods for Determining Wind Loads (MWFRS)

26.2 Clarification

Definitions, Simple Diaphragm Building

At a Glance

The definition of a simple diaphragm building for use with the simplified procedures has been revised for clarity.

2010 Standard

26.2 ~~6.2~~ DEFINITIONS

BUILDING, SIMPLE DIAPHRAGM: A building in which both windward and leeward wind loads are transmitted by roof and vertically spanning wall assemblies, through continuous floor and roof diaphragms, to the ~~same vertical~~ MWFRS ~~(e.g., no structural separations)~~.

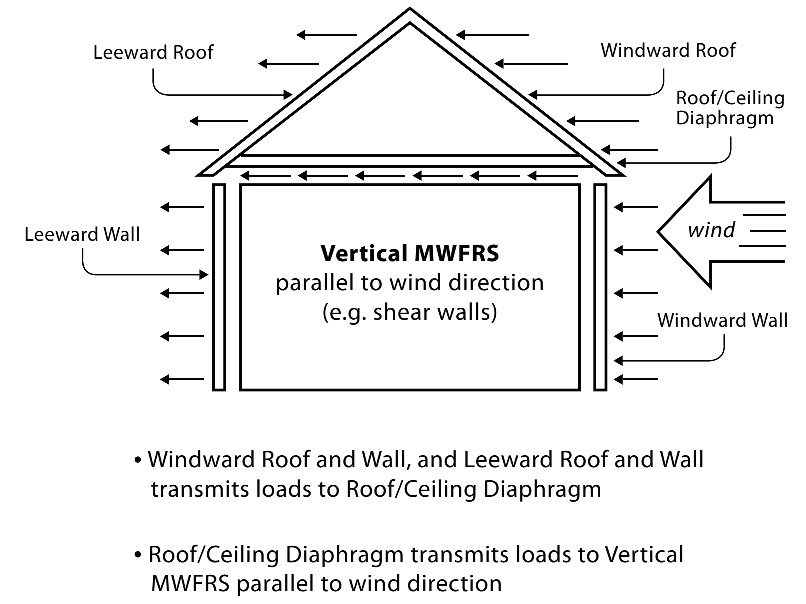
Analysis and Commentary

Since the introduction of a simplified method for simple diaphragm buildings in the 1998 edition of ASCE 7, there has often been confusion about which types of buildings qualify as "simple diaphragm buildings." It's an important determination for using the simplified procedures. The loads given in the simplified tables are the sum of the windward and leeward wall pressures and the sum of the horizontal components of the windward and leeward roof pressures. For simple diaphragm buildings, the roof and floor diaphragms collect the loads from the roof and vertically spanning walls that are normal to the direction of the wind. The roof and floor diaphragms then transfer these loads to the MWFRS that is parallel to the wind direction (such as shear walls). Since the loads essentially become a net horizontal wind force collected in the roof and floor diaphragms, the windward and leeward pressures can be summed to provide a single pressure for which to design the horizontal diaphragms and the MWFRS parallel to the wind direction.

The change to this definition, and the commentary as well, was due to a lack of clarity pertaining to the requirements for vertically spanning walls. The key clarification is that wind loads have to be transmitted from vertically spanning walls, meaning walls normal to the wind direction to the horizontal floor and roof diaphragms. The previous definition used the term "same vertical MWFRS", which could have implied that the horizontal diaphragms subsequently transmitted the loads back to the same vertically spanning walls. The new language makes it clear how the loads are to be transmitted so that the building truly qualifies as a simple diaphragm building.

The word continuous was added to clarify that the floor and roof diaphragms are not permitted to have structural separations such as expansion joints.

The following figure depicts a simplistic illustration of load transfer in a simple diaphragm building.



Simple Diaphragm Building

Good Examples

Houses with plywood shear walls
Typical CMU wall buildings
Concrete frames
Steel frames with vertically spanning walls and diaphragm floors and roofs

Bad Examples

Metal building frames with horizontally spanning girts
Unsymmetrical buildings
Any building with an expansion joint in the MWFRS

Figure 28.6-1 Modification

Enclosed Simple Diaphragm Low-Rise Buildings – Wind Loads – Main Wind-Force Resisting System

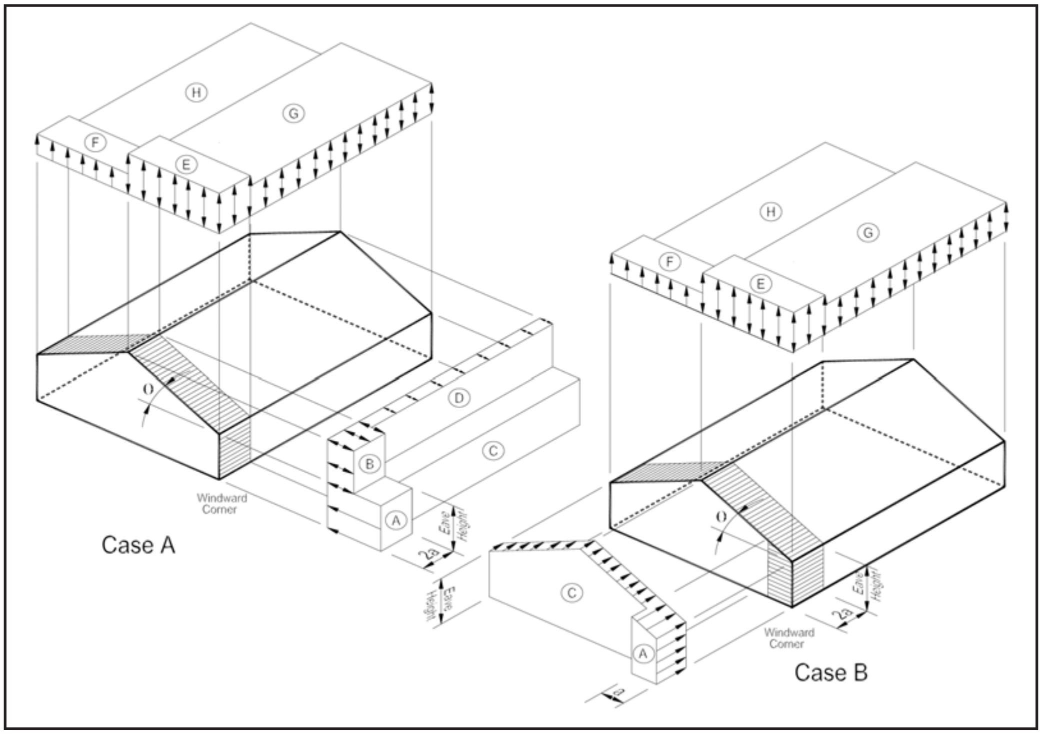
At a Glance

The application of the external pressures for the simplified method for simple diaphragm low-rise buildings has been revised for clarity and to reduce instances of misapplication of the pressure zones due to inappropriate interpretation of the footnotes.

2010 Standard

Replace Figure 6-2 with the following new Figure 28.6-1

Main Wind Force Resisting System ~~– Method 1~~		*h ≤ 60 ft.*
Figure 28.6-1 ~~6-2~~	Design Wind Pressures	Walls & Roofs
Enclosed Buildings		



Notes:

1. Pressures shown are applied to the horizontal and vertical projections, for exposure B, at h=30 ft (9.1m)~~, I=1.0 and K_{zt}=1.0~~. Adjust to other exposures and heights ~~conditions~~ using Equation 28.6-1 ~~6-1~~.
2. The load patterns shown shall be applied to each corner of the building in turn as the reference corner. (See Figure 28.4-1)
3. For Case B ~~the design of the longitudinal MWFRS~~ use θ = 0° ~~and locate the zone E/F, G/H boundary at the mid-length of the building~~.

4. Load cases 1 and 2 must be checked for 25° < θ ≤ 45°. Load case 2 at 25° is provided only for interpolation between 25° and 30°.
5. Plus and minus signs signify pressures acting toward and away from the projected surfaces, respectively.
6. For roof slopes other than those shown, linear interpolation is permitted.
7. The total horizontal load shall not be less than that determined by assuming $p_S = 0$ in zones B & D.

~~8. The zone pressures represent the following:~~

~~Horizontal pressure zones – Sum of the windward and leeward net (sum of internal and external pressures on vertical projection of:~~

~~A - End zone of wall~~	~~C - Interior zone of wall~~
~~B - End zone of roof~~	~~D - Interior zone of roof~~

~~Vertical pressure zones – Net (sum of internal and external) pressures on horizontal projection of:~~

~~E - End zone of windward roof~~	~~G - Interior zone of windward roof~~
~~F - End zone of leeward roof~~	~~H - Interior zone of leeward roof~~

8~~9~~. Where zone E or G falls on a roof overhang on the windward side of the building, use E_{OH} and G_{OH} for the pressure on the horizontal projection of the overhang. Overhangs on the leeward and side edges shall have the basic zone pressure applied.

9~~10~~. Notation:

a: 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

h: Mean roof height, in feet (meters), except that eave height shall be used for roof angles <10°.

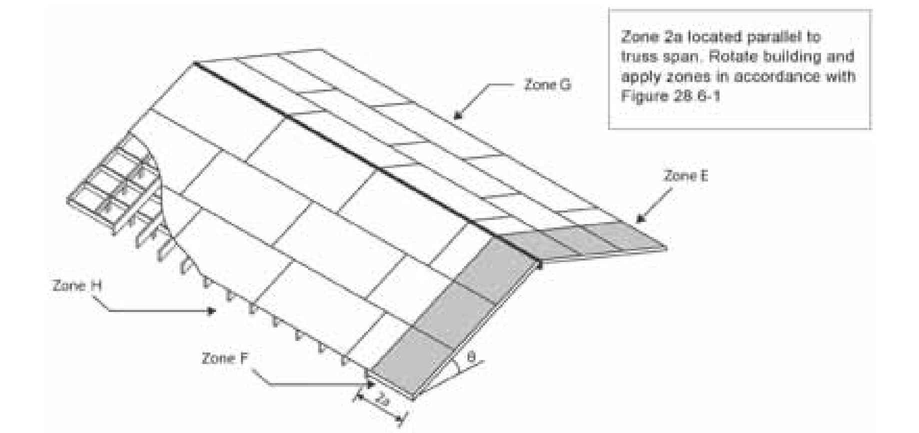
θ: Angle of plane of roof from horizontal, in degrees.

Analysis and Commentary

Since the inclusion of this simplified method in the 2002 edition of ASCE 7, there have been attempts to clarify the proper application of the external pressures on a building when this simplified approach was used. It is based on the Envelope Procedure contained in Section 28.4 that has been used in the metal building industry since the early 1980's. The net pressure coefficients, GC_{pf}, applicable to this method represent "pseudo" loading conditions that, when applied to the building, envelope the desired structural actions (bending moment, shear, thrust) independent of the wind direction. Therefore, to capture all the appropriate structural actions, the building must be designed for all wind directions by considering each corner of the building as the windward corner.

In the 2002 edition of ASCE 7, the two figures previously represented by Figure 28.4-1 (the basis for this simplified method, were replaced with 8 figures with the goal to more accurately represent the rotation of the loading conditions required to envelope the MWFRS load effects. Additionally, the phrase "Direction of MWFRS Being Designed" was added to the figures to clarify how the end zones were to be applied relative to the direction of the framing. However, the existing bottom 4 sketches in combination with Note 7 were routinely misinterpreted. This misinterpretation resulted in loads for low slope roofs that were generally consistent with the original requirements, but failed to adequately reproduce the appropriate loads for higher sloped roofs at the ends of the roof and overestimated the loads for the middle portion of the roof.

The end zones (Zone 2a) are intended to be applied in the direction of the main framing. For a metal building this would be in the direction of the moment frames or generally the transverse direction. For a light-framed simple diaphragm building that includes trusses and a wood structural panel roof deck, this would be in the direction of the roof trusses, or again, the transverse direction. While the footnotes were often misinterpreted, the end zones are not intended to be applied perpendicular to the main framing as was often misinterpreted by Figure 6-2 in ASCE 7-05. Only when the main framing is spanning in the longitudinal direction would the end zones be applied in that direction. The revised longitudinal direction is now identified as Case B and pressures are selected from the table by assuming a roof slope of 0 degrees, as specified by Note 3.



Application of Pressure Zones to Light-Framed Trussed Roof Building

This issue is critical particularly for determining roof-to-wall (RTW) loads for light-framed roofs such as trusses or rafters. For Case A where the wind direction is generally the transverse direction, or perpendicular to ridge, the net pressures decrease on the windward roof slope as the slope increases and ultimately become positive or inward pressure coefficients as the roof slope exceeds approximately 25 degrees. This greatly reduces the RTW loads in this direction. For example, consider a building with a 30 degree roof slope and wind speed of 120 mph. The applicable vertical roof pressures are:

Case A:	Zone E = 2.2 psf	(windward end zone)
	Zone G = 0.7 psf	(windward interior zone)
	Zone F = -15.6 psf	(leeward end zone)
	Zone H = -13.4 psf	(leeward interior zone)

However, ASCE 7-10 now clarifies that Case B has to be considered setting θ = 0°. The applicable vertical roof pressures:

Case B:	Zone E = -27.4 psf	(windward end zone)
	Zone G = -19.1 psf	(windward interior zone)
	Zone F = -15.6 psf	(leeward end zone)
	Zone H = -12.1 psf	(leeward interior zone)

For this situation, Case B provides the most severe loading condition for roof uplift. Therefore, trusses located in the end zone or the dimension “2a”, would have to be designed using the pressures for Zones E and F of Case B, and trusses located in the interior zones would have to be designed using the coefficients for Zones G and H of Case B.

Sections 27.5, 27.6 Addition

Enclosed Simple Diaphragm Buildings with $h \leq 160$ ft (48.8 m)

At a Glance

A new simplified method for enclosed simple diaphragm buildings with mean roof heights up to 160 ft has been added.

2010 Standard

(Note: Only portions of the method are shown for brevity.)

PART 2: ENCLOSED SIMPLE DIAPHRAGM BUILDINGS WITH $h \leq 160$ ft (48.8 m)

27.5 GENERAL REQUIREMENTS

27.5.1 Design Procedure.

The procedure specified herein applies to the determination of MWFRS wind loads of enclosed simple diaphragm buildings, as defined in Section 26.2, with a mean roof height $h \leq 160$ ft (48.8 m). The steps required for the determination of MWFRS wind loads on enclosed simple diaphragm buildings are shown in Table 27.5-1

27.5.2 Conditions.

In addition to the requirements in Section 27.1.2, a building whose design wind loads are determined in accordance with this section shall meet all of the following conditions for either a Class 1 or Class 2 building (see Fig. 27.5-1):

Class 1 Buildings:

1. The building shall be an enclosed simple diaphragm building as defined in Section 26.2.
2. The building shall have a mean roof height $h \leq 60$ ft (18.3 m).
3. The ratio of L/B shall not be less than 0.2 nor more than 5.0 ($0.2 \leq L/B \leq 5.0$).
4. The topographic effect factor $K_{zt} = 1.0$ or the wind pressures determined from this section shall be multiplied by K_{zt} at each height z as determined from Section 26.8. It shall be permitted to use one value of K_{zt} for the building calculated at $0.33h$. Alternatively it shall be permitted to enter the pressure table with a wind velocity equal to $V \sqrt{K_{zt}}$ where K_{zt} is determined at a height of $0.33h$.

Class 2 Buildings:

1. The building shall be an enclosed simple diaphragm building as defined in Section 26.2.
2. The building shall have a mean roof height 60 ft $< h \leq$ 160 ft (18.3 m $< h \leq$ 48.8 m).
3. The ratio of L/B shall not be less than 0.5 nor more than 2.0 ($0.5 \leq L/B \leq 2.0$).
4. The fundamental natural frequency (hertz) of the building shall not be less $75/h$ where h is in feet.
5. The topographic effect factor $K_{zt} = 1.0$ or the wind pressures determined from this section shall be multiplied by K_{zt} at each height z as determined from Section 26.8. It shall be permitted to use one value of K_{zt} for the building calculated at $0.33h$. Alternatively it shall be permitted to enter the pressure table with a wind velocity equal to $V \sqrt{K_{zt}}$ where K_{zt} is determined at a height of $0.33h$.

27.5.3 Wind Load Parameters Specified in Chapter 26.

Refer to Chapter 26 for determination of Basic Wind Speed V (Section 26.5) and exposure category (Section 26.7) and topographic factor K_{zt} (Section 26.8).

27.5.4 Diaphragm Flexibility.

The design procedure specified herein applies to buildings having either rigid or flexible diaphragms. The structural analysis shall consider the relative stiffness of diaphragms and the vertical elements of the MWFRS.

Diaphragms constructed of wood panels can be idealized as flexible. Diaphragms constructed of untopped metal decks, concrete filled metal decks, and concrete slabs, each having a span-to-depth ratio of 2 or less, are permitted to be idealized as rigid for consideration of wind loading.

27.6 WIND LOADS—MAIN WIND FORCE-RESISTING SYSTEM

27.6.1 Wall and Roof Surfaces—Class 1 and 2 Buildings. Net wind pressures for the walls and roof surfaces shall be determined from Tables 27.6-1 and 27.6-2, respectively, for the applicable exposure category as determined by Section 26.7.

For Class 1 buildings with L/B values less than 0.5, use wind pressures tabulated for $L/B = 0.5$. For Class 1 buildings with L/B values greater than 2.0, use wind pressures tabulated for $L/B = 2.0$.

Net wall pressures shall be applied to the projected area of the building walls in the direction of the wind, and exterior side wall pressures shall be applied to the projected area of the building walls normal to the direction of the wind acting outward according to Note 3 of Table 27.6-1, simultaneously with the roof pressures from Table 27.6-2 as shown in Fig. 27.6-1.

Where two load cases are shown in the table of roof pressures, the effects of each load case shall be investigated separately. The MWFRS in each direction shall be designed for the wind load cases as defined in Fig. 27.4-8.

> **EXCEPTION:** The torsional load cases in Fig. 27.4-8 (Case 2 and Case 4) need not be considered for buildings which meet the requirements of Appendix D.

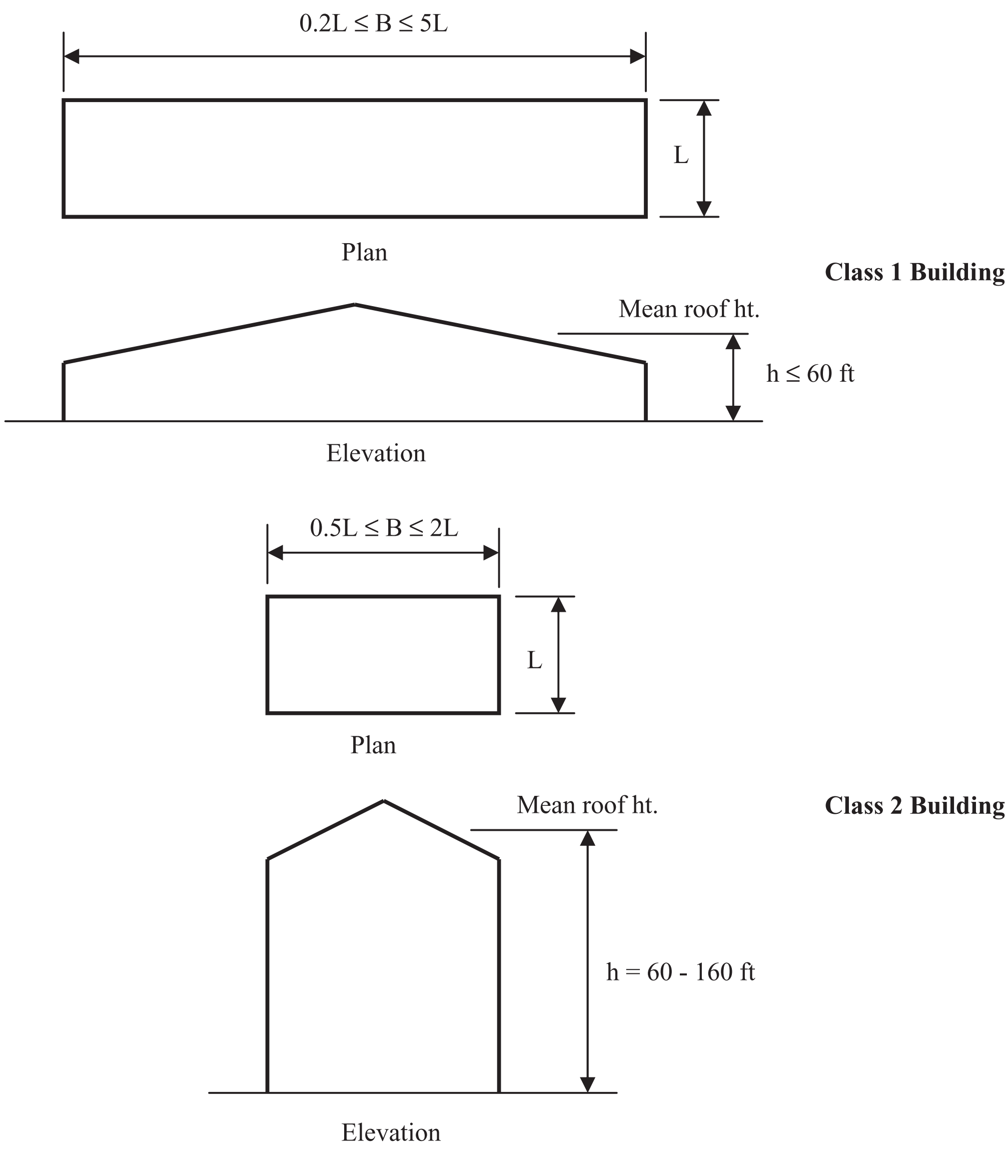
27.6.2 Parapets.

The effect of horizontal wind loads applied to all vertical surfaces of roof parapets for the design of the MWFRS shall be based on the application of an additional net horizontal wind pressure applied to the projected area of the parapet surface equal to 2.25 times the wall pressures tabulated in Table 27.6-1 for $L/B = 1.0$. The net pressure specified accounts for both the windward and leeward parapet loading on both the windward and leeward building surface. The parapet pressure shall be applied simultaneously with the specified wall and roof pressures shown in the table as shown in Fig. 27.6-2. The height h used to enter Table 27.6-1 to determine the parapet pressure shall be the height to the top of the parapet as shown in Fig. 27.6-2 (use $h = h_p$).

27.6.3 Roof Overhangs.

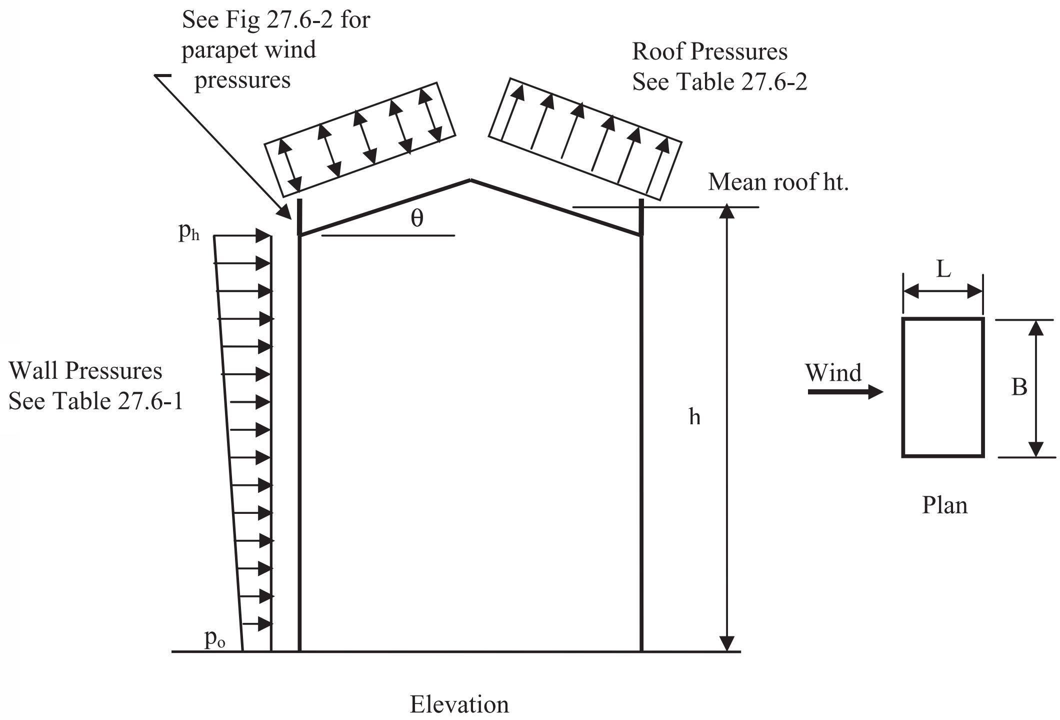
The effect of vertical wind loads on any roof overhangs shall be based on the application of a positive wind pressure on the underside of the windward overhang equal to 75% of the roof edge pressure from Table 27.6-2 for Zone 1 or Zone 3 as applicable. This pressure shall be applied to the windward roof overhang only and shall be applied simultaneously with other tabulated wall and roof pressures as shown in Fig. 27.6-3.

Main Wind Force Resisting System – Part 2		h ≤ 160 ft.
Figure 27.5-1	Building Class	Building Geometry Requirements
Enclosed Simple Diaphragm Buildings		

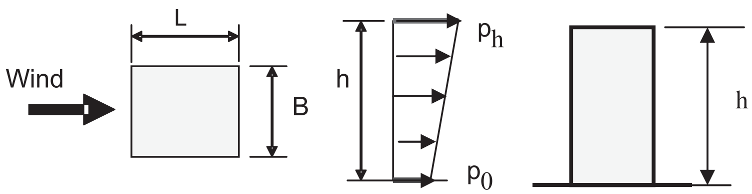


Note: Roof form may be flat, gable, mansard or hip

Main Wind Force Resisting System – Part 2		h ≤ 160 ft.
Figure 27.6-1	Wind Pressures – Walls and Roof	Application of Wind Pressures See Tables 27.6-1 and 27.6-2
Enclosed Simple Diaphragm Buildings		



Main Force Resisting System – Part 2		**$h \le 160$ ft.**
Table 27.6-1	**Wind Pressures - Walls**	**Application of Wall Pressures**
Enclosed Simple Diaphragm Buildings		



Plan **Wind Pressure** **Elevation**

Notes to Wall Pressure Table 27.6-1:

1. From table for each Exposure (B, C or D), V, L/B and h, determine p_h (top number) and p_0 (bottom number) horizontal along-wind net wall pressures.
2. Side wall external pressures shall be uniform over the wall surface acting outward and shall be taken as 54% of the tabulated p_h pressure for $0.2 \le L/B \le 1.0$ and 64% of the tabulated p_h pressure for $2.0 \le L/B \le 5.0$. Linear interpolation shall apply for $1.0 < L/B < 2.0$. Side wall external pressures do not include effect of internal pressure.
3. Apply along-wind net wall pressures as shown above to the projected area of the building walls in the direction of the wind and apply external side wall pressures to the projected area of the building walls normal to the direction wind, simultaneously with the roof pressures from Table 27.6-2.
4. Distribution of tabulated net wall pressures between windward and leeward wall faces shall be based on the linear distribution of total net pressure with building height as shown above and the leeward external wall pressures assumed uniformly distributed over the leeward wall surface acting outward at 38% of p_h for $0.2 \le L/B \le 1.0$ and 27% of p_h for $2.0 \le L/B \le 5.0$. Linear interpolation shall be used for $1.0 < L/B < 2.0$. The remaining net pressure shall be applied to the windward walls as an external wall pressure acting towards the wall surface. Windward and leeward wall pressures so determined do not include effect of internal pressure.
5. Interpolation between values of V, h and L/B is permitted.

Notation:

L = building plan dimension parallel to wind direction (ft.)
B = building plan dimension perpendicular to wind direction (ft)
h = mean roof height (ft.)
p_h, p_0 = along-wind net wall pressure at top and base of building respectively (psf)

Table 27.6-1
MWFRS – Part 2: Wind Loads – Walls
Exposure B

V(mph)	110			115			120			130			140			160			180			200		
h(ft.), L/B	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2
160	38.1	37.7	34.1	42.1	41.7	37.8	46.4	45.9	41.7	55.8	55.1	50.2	66.3	65.4	59.7	91.0	89.4	81.8	120.8	118.3	108.5	156.2	152.4	140.0
	25.6	25.4	21.0	28.3	28.1	23.3	31.2	30.9	25.7	37.5	37.1	30.9	44.6	44.0	36.8	61.2	60.1	50.4	81.3	79.6	66.9	105.2	102.6	86.2
150	36.9	36.6	33.0	40.7	40.4	36.5	44.9	44.4	40.3	53.9	53.3	48.5	63.9	63.1	57.6	87.5	86.1	78.9	116.1	113.8	104.5	149.9	146.5	134.7
	25.1	24.9	20.6	27.7	27.5	22.8	30.5	30.2	25.2	36.7	36.2	30.3	43.5	43.0	36.0	59.6	58.6	49.3	79.0	77.4	65.3	102.0	99.7	84.2
140	35.6	35.4	31.9	39.3	39.1	35.3	43.3	42.9	38.9	51.9	51.4	46.7	61.5	60.8	55.5	84.0	82.8	75.9	111.2	109.2	100.4	143.5	140.5	129.3
	24.5	24.4	20.2	27.1	26.9	22.4	29.8	29.6	24.6	35.7	35.4	29.6	42.4	41.9	35.2	57.9	57.0	48.1	76.6	75.2	63.7	98.8	96.7	82.0
130	34.4	34.2	30.8	37.9	37.7	34.0	41.7	41.4	37.4	49.9	49.5	44.9	59.1	58.5	53.3	80.5	79.5	72.8	106.3	104.6	96.2	136.9	134.3	123.8
	24.0	23.9	19.8	26.5	26.3	21.9	29.1	28.9	24.1	34.8	34.5	28.9	41.2	40.8	34.3	56.2	55.4	46.9	74.2	73.0	62.0	95.5	93.7	79.8
120	33.1	33.0	29.6	36.5	36.3	32.7	40.1	39.9	35.9	47.9	47.6	43.1	56.6	56.2	51.0	76.9	76.1	69.6	101.3	99.9	91.8	130.2	128.0	118.0
	23.4	23.3	19.4	25.8	25.7	21.4	28.4	28.2	23.6	33.9	33.7	28.3	40.1	39.7	33.5	54.4	53.8	45.6	71.7	70.7	60.2	92.2	90.6	77.4
110	31.8	31.7	28.4	35.1	34.9	31.3	38.5	38.3	34.4	45.9	45.6	41.2	54.1	53.8	48.8	73.3	72.6	66.3	96.3	95.1	87.4	123.5	121.6	112.1
	22.9	22.8	19.0	25.2	25.1	20.9	27.7	27.5	23.0	33.0	32.8	27.6	38.9	38.7	32.6	52.7	52.2	44.4	69.2	68.4	58.4	88.8	87.4	75.0
100	30.5	30.4	27.1	33.6	33.5	29.9	36.8	36.7	32.9	43.8	43.6	39.3	51.6	51.3	46.4	69.6	69.1	62.9	91.2	90.3	82.8	116.6	115.1	106.0
	22.3	22.3	18.5	24.6	24.5	20.4	26.9	26.8	22.5	32.1	31.9	26.8	37.8	37.6	31.7	50.9	50.5	43.0	66.7	66.0	56.6	85.3	84.2	72.5
90	29.2	29.1	25.9	32.1	32.0	28.5	35.1	35.0	31.2	44.7	41.6	37.3	49.1	48.8	44.0	65.9	65.5	59.5	86.0	85.3	78.0	109.6	108.5	99.8
	21.8	21.7	18.1	23.9	23.9	19.9	26.2	26.1	21.9	31.1	31.0	26.1	36.6	36.4	30.8	49.2	48.9	41.7	64.2	63.6	54.6	81.8	80.9	69.9
80	27.8	27.7	24.5	30.5	30.5	27.0	33.4	33.3	29.6	39.6	39.5	35.2	46.4	46.3	41.5	62.2	61.9	55.9	80.8	80.3	73.1	102.6	101.7	93.3
	21.2	21.2	17.7	23.3	23.2	19.4	25.5	25.4	21.3	30.2	30.1	25.4	35.4	35.3	29.9	47.4	47.2	40.3	61.6	61.2	52.6	78.3	77.6	67.2
70	26.3	26.3	23.1	28.9	28.8	25.4	31.6	31.5	27.9	37.4	37.3	33.1	43.7	43.6	38.9	58.3	58.1	52.2	75.5	75.1	68.1	95.5	94.9	86.6
	20.6	20.6	17.2	22.6	22.6	18.9	24.7	24.7	20.7	29.3	29.2	24.6	34.2	34.2	28.9	45.6	45.5	38.8	59.1	58.8	50.6	74.7	74.3	64.3
60	24.8	24.8	21.7	27.2	27.1	23.8	29.7	29.6	26.1	35.1	35.0	30.9	41.0	40.9	36.2	54.4	54.2	48.4	70.1	69.8	62.8	88.2	87.9	79.6
	20.0	20.0	16.7	21.9	21.9	18.4	23.9	23.9	20.1	28.3	28.2	23.6	33.0	33.0	27.9	43.9	43.8	37.3	56.5	56.3	48.5	71.2	70.9	61.4
50	23.1	23.1	20.2	25.3	25.3	22.1	27.6	27.6	24.2	32.6	32.6	28.6	38.0	38.0	33.4	50.3	50.2	44.5	64.5	64.4	57.4	80.9	80.7	72.5
	19.3	19.3	16.3	21.2	21.2	17.8	23.1	23.1	19.5	27.3	27.3	23.0	31.8	31.8	26.9	42.0	42.0	35.8	54.0	53.8	46.3	67.6	67.5	58.4
40	21.5	21.5	18.6	23.5	23.5	20.4	25.6	25.6	22.3	30.2	30.2	26.3	35.1	35.1	30.7	46.3	46.2	40.7	59.2	59.1	52.3	73.9	73.8	65.7
	18.8	18.7	15.8	20.5	20.5	17.4	22.4	22.4	18.9	26.4	26.4	22.4	30.7	30.7	26.1	40.5	40.4	34.6	51.7	51.7	44.5	64.6	64.5	55.8
30	19.6	19.6	16.9	21.4	21.4	18.5	23.3	23.3	20.2	27.5	27.4	23.8	31.9	31.9	27.7	41.9	41.9	36.6	53.4	53.4	46.8	66.5	66.4	58.5
	18.1	18.1	15.4	19.8	19.8	16.8	21.5	21.5	18.4	25.3	25.3	21.6	29.5	29.5	25.2	38.7	38.7	33.2	49.3	49.3	42.5	61.4	61.3	53.1
20	17.5	17.5	15.1	19.2	19.2	16.6	20.9	20.9	18.1	24.5	24.5	21.2	28.5	28.5	24.7	37.3	37.3	32.4	47.4	47.4	41.3	58.8	58.8	51.4
	17.2	17.2	14.8	18.8	18.8	16.2	20.5	20.5	17.7	24.1	24.1	20.8	28.0	28.0	24.2	36.7	36.7	31.7	46.6	46.6	40.4	57.8	57.7	50.3
15	16.7	16.7	14.5	18.2	18.2	15.8	19.9	19.9	17.3	23.3	23.3	20.3	27.1	27.1	23.6	35.4	35.4	30.9	44.9	44.9	39.3	55.6	55.6	48.7
	16.7	16.7	14.5	18.2	18.2	15.8	19.9	19.9	17.3	23.3	23.3	20.3	27.1	27.1	23.6	35.4	35.4	30.9	44.9	44.9	39.3	55.6	55.6	48.7

Table 27.6-1
MWFRS – Part 2: Wind Loads – Walls
Exposure C

V(mph)	110			115			120			130			140			160			180			200		
h(ft.), L/B	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2
160	49.2	48.7	43.7	54.5	53.8	48.3	60.0	59.3	53.3	72.2	71.1	64.1	85.8	84.3	76.1	117.4	115.0	103.9	155.4	151.8	137.2	200.2	195.0	176.2
	36.1	35.7	30.0	40.0	39.5	33.2	44.1	43.5	36.6	53.0	52.2	44.0	62.9	61.9	52.3	86.2	84.4	71.5	114.1	111.4	94.3	146.9	143.1	121.1
150	48.0	47.5	42.6	53.0	52.4	47.1	58.4	57.7	51.9	70.1	69.2	62.3	83.3	82.0	74.0	113.8	111.7	101.0	150.6	147.3	133.3	193.8	189.0	171.0
	35.5	35.2	29.6	39.3	38.8	32.7	43.3	42.8	36.1	52.0	51.3	43.3	61.7	60.7	51.4	84.3	82.8	70.2	111.5	109.1	92.7	143.5	140.0	118.9
140	46.6	46.2	41.4	51.5	51.0	45.8	56.7	56.1	50.4	68.1	67.2	60.6	80.7	79.6	71.8	110.2	108.3	98.0	145.6	142.6	129.2	187.2	182.9	165.7
	34.9	34.6	29.1	38.6	38.2	32.2	42.4	42.0	35.5	50.9	50.3	42.6	60.4	59.5	50.6	82.4	81.0	68.9	108.9	106.7	90.9	140.0	136.8	116.6
130	45.3	45.0	40.2	50.0	49.6	44.5	55.0	54.5	48.9	65.9	65.2	58.7	78.1	77.1	69.6	106.4	104.7	94.8	140.4	137.7	124.9	180.4	176.5	160.1
	34.3	34.0	28.7	37.8	37.5	31.7	41.6	41.2	34.9	49.9	49.3	41.9	59.1	58.3	49.6	80.5	79.2	67.6	106.2	104.1	89.1	136.4	133.4	114.2
120	43.9	43.6	39.0	48.5	48.1	43.1	53.3	52.8	47.4	63.8	63.1	56.8	75.4	74.6	67.3	102.6	101.1	91.5	135.1	132.7	120.5	173.3	169.8	154.3
	33.6	33.4	28.2	37.1	36.8	31.1	40.7	40.4	34.3	48.8	48.3	41.1	57.7	57.1	48.7	78.5	77.3	66.2	103.3	101.5	87.1	132.6	129.9	111.6
110	42.5	42.3	37.7	46.9	46.6	41.6	51.5	51.1	45.8	61.5	61.0	54.8	72.7	72.0	64.8	98.6	97.3	88.1	129.6	127.6	115.8	166.0	163.0	148.2
	32.9	32.8	27.7	36.3	36.1	30.6	39.9	39.6	33.6	47.7	47.3	40.3	56.3	55.8	47.6	76.4	75.4	64.7	100.4	98.8	85.1	128.6	126.3	108.9
100	41.1	40.9	36.4	45.2	45.0	40.1	49.6	49.3	44.1	59.2	58.8	52.7	69.8	69.3	62.3	94.5	93.5	84.5	123.9	122.2	111.0	158.5	155.9	141.9
	32.3	32.1	27.2	35.5	35.4	30.0	39.0	38.8	33.0	46.5	46.2	39.4	54.9	54.4	46.6	74.2	73.4	63.2	97.4	96.0	82.9	124.5	122.5	106.1
90	39.6	39.4	35.0	43.5	43.3	38.5	47.7	47.5	42.3	56.8	56.5	50.6	66.9	66.5	59.7	90.3	89.4	80.8	118.1	116.7	105.9	150.6	148.5	135.2
	31.6	31.5	26.6	34.7	34.6	29.4	38.1	37.9	32.3	45.4	45.1	38.5	53.4	53.1	45.5	72.1	71.4	61.6	94.2	93.2	80.7	120.3	118.6	103.0
80	38.0	37.9	33.5	41.8	41.6	36.9	45.8	45.6	40.5	54.4	54.2	48.3	63.9	63.6	56.9	85.9	85.3	76.8	112.0	111.0	100.5	142.6	140.9	128.1
	30.9	30.8	26.1	33.9	33.8	28.7	37.2	37.1	31.5	44.2	44.0	37.6	52.0	51.7	44.3	69.8	69.3	59.8	91.0	90.2	78.3	115.8	114.5	99.8
70	36.4	36.3	32.0	39.9	39.9	35.2	43.7	43.6	38.6	51.9	51.7	45.9	60.8	60.6	54.0	81.4	81.0	72.7	105.8	105.0	94.9	134.2	133.0	120.7
	30.2	30.1	25.5	33.1	33.1	28.1	36.3	36.2	30.8	43.0	42.9	36.6	50.5	50.3	43.1	67.5	67.2	58.0	87.8	87.1	75.7	111.3	110.3	96.3
60	34.6	34.6	30.3	38.0	38.0	33.3	41.6	41.5	36.5	49.2	49.1	43.4	57.6	57.4	50.9	76.8	76.5	68.3	99.4	98.8	88.9	125.6	124.7	112.8
	29.4	29.4	24.9	32.3	32.2	27.4	35.3	35.2	30.0	41.8	41.7	35.6	48.9	48.8	41.9	65.2	65.0	56.1	84.4	83.9	73.0	106.7	105.9	92.7
50	32.8	32.8	28.6	36.0	35.9	31.4	39.3	39.2	34.3	46.4	46.3	40.7	54.2	54.1	47.7	72.0	71.8	63.7	92.7	92.4	82.5	116.7	116.1	104.4
	28.7	28.6	24.3	31.4	31.4	26.7	34.3	34.3	29.2	40.5	40.5	34.6	47.4	47.3	40.5	62.9	62.7	54.2	81.0	80.7	70.2	101.9	101.4	88.8
40	30.8	30.8	26.7	33.7	33.7	29.3	36.8	36.8	32.0	43.4	43.4	37.8	50.6	50.5	44.2	66.9	66.8	58.8	85.8	85.6	75.8	107.4	107.1	95.5
	27.8	27.8	23.6	30.5	30.5	25.9	33.3	33.2	28.3	39.2	39.2	33.5	45.7	45.7	39.2	60.4	60.3	52.1	77.5	77.3	67.2	97.1	96.8	84.6
30	28.5	28.5	24.6	31.2	31.2	27.0	34.1	34.1	29.5	40.1	40.1	34.8	46.7	46.6	40.5	61.4	61.4	53.6	78.4	78.3	68.8	97.8	97.6	86.1
	26.9	26.9	22.9	29.4	29.4	25.1	32.1	32.1	27.4	37.8	37.8	32.4	44.0	43.9	37.7	57.9	57.8	49.9	73.9	73.8	64.0	92.1	91.9	80.2
20	26.2	26.2	22.6	28.6	28.6	24.7	31.2	31.2	26.9	36.7	36.7	31.7	42.6	42.6	36.9	55.9	55.9	48.5	71.1	71.1	61.9	88.2	88.2	77.0
	25.8	25.8	22.2	28.3	28.3	24.3	30.8	30.8	26.5	36.2	36.2	31.2	42.1	42.1	36.3	55.2	55.1	47.7	70.1	70.1	60.9	87.1	87.0	75.8
15	25.2	25.2	21.8	27.6	27.6	23.8	30.0	30.0	26.0	35.3	35.3	30.6	41.0	41.0	35.5	53.7	53.7	46.6	68.1	68.1	59.3	84.4	84.4	73.6
	25.2	25.2	21.8	27.6	27.6	23.8	30.0	30.0	26.0	35.3	35.3	30.6	41.0	41.0	35.5	53.7	53.7	46.6	68.1	68.1	59.3	84.4	84.4	73.6

Table 27.6-1
MWFRS – Part 2: Wind Loads – Walls
Exposure D

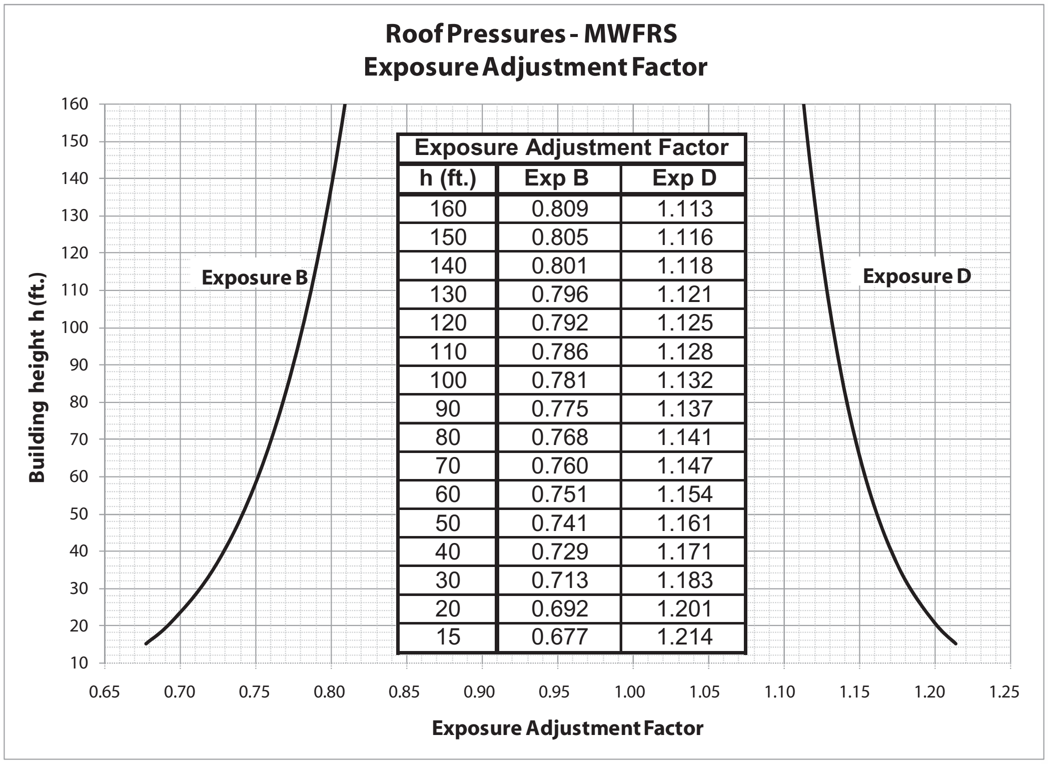
V(mph)	110			115			120			130			140			160			180			200		
h(ft.), L/B	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2
160	55.7	55.1	49.1	61.6	60.8	54.3	67.9	67.0	59.7	81.5	80.3	71.7	96.7	95.0	85.0	131.9	129.2	115.6	173.9	169.9	152.0	223.0	217.5	194.4
	42.9	42.4	35.7	47.4	46.8	39.5	52.2	51.5	43.5	62.7	61.7	52.2	74.4	73.1	61.9	101.4	99.4	84.2	133.7	130.7	110.7	171.5	167.2	141.6
150	54.5	53.9	48.0	60.2	59.5	53.0	66.3	65.4	58.4	79.5	78.4	70.0	94.3	92.8	83.0	128.5	126.0	112.8	169.3	165.6	148.3	217.0	211.8	189.6
	42.2	41.8	35.3	46.7	46.1	39.0	51.4	50.7	43.0	61.6	60.8	51.5	73.1	71.9	61.0	99.6	97.7	83.0	131.2	128.3	109.1	168.2	164.2	139.4
140	53.2	52.7	46.9	58.7	58.1	51.8	64.6	63.9	57.0	77.5	76.5	68.3	91.8	90.4	80.9	124.9	122.7	109.9	164.5	161.1	144.4	210.7	205.9	184.5
	41.6	41.2	34.8	45.9	45.4	38.5	50.5	49.9	42.4	60.6	59.8	50.8	71.7	70.7	60.1	97.7	95.9	81.7	128.6	125.9	107.3	164.7	160.9	137.2
130	51.8	51.4	45.7	57.2	56.7	50.5	62.9	62.3	55.5	75.4	74.5	66.5	89.2	88.0	78.7	121.2	119.2	106.9	159.5	156.4	140.3	204.2	199.7	179.2
	40.9	40.5	34.4	45.1	44.7	38.0	49.7	49.1	41.8	59.5	58.8	50.0	70.4	69.4	59.2	95.7	94.1	80.4	125.8	123.4	105.5	161.1	157.6	134.7
120	50.4	50.1	44.5	55.7	55.2	49.1	61.2	60.6	54.0	73.2	72.4	64.7	86.5	85.5	76.5	117.4	115.6	103.7	154.2	151.5	136.1	197.3	193.3	173.7
	40.2	39.9	33.9	44.4	44.0	37.4	48.8	48.3	41.1	58.3	57.7	49.2	69.0	68.1	58.2	93.6	92.2	78.9	122.9	120.7	103.5	157.3	154.0	132.2
110	49.0	48.7	43.2	54.0	53.6	47.7	59.4	58.9	52.4	70.9	70.2	62.7	83.8	82.8	74.1	113.4	111.9	100.4	148.8	146.3	131.6	190.2	186.5	167.9
	39.5	39.2	33.3	43.5	43.2	36.8	47.8	47.5	40.4	57.2	56.6	48.4	67.5	66.8	57.2	91.4	90.2	77.4	119.9	117.9	101.5	153.2	150.3	129.5
100	47.5	47.3	41.9	52.4	52.0	46.2	57.5	57.1	50.8	68.6	68.0	60.7	80.9	80.1	71.6	109.3	108.0	96.9	143.1	141.0	126.8	182.7	179.5	161.7
	38.8	38.6	32.8	42.7	42.5	36.2	46.9	46.6	39.7	55.9	55.5	47.5	66.0	65.4	56.1	89.2	88.1	75.9	116.8	115.0	99.3	149.0	146.4	126.6
90	46.0	45.8	40.5	50.6	50.4	44.6	55.5	55.2	49.0	66.2	65.7	58.5	77.9	77.3	69.0	105.0	103.9	93.2	137.2	135.4	121.8	174.8	172.1	155.2
	38.0	37.9	32.2	41.9	41.7	35.5	45.9	45.7	39.0	54.7	54.3	46.6	64.4	63.9	54.9	86.8	85.9	74.2	113.5	112.0	97.0	144.6	142.3	123.5
80	44.4	44.2	39.0	48.8	48.6	43.0	53.5	53.3	47.2	63.6	63.3	56.2	74.8	74.3	66.2	100.6	99.7	89.3	131.0	129.6	116.5	166.6	164.4	148.2
	37.3	37.1	31.6	41.0	40.8	34.8	44.9	44.7	38.2	53.4	53.1	45.6	62.8	62.4	53.7	84.4	83.7	72.4	110.0	108.8	94.5	139.9	138.0	120.2
70	42.7	42.6	37.4	46.9	46.8	41.2	51.4	51.2	45.2	61.0	60.7	53.8	71.6	71.2	63.3	95.9	95.2	85.1	124.6	123.5	110.9	158.0	156.3	140.8
	36.5	36.4	31.0	40.1	40.0	34.1	43.9	43.8	37.4	52.1	51.9	44.5	61.2	60.9	52.4	81.9	81.4	70.5	106.5	105.5	91.8	135.0	133.5	116.6
60	40.9	40.9	35.8	44.9	44.8	39.3	49.2	49.0	43.1	58.2	58.1	51.2	68.2	68.0	60.1	91.0	90.6	80.6	117.9	117.1	104.8	149.0	147.7	132.8
	35.7	35.6	30.3	39.2	39.1	33.4	42.9	42.8	36.6	50.8	50.6	43.4	59.5	59.3	51.0	79.4	79.0	68.4	102.8	102.1	88.9	129.9	128.8	112.7
50	39.0	39.0	34.0	42.8	42.7	37.3	46.8	46.7	40.8	55.3	55.2	48.4	64.7	64.5	56.8	85.9	85.6	75.9	110.8	110.3	98.3	139.5	138.7	124.2
	34.9	34.8	29.7	38.2	38.2	32.6	41.8	41.7	35.7	49.4	49.3	42.3	57.7	57.6	49.6	76.7	76.5	66.2	99.0	98.5	85.8	124.6	123.8	108.5
40	37.0	36.9	32.0	40.5	40.5	35.1	44.2	44.2	38.4	52.2	52.1	45.4	60.9	60.8	53.1	80.5	80.4	70.7	103.4	103.1	91.2	129.6	129.1	114.9
	34.0	33.9	28.9	37.2	37.2	31.7	40.6	40.6	34.7	47.9	47.9	41.1	55.9	55.8	48.0	74.0	73.8	63.9	95.0	94.7	82.5	119.1	118.7	103.9
30	34.7	34.6	29.9	37.9	37.9	32.7	41.4	41.4	35.7	48.7	48.7	42.2	56.7	56.7	49.2	74.8	74.7	65.2	95.5	95.4	83.7	119.2	119.0	104.9
	33.0	33.0	28.2	36.1	36.1	30.9	39.4	39.4	33.7	46.4	46.3	39.8	54.0	54.0	46.4	71.1	71.1	61.4	90.9	90.8	78.9	113.5	113.2	98.9
20	32.2	32.1	27.6	35.2	35.2	30.3	38.3	38.3	33.0	45.1	45.1	38.8	52.4	52.4	45.2	68.7	68.7	59.5	87.5	87.4	76.0	108.6	108.5	94.7
	31.8	31.8	27.3	34.8	34.8	29.9	37.9	37.9	32.6	44.6	44.6	38.3	51.8	51.8	44.6	68.0	68.0	58.8	86.5	86.5	75.0	107.5	107.4	93.5
15	31.1	31.1	26.8	34.0	34.0	29.3	37.0	37.0	31.9	43.5	43.5	37.5	50.5	50.5	43.6	66.2	66.1	57.3	84.0	84.0	73.0	104.1	104.1	90.7
	31.1	31.1	26.8	34.0	34.0	29.3	37.0	37.0	31.9	43.5	43.5	37.5	50.5	50.5	43.6	66.2	66.1	57.3	84.0	84.0	73.0	104.1	104.1	90.7

Main Wind Force Resisting System – Part 2		h ≤ 160 ft. Application of Roof Pressures
Table 27.6-2	Wind Pressures - Roof	
Enclosed Simple Diaphragm Buildings		

Notes to Roof Pressure Table 27.6-2:

1. From table for Exposure C, V, h and roof slope, determine roof pressure p_h for each roof zone shown in the figures for the applicable roof form. For other exposures B or D, multiply pressures from table by appropriate exposure adjustment factor as determined from figure below.
2. Where two load cases are shown, both load cases shall be investigated. Load case 2 is required to investigate maximum overturning on the building from roof pressures shown.
3. Apply along-wind net wall pressures to the projected area of the building walls in the direction of the wind and apply exterior side wall pressures to the projected area of the building walls normal to the direction of the wind acting outward, simultaneously with the roof pressures from Table 27.6-2.
4. Where a value of zero is shown in the tables for the flat roof case, it is provided for the purpose of interpolation.
5. Interpolation between V, h and roof slope is permitted.

LIVE GRAPH
Click here to view



Exposure Adjustment Factor		
h (ft.)	Exp B	Exp D
160	0.809	1.113
150	0.805	1.116
140	0.801	1.118
130	0.796	1.121
120	0.792	1.125
110	0.786	1.128
100	0.781	1.132
90	0.775	1.137
80	0.768	1.141
70	0.760	1.147
60	0.751	1.154
50	0.741	1.161
40	0.729	1.171
30	0.713	1.183
20	0.692	1.201
15	0.677	1.214

Main Wind Force Resisting System – Part 2		h ≤ 160 ft.
Table 27.6-2	Wind Pressures - Roof	Application of Roof Pressures
Enclosed Simple Diaphragm Buildings		

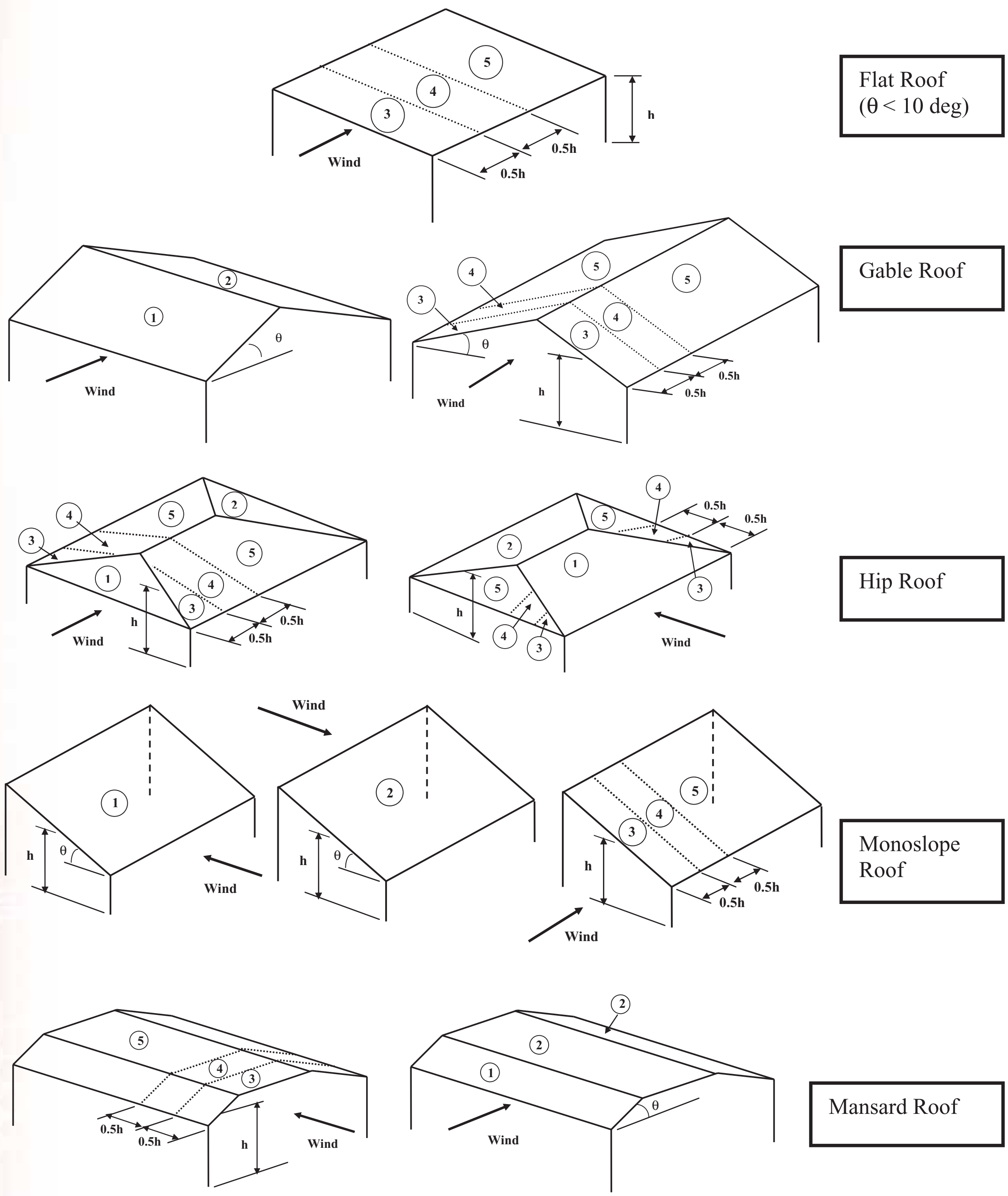


Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 110–120 mph
h = 15–40 ft.

V (MPH)			110					115					120				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
40	Flat < 2:12 (9.46 deg)	1	NA	NA	-29.1	-26.0	-21.3	NA	NA	-31.8	-28.4	-23.3	NA	NA	-34.7	-30.9	-25.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-28.6	-19.4	-29.1	-26.0	-21.3	-31.2	-22.5	-31.8	-28.4	-23.3	-34.0	-23.1	-34.7	-30.9	-25.3
		2	4.1	-5.8	0.0	0.0	0.0	4.5	-6.3	0.0	0.0	0.0	4.9	-6.9	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-23.5	-19.0	-29.1	-26.0	-21.3	-25.7	-20.7	-31.8	-28.4	-23.3	-28.0	-22.6	-34.7	-30.9	-25.3
		2	8.1	-8.3	0.0	0.0	0.0	8.9	-9.1	0.0	0.0	0.0	9.7	-9.9	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-18.8	-19.0	-29.1	-26.0	-21.3	-20.6	-20.7	-31.8	-28.4	-23.3	-22.4	-22.6	-34.7	-30.9	-25.3
		2	10.8	-9.1	0.0	0.0	0.0	11.8	-9.9	0.0	0.0	0.0	12.9	-10.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-15.1	-19.0	-29.1	-26.0	-21.3	-16.5	-20.7	-31.8	-28.4	-23.3	-18.0	-22.6	-34.7	-30.9	-25.3
		2	12.0	-9.1	0.0	0.0	0.0	13.1	-9.9	0.0	0.0	0.0	14.2	-10.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-8.8	-19.0	-29.1	-26.0	-21.3	-9.6	-20.7	-31.8	-28.4	-23.3	-10.4	-22.6	-34.7	-30.9	-25.3
		2	14.3	-9.1	0.0	0.0	0.0	15.6	-9.9	0.0	0.0	0.0	17.0	-10.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-4.9	-19.0	-29.1	-26.0	-21.3	-5.4	-20.7	-31.8	-28.4	-23.3	-5.9	-22.6	-34.7	-30.9	-25.3
		2	14.3	-9.1	0.0	0.0	0.0	15.6	-9.9	0.0	0.0	0.0	17.0	-10.8	0.0	0.0	0.0
30	Flat < 2:12 (9.46 deg)	1	NA	NA	-27.4	-24.4	-20.0	NA	NA	-30.0	-26.7	-21.9	NA	NA	-32.6	-29.1	-23.9
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-26.9	-18.3	-27.4	-24.4	-20.0	-29.4	-21.2	-30.0	-26.7	-21.9	-32.0	-21.8	-32.6	-29.1	-23.9
		2	3.9	-5.5	0.0	0.0	0.0	4.2	-6.0	0.0	0.0	0.0	4.6	-6.5	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-22.1	-17.8	-27.4	-24.4	-20.0	-24.2	-19.5	-30.0	-26.7	-21.9	-26.3	-21.2	-32.6	-29.1	-23.9
		2	7.7	-7.8	0.0	0.0	0.0	8.4	-8.6	0.0	0.0	0.0	9.1	-9.3	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-17.7	-17.8	-27.4	-24.4	-20.0	-19.4	-19.5	-30.0	-26.7	-21.9	-21.1	-21.2	-32.6	-29.1	-23.9
		2	10.2	-8.5	0.0	0.0	0.0	11.1	-9.3	0.0	0.0	0.0	12.1	-10.2	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-14.3	-17.8	-27.4	-24.4	-20.0	-15.6	-19.5	-30.0	-26.7	-21.9	-17.0	-21.2	-32.6	-29.1	-23.9
		2	11.3	-8.5	0.0	0.0	0.0	12.3	-9.3	0.0	0.0	0.0	13.4	-10.2	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-8.3	-17.8	-27.4	-24.4	-20.0	-9.0	-19.5	-30.0	-26.7	-21.9	-9.8	-21.2	-32.6	-29.1	-23.9
		2	13.4	-8.5	0.0	0.0	0.0	14.7	-9.3	0.0	0.0	0.0	16.0	-10.2	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-4.7	-17.8	-27.4	-24.4	-20.0	-5.1	-19.5	-30.0	-26.7	-21.9	-5.5	-21.2	-32.6	-29.1	-23.9
		2	13.4	-8.5	0.0	0.0	0.0	14.7	-9.3	0.0	0.0	0.0	16.0	-10.2	0.0	0.0	0.0
20	Flat < 2:12 (9.46 deg)	1	NA	NA	-25.2	-22.4	-18.4	NA	NA	-27.5	-24.5	-20.1	NA	NA	-30.0	-26.7	-21.9
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-24.7	-16.8	-25.2	-22.4	-18.4	-27.0	-19.4	-27.5	-24.5	-20.1	-29.4	-20.0	-30.0	-26.7	-21.9
		2	3.6	-5.0	0.0	0.0	0.0	3.9	-5.5	0.0	0.0	0.0	4.2	-6.0	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-20.3	-16.4	-25.2	-22.4	-18.4	-22.2	-17.9	-27.5	-24.5	-20.1	-24.2	-19.5	-30.0	-26.7	-21.9
		2	7.0	-7.2	0.0	0.0	0.0	7.7	-7.9	0.0	0.0	0.0	8.4	-8.6	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-16.3	-16.4	-25.2	-22.4	-18.4	-17.8	-17.9	-27.5	-24.5	-20.1	-19.4	-19.5	-30.0	-26.7	-21.9
		2	9.4	-7.8	0.0	0.0	0.0	10.2	-8.6	0.0	0.0	0.0	11.1	-9.3	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-13.1	-16.4	-25.2	-22.4	-18.4	-14.3	-17.9	-27.5	-24.5	-20.1	-15.6	-19.5	-30.0	-26.7	-21.9
		2	10.3	-7.8	0.0	0.0	0.0	11.3	-8.6	0.0	0.0	0.0	12.3	-9.3	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-7.6	-16.4	-25.2	-22.4	-18.4	-8.3	-17.9	-27.5	-24.5	-20.1	-9.0	-19.5	-30.0	-26.7	-21.9
		2	12.3	-7.8	0.0	0.0	0.0	13.5	-8.6	0.0	0.0	0.0	14.7	-9.3	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-4.3	-16.4	-25.2	-22.4	-18.4	-4.7	-17.9	-27.5	-24.5	-20.1	-5.1	-19.5	-30.0	-26.7	-21.9
		2	12.3	-7.8	0.0	0.0	0.0	13.5	-8.6	0.0	0.0	0.0	14.7	-9.3	0.0	0.0	0.0
15	Flat < 2:12 (9.46 deg)	1	NA	NA	-23.7	-21.1	-17.3	NA	NA	-25.9	-23.1	-18.9	NA	NA	-28.2	-25.1	-20.6
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-23.2	-15.8	-23.7	-21.1	-17.3	-25.4	-18.3	-25.9	-23.1	-18.9	-27.7	-18.8	-28.2	-25.1	-20.6
		2	3.4	-4.7	0.0	0.0	0.0	3.7	-5.2	0.0	0.0	0.0	4.0	-5.6	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-19.1	-15.4	-23.7	-21.1	-17.3	-20.9	-16.9	-25.9	-23.1	-18.9	-22.7	-18.4	-28.2	-25.1	-20.6
		2	6.6	-6.8	0.0	0.0	0.0	7.2	-7.4	0.0	0.0	0.0	7.9	-8.1	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-15.3	-15.4	-23.7	-21.1	-17.3	-16.8	-16.9	-25.9	-23.1	-18.9	-18.2	-18.4	-28.2	-25.1	-20.6
		2	8.8	-7.4	0.0	0.0	0.0	9.6	-8.1	0.0	0.0	0.0	10.5	-8.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-12.3	-15.4	-23.7	-21.1	-17.3	-13.5	-16.9	-25.9	-23.1	-18.9	-14.7	-18.4	-28.2	-25.1	-20.6
		2	9.7	-7.4	0.0	0.0	0.0	10.6	-8.1	0.0	0.0	0.0	11.6	-8.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-7.1	-15.4	-23.7	-21.1	-17.3	-7.8	-16.9	-25.9	-23.1	-18.9	-8.5	-18.4	-28.2	-25.1	-20.6
		2	11.6	-7.4	0.0	0.0	0.0	12.7	-8.1	0.0	0.0	0.0	13.8	-8.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-4.0	-15.4	-23.7	-21.1	-17.3	-4.4	-16.9	-25.9	-23.1	-18.9	-4.8	-18.4	-28.2	-25.1	-20.6
		2	11.6	-7.4	0.0	0.0	0.0	12.7	-8.1	0.0	0.0	0.0	13.8	-8.8	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 130–150 mph
h = 15–40 ft.

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
40	Flat < 2:12 (9.46 deg)	1	NA	NA	-40.7	-36.3	-29.7	NA	NA	-47.2	-42.1	-34.5	NA	NA	-54.2	-48.3	-39.6
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-39.9	-27.1	-40.7	-36.3	-29.7	-46.3	-31.5	-47.2	-42.1	-34.5	-53.1	-36.1	-54.2	-48.3	-39.6
		2	5.8	-8.1	0.0	0.0	0.0	6.7	-9.4	0.0	0.0	0.0	7.7	-10.8	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-32.8	-26.5	-40.7	-36.3	-29.7	-38.1	-30.7	-47.2	-42.1	-34.5	-43.7	-35.3	-54.2	-48.3	-39.6
		2	11.4	-11.6	0.0	0.0	0.0	13.2	-13.5	0.0	0.0	0.0	15.1	-15.5	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-26.3	-26.5	-40.7	-36.3	-29.7	-30.5	-30.7	-47.2	-42.1	-34.5	-35.1	-35.3	-54.2	-48.3	-39.6
		2	15.1	-12.7	0.0	0.0	0.0	17.5	-14.7	0.0	0.0	0.0	20.1	-16.9	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-21.1	-26.5	-40.7	-36.3	-29.7	-24.5	-30.7	-47.2	-42.1	-34.5	-28.2	-35.3	-54.2	-48.3	-39.6
		2	16.7	-12.7	0.0	0.0	0.0	19.4	-14.7	0.0	0.0	0.0	22.2	-16.9	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-12.2	-26.5	-40.7	-36.3	-29.7	-14.2	-30.7	-47.2	-42.1	-34.5	-16.3	-35.3	-54.2	-48.3	-39.6
		2	20.0	-12.7	0.0	0.0	0.0	23.1	-14.7	0.0	0.0	0.0	8.5	-16.9	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.9	-26.5	-40.7	-36.3	-29.7	-8.0	-30.7	-47.2	-42.1	-34.5	-9.2	-35.3	-54.2	-48.3	-39.6
		2	20.0	-12.7	0.0	0.0	0.0	23.1	-14.7	0.0	0.0	0.0	26.6	-16.9	0.0	0.0	0.0
30	Flat < 2:12 (9.46 deg)	1	NA	NA	-38.3	-34.1	-28.0	NA	NA	-44.4	-39.6	-32.5	NA	NA	-51.0	-45.4	-37.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-37.6	-25.5	-38.3	-34.1	-28.0	-43.6	-29.6	-44.4	-39.6	-32.5	-50.0	-34.0	-51.0	-45.4	-37.3
		2	5.4	-7.6	0.0	0.0	0.0	6.3	-8.8	0.0	0.0	0.0	7.2	-10.1	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-30.9	-24.9	-38.3	-34.1	-28.0	-35.8	-28.9	-44.4	-39.6	-32.5	-41.1	-33.2	-51.0	-45.4	-37.3
		2	10.7	-10.9	0.0	0.0	0.0	12.4	-12.7	0.0	0.0	0.0	14.2	-14.6	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-24.8	-24.9	-38.3	-34.1	-28.0	-28.7	-28.9	-44.4	-39.6	-32.5	-33.0	-33.2	-51.0	-45.4	-37.3
		2	14.2	-11.9	0.0	0.0	0.0	16.5	-13.8	0.0	0.0	0.0	18.9	-15.9	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-19.9	-24.9	-38.3	-34.1	-28.0	-23.1	-28.9	-44.4	-39.6	-32.5	-26.5	-33.2	-51.0	-45.4	-37.3
		2	15.7	-11.9	0.0	0.0	0.0	18.2	-13.8	0.0	0.0	0.0	20.9	-15.9	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-11.5	-24.9	-38.3	-34.1	-28.0	-13.4	-28.9	-44.4	-39.6	-32.5	-15.3	-33.2	-51.0	-45.4	-37.3
		2	18.8	-11.9	0.0	0.0	0.0	21.8	-13.8	0.0	0.0	0.0	8.0	-15.9	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.5	-24.9	-38.3	-34.1	-28.0	-7.5	-28.9	-44.4	-39.6	-32.5	-8.7	-33.2	-51.0	-45.4	-37.3
		2	18.8	-11.9	0.0	0.0	0.0	21.8	-13.8	0.0	0.0	0.0	25.0	-15.9	0.0	0.0	0.0
20	Flat < 2:12 (9.46 deg)	1	NA	NA	-35.2	-31.3	-25.7	NA	NA	-40.8	-36.3	-29.8	NA	NA	-46.8	-41.7	-34.2
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-34.5	-23.4	-35.2	-31.3	-25.7	-40.0	-27.2	-40.8	-36.3	-29.8	-45.9	-31.2	-46.8	-41.7	-34.2
		2	5.0	-7.0	0.0	0.0	0.0	5.8	-8.1	0.0	0.0	0.0	6.6	-9.3	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-28.4	-22.9	-35.2	-31.3	-25.7	-32.9	-26.5	-40.8	-36.3	-29.8	-37.8	-30.5	-46.8	-41.7	-34.2
		2	9.8	-10.0	0.0	0.0	0.0	11.4	-11.7	0.0	0.0	0.0	13.1	-13.4	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-22.8	-22.9	-35.2	-31.3	-25.7	-26.4	-26.5	-40.8	-36.3	-29.8	-30.3	-30.5	-46.8	-41.7	-34.2
		2	13.1	-10.9	0.0	0.0	0.0	15.2	-12.7	0.0	0.0	0.0	17.4	-14.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-18.3	-22.9	-35.2	-31.3	-25.7	-21.2	-26.5	-40.8	-36.3	-29.8	-24.3	-30.5	-46.8	-41.7	-34.2
		2	14.4	-10.9	0.0	0.0	0.0	16.7	-12.7	0.0	0.0	0.0	19.2	-14.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-10.6	-22.9	-35.2	-31.3	-25.7	-12.3	-26.5	-40.8	-36.3	-29.8	-14.1	-30.5	-46.8	-41.7	-34.2
		2	17.2	-10.9	0.0	0.0	0.0	20.0	-12.7	0.0	0.0	0.0	7.4	-14.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.0	-22.9	-35.2	-31.3	-25.7	-6.9	-26.5	-40.8	-36.3	-29.8	-7.9	-30.5	-46.8	-41.7	-34.2
		2	17.2	-10.9	0.0	0.0	0.0	20.0	-12.7	0.0	0.0	0.0	23.0	-14.6	0.0	0.0	0.0
15	Flat < 2:12 (9.46 deg)	1	NA	NA	-33.1	-29.5	-24.2	NA	NA	-38.4	-34.2	-28.1	NA	NA	-44.1	-39.3	-32.2
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-32.5	-22.1	-33.1	-29.5	-24.2	-37.7	-25.6	-38.4	-34.2	-28.1	-43.2	-29.4	-44.1	-39.3	-32.2
		2	4.7	-6.6	0.0	0.0	0.0	5.4	-7.6	0.0	0.0	0.0	6.2	-8.8	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-26.7	-21.5	-33.1	-29.5	-24.2	-31.0	-25.0	-38.4	-34.2	-28.1	-35.5	-28.7	-44.1	-39.3	-32.2
		2	9.2	-9.5	0.0	0.0	0.0	10.7	-11.0	0.0	0.0	0.0	12.3	-12.6	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-21.4	-21.5	-33.1	-29.5	-24.2	-24.8	-25.0	-38.4	-34.2	-28.1	-28.5	-28.7	-44.1	-39.3	-32.2
		2	12.3	-10.3	0.0	0.0	0.0	14.3	-11.9	0.0	0.0	0.0	16.4	-13.7	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-17.2	-21.5	-33.1	-29.5	-24.2	-19.9	-25.0	-38.4	-34.2	-28.1	-22.9	-28.7	-44.1	-39.3	-32.2
		2	13.6	-10.3	0.0	0.0	0.0	15.7	-11.9	0.0	0.0	0.0	18.1	-13.7	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-10.0	-21.5	-33.1	-29.5	-24.2	-11.5	-25.0	-38.4	-34.2	-28.1	-13.3	-28.7	-44.1	-39.3	-32.2
		2	16.2	-10.3	0.0	0.0	0.0	18.8	-11.9	0.0	0.0	0.0	6.9	-13.7	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-5.6	-21.5	-33.1	-29.5	-24.2	-6.5	-25.0	-38.4	-34.2	-28.1	-7.5	-28.7	-44.1	-39.3	-32.2
		2	16.2	-10.3	0.0	0.0	0.0	18.8	-11.9	0.0	0.0	0.0	21.6	-13.7	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 160–200 mph
h = 15–40 ft.

V (MPH)			160					180					200				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat < 2:12 (9.46 deg)	1	NA	NA	-61.6	-54.9	-45.1	NA	NA	-78.0	-69.5	-57.0	NA	NA	-96.3	-85.8	-70.4
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-60.5	-43.5	-61.6	-54.9	-45.1	-76.5	-52.0	-78.0	-69.5	-57.0	-94.5	-64.2	-96.3	-85.8	-70.4
		2	8.7	-12.3	0.0	0.0	0.0	11.0	-15.5	0.0	0.0	0.0	13.6	-19.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-49.7	-40.1	-61.6	-54.9	-45.1	-62.9	-50.8	-78.0	-69.5	-57.0	-77.7	-62.7	-96.3	-85.8	-70.4
		2	17.2	-17.6	0.0	0.0	0.0	21.8	-22.3	0.0	0.0	0.0	26.9	-27.5	0.0	0.0	0.0
40	5:12 (22.6 deg)	1	-39.9	-40.1	-61.6	-54.9	-45.1	-50.5	-50.8	-78.0	-69.5	-57.0	-62.3	-62.7	-96.3	-85.8	-70.4
		2	22.9	-19.2	0.0	0.0	0.0	29.0	-24.3	0.0	0.0	0.0	35.8	-30.0	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-32.0	-40.1	-61.6	-54.9	-45.1	-40.5	-50.8	-78.0	-69.5	-57.0	-50.0	-62.7	-96.3	-85.8	-70.4
		2	25.3	-19.2	0.0	0.0	0.0	32.0	-24.3	0.0	0.0	0.0	39.5	-30.0	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-18.5	-40.1	-61.6	-54.9	-45.1	-23.5	-50.8	-78.0	-69.5	-57.0	-29.0	-62.7	-96.3	-85.8	-70.4
		2	30.2	-19.2	0.0	0.0	0.0	38.3	-24.3	0.0	0.0	0.0	47.2	-30.0	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-10.5	-40.1	-61.6	-54.9	-45.1	-13.2	-50.8	-78.0	-69.5	-57.0	-16.3	-62.7	-96.3	-85.8	-70.4
		2	30.2	-19.2	0.0	0.0	0.0	38.3	-24.3	0.0	0.0	0.0	47.2	-30.0	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-58.0	-51.7	-42.4	NA	NA	-73.4	-65.4	-53.7	NA	NA	-90.6	-80.8	-66.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-56.9	-41.0	-58.0	-51.7	-42.4	-72.0	-49.0	-73.4	-65.4	-53.7	-88.9	-60.4	-90.6	-80.8	-66.3
		2	8.2	-11.5	0.0	0.0	0.0	10.4	-14.6	0.0	0.0	0.0	12.8	-18.0	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-46.8	-37.8	-58.0	-51.7	-42.4	-59.2	-47.8	-73.4	-65.4	-53.7	-73.1	-59.0	-90.6	-80.8	-66.3
		2	16.2	-16.6	0.0	0.0	0.0	20.5	-21.0	0.0	0.0	0.0	25.3	-25.9	0.0	0.0	0.0
30	5:12 (22.6 deg)	1	-37.5	-37.8	-58.0	-51.7	-42.4	-47.5	-47.8	-73.4	-65.4	-53.7	-58.6	-59.0	-90.6	-80.8	-66.3
		2	21.6	-18.1	0.0	0.0	0.0	27.3	-22.9	0.0	0.0	0.0	33.7	-28.2	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-30.1	-37.8	-58.0	-51.7	-42.4	-38.2	-47.8	-73.4	-65.4	-53.7	-47.1	-59.0	-90.6	-80.8	-66.3
		2	23.8	-18.1	0.0	0.0	0.0	30.1	-22.9	0.0	0.0	0.0	37.2	-28.2	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-17.5	-37.8	-58.0	-51.7	-42.4	-22.1	-47.8	-73.4	-65.4	-53.7	-27.3	-59.0	-90.6	-80.8	-66.3
		2	28.5	-18.1	0.0	0.0	0.0	36.0	-22.9	0.0	0.0	0.0	44.5	-28.2	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-9.8	-37.8	-58.0	-51.7	-42.4	-12.5	-47.8	-73.4	-65.4	-53.7	-15.4	-59.0	-90.6	-80.8	-66.3
		2	28.5	-18.1	0.0	0.0	0.0	36.0	-22.9	0.0	0.0	0.0	44.5	-28.2	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-53.3	-47.5	-38.9	NA	NA	-67.4	-60.1	-49.3	NA	NA	-83.2	-74.2	-60.8
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-52.2	-37.6	-53.3	-47.5	-38.9	-66.1	-45.0	-67.4	-60.1	-49.3	-81.6	-55.5	-83.2	-74.2	-60.8
		2	7.5	-10.6	0.0	0.0	0.0	9.5	-13.4	0.0	0.0	0.0	11.8	-16.6	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-43.0	-34.7	-53.3	-47.5	-38.9	-54.4	-43.9	-67.4	-60.1	-49.3	-67.1	-54.2	-83.2	-74.2	-60.8
		2	14.9	-15.2	0.0	0.0	0.0	18.8	-19.3	0.0	0.0	0.0	23.2	-23.8	0.0	0.0	0.0
20	5:12 (22.6 deg)	1	-34.5	-34.7	-53.3	-47.5	-38.9	-43.6	-43.9	-67.4	-60.1	-49.3	-53.9	-54.2	-83.2	-74.2	-60.8
		2	19.8	-16.6	0.0	0.0	0.0	25.1	-21.0	0.0	0.0	0.0	30.9	-25.9	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-27.7	-34.7	-53.3	-47.5	-38.9	-35.0	-43.9	-67.4	-60.1	-49.3	-43.3	-54.2	-83.2	-74.2	-60.8
		2	21.9	-16.6	0.0	0.0	0.0	27.7	-21.0	0.0	0.0	0.0	34.1	-25.9	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-16.0	-34.7	-53.3	-47.5	-38.9	-20.3	-43.9	-67.4	-60.1	-49.3	-25.0	-54.2	-83.2	-74.2	-60.8
		2	26.1	-16.6	0.0	0.0	0.0	33.1	-21.0	0.0	0.0	0.0	40.8	-25.9	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-9.0	-34.7	-53.3	-47.5	-38.9	-11.4	-43.9	-67.4	-60.1	-49.3	-14.1	-54.2	-83.2	-74.2	-60.8
		2	26.1	-16.6	0.0	0.0	0.0	33.1	-21.0	0.0	0.0	0.0	40.8	-25.9	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-50.1	-44.7	-36.6	NA	NA	-63.4	-56.6	-46.4	NA	NA	-78.3	-69.8	-57.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-49.2	-35.4	-50.1	-44.7	-36.6	-62.2	-42.3	-63.4	-56.6	-46.4	-76.8	-52.2	-78.3	-69.8	-57.3
		2	7.1	-10.0	0.0	0.0	0.0	9.0	-12.6	0.0	0.0	0.0	11.1	-15.6	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-40.4	-32.6	-50.1	-44.7	-36.6	-51.2	-41.3	-63.4	-56.6	-46.4	-63.2	-51.0	-78.3	-69.8	-57.3
		2	14.0	-14.3	0.0	0.0	0.0	17.7	-18.1	0.0	0.0	0.0	21.9	-22.4	0.0	0.0	0.0
15	5:12 (22.6 deg)	1	-32.4	-32.6	-50.1	-44.7	-36.6	-41.1	-41.3	-63.4	-56.6	-46.4	-50.7	-51.0	-78.3	-69.8	-57.3
		2	18.6	-15.6	0.0	0.0	0.0	23.6	-19.7	0.0	0.0	0.0	29.1	-24.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-26.1	-32.6	-50.1	-44.7	-36.6	-33.0	-41.3	-63.4	-56.6	-46.4	-40.7	-51.0	-78.3	-69.8	-57.3
		2	20.6	-15.6	0.0	0.0	0.0	26.0	-19.7	0.0	0.0	0.0	32.1	-24.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-15.1	-32.6	-50.1	-44.7	-36.6	-19.1	-41.3	-63.4	-56.6	-46.4	-23.6	-51.0	-78.3	-69.8	-57.3
		2	24.6	-15.6	0.0	0.0	0.0	31.1	-19.7	0.0	0.0	0.0	38.4	-24.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.5	-32.6	-50.1	-44.7	-36.6	-10.8	-41.3	-63.4	-56.6	-46.4	-13.3	-51.0	-78.3	-69.8	-57.3
		2	24.6	-15.6	0.0	0.0	0.0	31.1	-19.7	0.0	0.0	0.0	38.4	-24.4	0.0	0.0	0.0

MWFRS – Roof
V = 110–120 mph
h = 50–80 ft.

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

V (MPH)			110					115					120				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
80	Flat < 2:12 (9.46 deg)	1	NA	NA	-33.7	-30.0	-24.6	NA	NA	-36.8	-32.8	-26.9	NA	NA	-40.1	-35.8	-29.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-33.1	-22.5	-33.7	-30.0	-24.6	-36.1	-26.0	-36.8	-32.8	-26.9	-39.4	-26.8	-40.1	-35.8	-29.3
		2	4.8	-6.7	0.0	0.0	0.0	5.2	-7.3	0.0	0.0	0.0	5.7	-8.0	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-27.2	-21.9	-33.7	-30.0	-24.6	-29.7	-24.0	-36.8	-32.8	-26.9	-32.4	-26.1	-40.1	-35.8	-29.3
		2	9.4	-9.6	0.0	0.0	0.0	10.3	-10.5	0.0	0.0	0.0	11.2	-11.5	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-21.8	-21.9	-33.7	-30.0	-24.6	-23.8	-24.0	-36.8	-32.8	-26.9	-26.0	-26.1	-40.1	-35.8	-29.3
		2	12.5	-10.5	0.0	0.0	0.0	13.7	-11.5	0.0	0.0	0.0	14.9	-12.5	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-17.5	-21.9	-33.7	-30.0	-24.6	-19.1	-24.0	-36.8	-32.8	-26.9	-20.8	-26.1	-40.1	-35.8	-29.3
		2	13.8	-10.5	0.0	0.0	0.0	15.1	-11.5	0.0	0.0	0.0	16.5	-12.5	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-10.1	-21.9	-33.7	-30.0	-24.6	-11.1	-24.0	-36.8	-32.8	-26.9	-12.1	-26.1	-40.1	-35.8	-29.3
		2	16.5	-10.5	0.0	0.0	0.0	18.1	-11.5	0.0	0.0	0.0	19.7	-12.5	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-5.7	-21.9	-33.7	-30.0	-24.6	-6.3	-24.0	-36.8	-32.8	-26.9	-6.8	-26.1	-40.1	-35.8	-29.3
		2	16.5	-10.5	0.0	0.0	0.0	18.1	-11.5	0.0	0.0	0.0	19.7	-12.5	0.0	0.0	0.0
70	Flat < 2:12 (9.46 deg)	1	NA	NA	-32.8	-29.2	-24.0	NA	NA	-35.8	-31.9	-26.2	NA	NA	-39.0	-34.8	-28.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-32.1	-21.9	-32.8	-29.2	-24.0	-35.1	-25.3	-35.8	-31.9	-26.2	-38.3	-26.0	-39.0	-34.8	-28.5
		2	4.6	-6.5	0.0	0.0	0.0	5.1	-7.1	0.0	0.0	0.0	5.5	-7.8	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-26.4	-21.3	-32.8	-29.2	-24.0	-28.9	-23.3	-35.8	-31.9	-26.2	-31.5	-25.4	-39.0	-34.8	-28.5
		2	9.2	-9.4	0.0	0.0	0.0	10.0	-10.2	0.0	0.0	0.0	10.9	-11.1	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-21.2	-21.3	-32.8	-29.2	-24.0	-23.2	-23.3	-35.8	-31.9	-26.2	-25.2	-25.4	-39.0	-34.8	-28.5
		2	12.2	-10.2	0.0	0.0	0.0	13.3	-11.1	0.0	0.0	0.0	14.5	-12.1	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-17.0	-21.3	-32.8	-29.2	-24.0	-18.6	-23.3	-35.8	-31.9	-26.2	-20.3	-25.4	-39.0	-34.8	-28.5
		2	13.4	-10.2	0.0	0.0	0.0	14.7	-11.1	0.0	0.0	0.0	16.0	-12.1	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-9.9	-21.3	-32.8	-29.2	-24.0	-10.8	-23.3	-35.8	-31.9	-26.2	-11.7	-25.4	-39.0	-34.8	-28.5
		2	16.1	-10.2	0.0	0.0	0.0	17.6	-11.1	0.0	0.0	0.0	19.1	-12.1	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-5.6	-21.3	-32.8	-29.2	-24.0	-6.1	-23.3	-35.8	-31.9	-26.2	-6.6	-25.4	-39.0	-34.8	-28.5
		2	16.1	-10.2	0.0	0.0	0.0	17.6	-11.1	0.0	0.0	0.0	19.1	-12.1	0.0	0.0	0.0
60	Flat < 2:12 (9.46 deg)	1	NA	NA	-31.7	-28.3	-23.2	NA	NA	-34.7	-30.9	-25.3	NA	NA	-37.8	-33.7	-27.6
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-31.1	-21.2	-31.7	-28.3	-23.2	-34.0	-24.5	-34.7	-30.9	-25.3	-37.0	-25.2	-37.8	-33.7	-27.6
		2	4.5	-6.3	0.0	0.0	0.0	4.9	-6.9	0.0	0.0	0.0	5.3	-7.5	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-25.6	-20.6	-31.7	-28.3	-23.2	-28.0	-22.6	-34.7	-30.9	-25.3	-30.4	-24.6	-37.8	-33.7	-27.6
		2	8.9	-9.1	0.0	0.0	0.0	9.7	-9.9	0.0	0.0	0.0	10.5	-10.8	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-20.5	-20.6	-31.7	-28.3	-23.2	-22.4	-22.6	-34.7	-30.9	-25.3	-24.4	-24.6	-37.8	-33.7	-27.6
		2	11.8	-9.9	0.0	0.0	0.0	12.9	-10.8	0.0	0.0	0.0	14.0	-11.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-16.5	-20.6	-31.7	-28.3	-23.2	-18.0	-22.6	-34.7	-30.9	-25.3	-19.6	-24.6	-37.8	-33.7	-27.6
		2	13.0	-9.9	0.0	0.0	0.0	14.2	-10.8	0.0	0.0	0.0	15.5	-11.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-9.5	-20.6	-31.7	-28.3	-23.2	-10.4	-22.6	-34.7	-30.9	-25.3	-11.4	-24.6	-37.8	-33.7	-27.6
		2	15.6	-9.9	0.0	0.0	0.0	17.0	-10.8	0.0	0.0	0.0	18.5	-11.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-5.4	-20.6	-31.7	-28.3	-23.2	-5.9	-22.6	-34.7	-30.9	-25.3	-6.4	-24.6	-37.8	-33.7	-27.6
		2	15.6	-9.9	0.0	0.0	0.0	17.0	-10.8	0.0	0.0	0.0	18.5	-11.8	0.0	0.0	0.0
50	Flat < 2:12 (9.46 deg)	1	NA	NA	-30.5	-27.2	-22.3	NA	NA	-33.4	-29.7	-24.4	NA	NA	-36.3	-32.4	-26.6
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-30.0	-20.4	-30.5	-27.2	-22.3	-32.7	-23.6	-33.4	-29.7	-24.4	-35.6	-24.2	-36.3	-32.4	-26.6
		2	4.3	-6.1	0.0	0.0	0.0	4.7	-6.6	0.0	0.0	0.0	5.1	-7.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-24.6	-19.9	-30.5	-27.2	-22.3	-26.9	-21.7	-33.4	-29.7	-24.4	-29.3	-23.6	-36.3	-32.4	-26.6
		2	8.5	-8.7	0.0	0.0	0.0	9.3	-9.5	0.0	0.0	0.0	10.1	-10.4	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-19.8	-19.9	-30.5	-27.2	-22.3	-21.6	-21.7	-33.4	-29.7	-24.4	-23.5	-23.6	-36.3	-32.4	-26.6
		2	11.3	-9.5	0.0	0.0	0.0	12.4	-10.4	0.0	0.0	0.0	13.5	-11.3	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-15.9	-19.9	-30.5	-27.2	-22.3	-17.3	-21.7	-33.4	-29.7	-24.4	-18.9	-23.6	-36.3	-32.4	-26.6
		2	12.5	-9.5	0.0	0.0	0.0	13.7	-10.4	0.0	0.0	0.0	14.9	-11.3	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-9.2	-19.9	-30.5	-27.2	-22.3	-10.0	-21.7	-33.4	-29.7	-24.4	-10.9	-23.6	-36.3	-32.4	-26.6
		2	15.0	-9.5	0.0	0.0	0.0	16.4	-10.4	0.0	0.0	0.0	17.8	-11.3	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-5.2	-19.9	-30.5	-27.2	-22.3	-5.7	-21.7	-33.4	-29.7	-24.4	-6.2	-23.6	-36.3	-32.4	-26.6
		2	15.0	-9.5	0.0	0.0	0.0	16.4	-10.4	0.0	0.0	0.0	17.8	-11.3	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 130–150 mph
h = 50–80 ft.

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
80	Flat < 2:12 (9.46 deg)	1	NA	NA	-47.1	-42.0	-34.4	NA	NA	-54.6	-48.7	-39.9	NA	NA	-62.7	-55.9	-45.8
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-46.2	-31.4	-47.1	-42.0	-34.4	-53.6	-36.4	-54.6	-48.7	-39.9	-61.5	-41.8	-62.7	-55.9	-45.8
		2	6.7	-9.4	0.0	0.0	0.0	7.7	-10.9	0.0	0.0	0.0	8.9	-12.5	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-38.0	-30.6	-47.1	-42.0	-34.4	-44.0	-35.5	-54.6	-48.7	-39.9	-50.5	-40.8	-62.7	-55.9	-45.8
		2	13.1	-13.5	0.0	0.0	0.0	15.2	-15.6	0.0	0.0	0.0	17.5	-17.9	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-30.5	-30.6	-47.1	-42.0	-34.4	-35.3	-35.5	-54.6	-48.7	-39.9	-40.6	-40.8	-62.7	-55.9	-45.8
		2	17.5	-14.7	0.0	0.0	0.0	20.3	-17.0	0.0	0.0	0.0	23.3	-19.5	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-24.5	-30.6	-47.1	-42.0	-34.4	-28.4	-35.5	-54.6	-48.7	-39.9	-32.6	-40.8	-62.7	-55.9	-45.8
		2	19.3	-14.7	0.0	0.0	0.0	22.4	-17.0	0.0	0.0	0.0	25.7	-19.5	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-14.2	-30.6	-47.1	-42.0	-34.4	-16.4	-35.5	-54.6	-48.7	-39.9	-18.9	-40.8	-62.7	-55.9	-45.8
		2	23.1	-14.7	0.0	0.0	0.0	26.8	-17.0	0.0	0.0	0.0	9.9	-19.5	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.0	-30.6	-47.1	-42.0	-34.4	-9.3	-35.5	-54.6	-48.7	-39.9	-10.6	-40.8	-62.7	-55.9	-45.8
		2	23.1	-14.7	0.0	0.0	0.0	26.8	-17.0	0.0	0.0	0.0	30.7	-19.5	0.0	0.0	0.0
70	Flat < 2:12 (9.46 deg)	1	NA	NA	-45.8	-40.8	-33.5	NA	NA	-53.1	-47.3	-38.8	NA	NA	-60.9	-54.3	-44.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-44.9	-30.5	-45.8	-40.8	-33.5	-52.1	-35.4	-53.1	-47.3	-38.8	-59.8	-40.6	-60.9	-54.3	-44.5
		2	6.5	-9.1	0.0	0.0	0.0	7.5	-10.6	0.0	0.0	0.0	8.6	-12.1	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-36.9	-29.8	-45.8	-40.8	-33.5	-42.8	-34.6	-53.1	-47.3	-38.8	-49.1	-39.7	-60.9	-54.3	-44.5
		2	12.8	-13.1	0.0	0.0	0.0	14.8	-15.2	0.0	0.0	0.0	17.0	-17.4	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-29.6	-29.8	-45.8	-40.8	-33.5	-34.4	-34.6	-53.1	-47.3	-38.8	-39.4	-39.7	-60.9	-54.3	-44.5
		2	17.0	-14.2	0.0	0.0	0.0	19.7	-16.5	0.0	0.0	0.0	22.6	-19.0	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-23.8	-29.8	-45.8	-40.8	-33.5	-27.6	-34.6	-53.1	-47.3	-38.8	-31.7	-39.7	-60.9	-54.3	-44.5
		2	18.8	-14.2	0.0	0.0	0.0	21.8	-16.5	0.0	0.0	0.0	25.0	-19.0	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-13.8	-29.8	-45.8	-40.8	-33.5	-16.0	-34.6	-53.1	-47.3	-38.8	-18.3	-39.7	-60.9	-54.3	-44.5
		2	22.5	-14.2	0.0	0.0	0.0	26.0	-16.5	0.0	0.0	0.0	9.6	-19.0	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-7.8	-29.8	-45.8	-40.8	-33.5	-9.0	-34.6	-53.1	-47.3	-38.8	-10.3	-39.7	-60.9	-54.3	-44.5
		2	22.5	-14.2	0.0	0.0	0.0	26.0	-16.5	0.0	0.0	0.0	29.9	-19.0	0.0	0.0	0.0
60	Flat < 2:12 (9.46 deg)	1	NA	NA	-44.3	-39.5	-32.4	NA	NA	-51.4	-45.8	-37.6	NA	NA	-59.0	-52.6	-43.1
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-43.5	-29.6	-44.3	-39.5	-32.4	-50.4	-34.3	-51.4	-45.8	-37.6	-57.9	-39.3	-59.0	-52.6	-43.1
		2	6.3	-8.8	0.0	0.0	0.0	7.3	-10.2	0.0	0.0	0.0	8.3	-11.7	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-35.7	-28.8	-44.3	-39.5	-32.4	-41.4	-33.4	-51.4	-45.8	-37.6	-47.6	-38.4	-59.0	-52.6	-43.1
		2	12.4	-12.7	0.0	0.0	0.0	14.3	-14.7	0.0	0.0	0.0	16.5	-16.9	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-28.7	-28.8	-44.3	-39.5	-32.4	-33.3	-33.4	-51.4	-45.8	-37.6	-38.2	-38.4	-59.0	-52.6	-43.1
		2	16.5	-13.8	0.0	0.0	0.0	19.1	-16.0	0.0	0.0	0.0	21.9	-18.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-23.0	-28.8	-44.3	-39.5	-32.4	-26.7	-33.4	-51.4	-45.8	-37.6	-30.7	-38.4	-59.0	-52.6	-43.1
		2	18.2	-13.8	0.0	0.0	0.0	21.1	-16.0	0.0	0.0	0.0	24.2	-18.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-13.3	-28.8	-44.3	-39.5	-32.4	-15.5	-33.4	-51.4	-45.8	-37.6	-17.8	-38.4	-59.0	-52.6	-43.1
		2	21.7	-13.8	0.0	0.0	0.0	25.2	-16.0	0.0	0.0	0.0	9.3	-18.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-7.5	-28.8	-44.3	-39.5	-32.4	-8.7	-33.4	-51.4	-45.8	-37.6	-10.0	-38.4	-59.0	-52.6	-43.1
		2	21.7	-13.8	0.0	0.0	0.0	25.2	-16.0	0.0	0.0	0.0	28.9	-18.4	0.0	0.0	0.0
50	Flat < 2:12 (9.46 deg)	1	NA	NA	-42.6	-38.0	-31.2	NA	NA	-49.4	-44.1	-36.2	NA	NA	-56.8	-50.6	-41.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-41.8	-28.4	-42.6	-38.0	-31.2	-48.5	-33.0	-49.4	-44.1	-36.2	-55.7	-37.9	-56.8	-50.6	-41.5
		2	6.0	-8.5	0.0	0.0	0.0	7.0	-9.8	0.0	0.0	0.0	8.0	-11.3	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-34.4	-27.8	-42.6	-38.0	-31.2	-39.9	-32.2	-49.4	-44.1	-36.2	-45.8	-37.0	-56.8	-50.6	-41.5
		2	11.9	-12.2	0.0	0.0	0.0	13.8	-14.1	0.0	0.0	0.0	15.9	-16.2	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-27.6	-27.8	-42.6	-38.0	-31.2	-32.0	-32.2	-49.4	-44.1	-36.2	-36.7	-37.0	-56.8	-50.6	-41.5
		2	15.8	-13.3	0.0	0.0	0.0	18.4	-15.4	0.0	0.0	0.0	21.1	-17.7	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-22.2	-27.8	-42.6	-38.0	-31.2	-25.7	-32.2	-49.4	-44.1	-36.2	-29.5	-37.0	-56.8	-50.6	-41.5
		2	17.5	-13.3	0.0	0.0	0.0	20.3	-15.4	0.0	0.0	0.0	23.3	-17.7	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-12.8	-27.8	-42.6	-38.0	-31.2	-14.9	-32.2	-49.4	-44.1	-36.2	-17.1	-37.0	-56.8	-50.6	-41.5
		2	20.9	-13.3	0.0	0.0	0.0	24.3	-15.4	0.0	0.0	0.0	8.9	-17.7	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-7.2	-27.8	-42.6	-38.0	-31.2	-8.4	-32.2	-49.4	-44.1	-36.2	-9.6	-37.0	-56.8	-50.6	-41.5
		2	20.9	-13.3	0.0	0.0	0.0	24.3	-15.4	0.0	0.0	0.0	27.8	-17.7	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 160–200 mph
h = 50–80 ft.

V (MPH)			160					180					200				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat < 2:12 (9.46 deg)	1	NA	NA	-71.3	-63.6	-52.1	NA	NA	-90.2	-80.5	-66.0	NA	NA	-111.4	-99.3	-81.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-70.0	-50.4	-71.3	-63.6	-52.1	-88.5	-60.2	-90.2	-80.5	-66.0	-109.3	-74.3	-111.4	-99.3	-81.5
		2	10.1	-14.2	0.0	0.0	0.0	12.8	-18.0	0.0	0.0	0.0	15.8	-22.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-57.5	-46.4	-71.3	-63.6	-52.1	-72.8	-58.7	-90.2	-80.5	-66.0	-89.9	-72.5	-111.4	-99.3	-81.5
		2	19.9	-20.4	0.0	0.0	0.0	25.2	-25.8	0.0	0.0	0.0	31.1	-31.8	0.0	0.0	0.0
80	5:12 (22.6 deg)	1	-46.1	-46.4	-71.3	-63.6	-52.1	-58.4	-58.7	-90.2	-80.5	-66.0	-72.1	-72.5	-111.4	-99.3	-81.5
		2	26.5	-22.2	0.0	0.0	0.0	33.5	-28.1	0.0	0.0	0.0	41.4	-34.7	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-37.1	-46.4	-71.3	-63.6	-52.1	-46.9	-58.7	-90.2	-80.5	-66.0	-57.9	-72.5	-111.4	-99.3	-81.5
		2	29.3	-22.2	0.0	0.0	0.0	37.0	-28.1	0.0	0.0	0.0	45.7	-34.7	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-21.5	-46.4	-71.3	-63.6	-52.1	-27.2	-58.7	-90.2	-80.5	-66.0	-33.5	-72.5	-111.4	-99.3	-81.5
		2	35.0	-22.2	0.0	0.0	0.0	44.3	-28.1	0.0	0.0	0.0	54.7	-34.7	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-12.1	-46.4	-71.3	-63.6	-52.1	-15.3	-58.7	-90.2	-80.5	-66.0	-18.9	-72.5	-111.4	-99.3	-81.5
		2	35.0	-22.2	0.0	0.0	0.0	44.3	-28.1	0.0	0.0	0.0	54.7	-34.7	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-69.3	-61.8	-50.7	NA	NA	-87.7	-78.2	-64.2	NA	NA	-108.3	-96.6	-79.2
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-68.0	-49.0	-69.3	-61.8	-50.7	-86.1	-58.5	-87.7	-78.2	-64.2	-106.3	-72.2	-108.3	-96.6	-79.2
		2	9.8	-13.8	0.0	0.0	0.0	12.4	-17.5	0.0	0.0	0.0	15.3	-21.6	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-55.9	-45.1	-69.3	-61.8	-50.7	-70.8	-57.1	-87.7	-78.2	-64.2	-87.4	-70.5	-108.3	-96.6	-79.2
		2	19.4	-19.8	0.0	0.0	0.0	24.5	-25.1	0.0	0.0	0.0	30.2	-31.0	0.0	0.0	0.0
70	5:12 (22.6 deg)	1	-44.9	-45.1	-69.3	-61.8	-50.7	-56.8	-57.1	-87.7	-78.2	-64.2	-70.1	-70.5	-108.3	-96.6	-79.2
		2	25.8	-21.6	0.0	0.0	0.0	32.6	-27.3	0.0	0.0	0.0	40.3	-33.7	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-36.0	-45.1	-69.3	-61.8	-50.7	-45.6	-57.1	-87.7	-78.2	-64.2	-56.3	-70.5	-108.3	-96.6	-79.2
		2	28.4	-21.6	0.0	0.0	0.0	36.0	-27.3	0.0	0.0	0.0	44.5	-33.7	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-20.9	-45.1	-69.3	-61.8	-50.7	-26.4	-57.1	-87.7	-78.2	-64.2	-32.6	-70.5	-108.3	-96.6	-79.2
		2	34.0	-21.6	0.0	0.0	0.0	43.0	-27.3	0.0	0.0	0.0	53.1	-33.7	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-11.8	-45.1	-69.3	-61.8	-50.7	-14.9	-57.1	-87.7	-78.2	-64.2	-18.4	-70.5	-108.3	-96.6	-79.2
		2	34.0	-21.6	0.0	0.0	0.0	43.0	-27.3	0.0	0.0	0.0	53.1	-33.7	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-67.1	-59.8	-49.1	NA	NA	-84.9	-75.7	-62.1	NA	NA	-104.9	-93.5	-76.7
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-65.8	-47.4	-67.1	-59.8	-49.1	-83.3	-56.7	-84.9	-75.7	-62.1	-102.9	-69.9	-104.9	-93.5	-76.7
		2	9.5	-13.4	0.0	0.0	0.0	12.0	-16.9	0.0	0.0	0.0	14.8	-20.9	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-54.1	-43.7	-67.1	-59.8	-49.1	-68.5	-55.3	-84.9	-75.7	-62.1	-84.6	-68.3	-104.9	-93.5	-76.7
		2	18.7	-19.2	0.0	0.0	0.0	23.7	-24.3	0.0	0.0	0.0	29.3	-30.0	0.0	0.0	0.0
60	5:12 (22.6 deg)	1	-43.4	-43.7	-67.1	-59.8	-49.1	-55.0	-55.3	-84.9	-75.7	-62.1	-67.9	-68.3	-104.9	-93.5	-76.7
		2	24.9	-20.9	0.0	0.0	0.0	31.6	-26.4	0.0	0.0	0.0	39.0	-32.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-34.9	-43.7	-67.1	-59.8	-49.1	-44.2	-55.3	-84.9	-75.7	-62.1	-54.5	-68.3	-104.9	-93.5	-76.7
		2	27.5	-20.9	0.0	0.0	0.0	34.9	-26.4	0.0	0.0	0.0	43.0	-32.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-20.2	-43.7	-67.1	-59.8	-49.1	-25.6	-55.3	-84.9	-75.7	-62.1	-31.6	-68.3	-104.9	-93.5	-76.7
		2	32.9	-20.9	0.0	0.0	0.0	41.7	-26.4	0.0	0.0	0.0	51.4	-32.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-11.4	-43.7	-67.1	-59.8	-49.1	-14.4	-55.3	-84.9	-75.7	-62.1	-17.8	-68.3	-104.9	-93.5	-76.7
		2	32.9	-20.9	0.0	0.0	0.0	41.7	-26.4	0.0	0.0	0.0	51.4	-32.6	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-64.6	-57.6	-47.2	NA	NA	-81.7	-72.9	-59.8	NA	NA	-100.9	-90.0	-73.8
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-63.4	-45.6	-64.6	-57.6	-47.2	-80.2	-54.5	-81.7	-72.9	-59.8	-99.0	-67.3	-100.9	-90.0	-73.8
		2	9.1	-12.9	0.0	0.0	0.0	11.6	-16.3	0.0	0.0	0.0	14.3	-20.1	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-52.1	-42.0	-64.6	-57.6	-47.2	-65.9	-53.2	-81.7	-72.9	-59.8	-81.4	-65.7	-100.9	-90.0	-73.8
		2	18.0	-18.5	0.0	0.0	0.0	22.8	-23.4	0.0	0.0	0.0	28.2	-28.8	0.0	0.0	0.0
50	5:12 (22.6 deg)	1	-41.8	-42.0	-64.6	-57.6	-47.2	-52.9	-53.2	-81.7	-72.9	-59.8	-65.3	-65.7	-100.9	-90.0	-73.8
		2	24.0	-20.1	0.0	0.0	0.0	30.4	-25.4	0.0	0.0	0.0	37.5	-31.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-33.6	-42.0	-64.6	-57.6	-47.2	-42.5	-53.2	-81.7	-72.9	-59.8	-52.5	-65.7	-100.9	-90.0	-73.8
		2	26.5	-20.1	0.0	0.0	0.0	33.5	-25.4	0.0	0.0	0.0	41.4	-31.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-19.4	-42.0	-64.6	-57.6	-47.2	-24.6	-53.2	-81.7	-72.9	-59.8	-30.4	-65.7	-100.9	-90.0	-73.8
		2	31.7	-20.1	0.0	0.0	0.0	40.1	-25.4	0.0	0.0	0.0	49.5	-31.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-11.0	-42.0	-64.6	-57.6	-47.2	-13.9	-53.2	-81.7	-72.9	-59.8	-17.1	-65.7	-100.9	-90.0	-73.8
		2	31.7	-20.1	0.0	0.0	0.0	40.1	-25.4	0.0	0.0	0.0	49.5	-31.4	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 110–120 mph
h = 90–120 ft.

V (MPH)			110					115					120				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
120	Flat < 2:12 (9.46 deg)	1	NA	NA	-36.7	-32.7	-26.8	NA	NA	-40.1	-35.8	-29.3	NA	NA	-43.7	-38.9	-31.9
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-36.0	-24.5	-36.7	-32.7	-26.8	-39.4	-28.3	-40.1	-35.8	-29.3	-42.9	-29.1	-43.7	-38.9	-31.9
		2	5.2	-7.3	0.0	0.0	0.0	5.7	-8.0	0.0	0.0	0.0	6.2	-8.7	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-29.6	-23.9	-36.7	-32.7	-26.8	-32.4	-26.1	-40.1	-35.8	-29.3	-35.2	-28.4	-43.7	-38.9	-31.9
		2	10.2	-10.5	0.0	0.0	0.0	11.2	-11.5	0.0	0.0	0.0	12.2	-12.5	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-23.8	-23.9	-36.7	-32.7	-26.8	-26.0	-26.1	-40.1	-35.8	-29.3	-28.3	-28.4	-43.7	-38.9	-31.9
		2	13.6	-11.4	0.0	0.0	0.0	14.9	-12.5	0.0	0.0	0.0	16.2	-13.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-19.1	-23.9	-36.7	-32.7	-26.8	-20.9	-26.1	-40.1	-35.8	-29.3	-22.7	-28.4	-43.7	-38.9	-31.9
		2	15.1	-11.4	0.0	0.0	0.0	16.5	-12.5	0.0	0.0	0.0	17.9	-13.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-11.0	-23.9	-36.7	-32.7	-26.8	-12.1	-26.1	-40.1	-35.8	-29.3	-13.1	-28.4	-43.7	-38.9	-31.9
		2	18.0	-11.4	0.0	0.0	0.0	19.7	-12.5	0.0	0.0	0.0	21.4	-13.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.2	-23.9	-36.7	-32.7	-26.8	-6.8	-26.1	-40.1	-35.8	-29.3	-7.4	-28.4	-43.7	-38.9	-31.9
		2	18.0	-11.4	0.0	0.0	0.0	19.7	-12.5	0.0	0.0	0.0	21.4	-13.6	0.0	0.0	0.0
110	Flat < 2:12 (9.46 deg)	1	NA	NA	-36.0	-32.1	-26.3	NA	NA	-39.4	-35.1	-28.8	NA	NA	-42.9	-38.2	-31.4
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-35.4	-24.0	-36.0	-32.1	-26.3	-38.6	-27.8	-39.4	-35.1	-28.8	-42.1	-28.6	-42.9	-38.2	-31.4
		2	5.1	-7.2	0.0	0.0	0.0	5.6	-7.8	0.0	0.0	0.0	6.1	-8.5	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-29.1	-23.5	-36.0	-32.1	-26.3	-31.8	-25.6	-39.4	-35.1	-28.8	-34.6	-27.9	-42.9	-38.2	-31.4
		2	10.1	-10.3	0.0	0.0	0.0	11.0	-11.3	0.0	0.0	0.0	12.0	-12.3	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-23.3	-23.5	-36.0	-32.1	-26.3	-25.5	-25.6	-39.4	-35.1	-28.8	-27.8	-27.9	-42.9	-38.2	-31.4
		2	13.4	-11.2	0.0	0.0	0.0	14.6	-12.3	0.0	0.0	0.0	15.9	-13.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-18.7	-23.5	-36.0	-32.1	-26.3	-20.5	-25.6	-39.4	-35.1	-28.8	-22.3	-27.9	-42.9	-38.2	-31.4
		2	14.8	-11.2	0.0	0.0	0.0	16.2	-12.3	0.0	0.0	0.0	17.6	-13.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-10.8	-23.5	-36.0	-32.1	-26.3	-11.9	-25.6	-39.4	-35.1	-28.8	-12.9	-27.9	-42.9	-38.2	-31.4
		2	17.7	-11.2	0.0	0.0	0.0	19.3	-12.3	0.0	0.0	0.0	21.0	-13.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.1	-23.5	-36.0	-32.1	-26.3	-6.7	-25.6	-39.4	-35.1	-28.8	-7.3	-27.9	-42.9	-38.2	-31.4
		2	17.7	-11.2	0.0	0.0	0.0	19.3	-12.3	0.0	0.0	0.0	21.0	-13.4	0.0	0.0	0.0
100	Flat < 2:12 (9.46 deg)	1	NA	NA	-35.3	-31.5	-25.8	NA	NA	-38.6	-34.4	-28.2	NA	NA	-42.0	-37.5	-30.7
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-34.7	-23.6	-35.3	-31.5	-25.8	-37.9	-27.3	-38.6	-34.4	-28.2	-41.2	-28.0	-42.0	-37.5	-30.7
		2	5.0	-7.0	0.0	0.0	0.0	5.5	-7.7	0.0	0.0	0.0	5.9	-8.4	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-28.5	-23.0	-35.3	-31.5	-25.8	-31.1	-25.1	-38.6	-34.4	-28.2	-33.9	-27.4	-42.0	-37.5	-30.7
		2	9.9	-10.1	0.0	0.0	0.0	10.8	-11.0	0.0	0.0	0.0	11.7	-12.0	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-22.9	-23.0	-35.3	-31.5	-25.8	-25.0	-25.1	-38.6	-34.4	-28.2	-27.2	-27.4	-42.0	-37.5	-30.7
		2	13.1	-11.0	0.0	0.0	0.0	14.4	-12.0	0.0	0.0	0.0	15.6	-13.1	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-18.4	-23.0	-35.3	-31.5	-25.8	-20.1	-25.1	-38.6	-34.4	-28.2	-21.9	-27.4	-42.0	-37.5	-30.7
		2	14.5	-11.0	0.0	0.0	0.0	15.8	-12.0	0.0	0.0	0.0	17.3	-13.1	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-10.6	-23.0	-35.3	-31.5	-25.8	-11.6	-25.1	-38.6	-34.4	-28.2	-12.7	-27.4	-42.0	-37.5	-30.7
		2	17.3	-11.0	0.0	0.0	0.0	18.9	-12.0	0.0	0.0	0.0	20.6	-13.1	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.0	-23.0	-35.3	-31.5	-25.8	-6.6	-25.1	-38.6	-34.4	-28.2	-7.1	-27.4	-42.0	-37.5	-30.7
		2	17.3	-11.0	0.0	0.0	0.0	18.9	-12.0	0.0	0.0	0.0	20.6	-13.1	0.0	0.0	0.0
90	Flat < 2:12 (9.46 deg)	1	NA	NA	-34.5	-30.8	-25.3	NA	NA	-37.8	-33.7	-27.6	NA	NA	-41.1	-36.7	-30.1
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-33.9	-23.0	-34.5	-30.8	-25.3	-37.0	-26.7	-37.8	-33.7	-27.6	-40.3	-27.4	-41.1	-36.7	-30.1
		2	4.9	-6.9	0.0	0.0	0.0	5.3	-7.5	0.0	0.0	0.0	5.8	-8.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-27.9	-22.5	-34.5	-30.8	-25.3	-30.5	-24.6	-37.8	-33.7	-27.6	-33.2	-26.8	-41.1	-36.7	-30.1
		2	9.6	-9.9	0.0	0.0	0.0	10.5	-10.8	0.0	0.0	0.0	11.5	-11.8	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-22.4	-22.5	-34.5	-30.8	-25.3	-24.4	-24.6	-37.8	-33.7	-27.6	-26.6	-26.8	-41.1	-36.7	-30.1
		2	12.8	-10.8	0.0	0.0	0.0	14.0	-11.8	0.0	0.0	0.0	15.3	-12.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-18.0	-22.5	-34.5	-30.8	-25.3	-19.6	-24.6	-37.8	-33.7	-27.6	-21.4	-26.8	-41.1	-36.7	-30.1
		2	14.2	-10.8	0.0	0.0	0.0	15.5	-11.8	0.0	0.0	0.0	16.9	-12.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-10.4	-22.5	-34.5	-30.8	-25.3	-11.4	-24.6	-37.8	-33.7	-27.6	-12.4	-26.8	-41.1	-36.7	-30.1
		2	16.9	-10.8	0.0	0.0	0.0	18.5	-11.8	0.0	0.0	0.0	20.2	-12.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-5.9	-22.5	-34.5	-30.8	-25.3	-6.4	-24.6	-37.8	-33.7	-27.6	-7.0	-26.8	-41.1	-36.7	-30.1
		2	16.9	-10.8	0.0	0.0	0.0	18.5	-11.8	0.0	0.0	0.0	20.2	-12.8	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 130–150 mph
h = 90–120 ft.

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
120	Flat < 2:12 (9.46 deg)	1	NA	NA	-51.3	-45.7	-37.5	NA	NA	-59.5	-53.0	-43.5	NA	NA	-36.7	-32.7	-26.8
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-50.3	-34.2	-51.3	-45.7	-37.5	-58.3	-39.7	-59.5	-53.0	-43.5	-36.0	-24.5	-36.7	-32.7	-26.8
		2	7.3	-10.2	0.0	0.0	0.0	8.4	-11.8	0.0	0.0	0.0	5.2	-7.3	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-41.4	-33.4	-51.3	-45.7	-37.5	-48.0	-38.7	-59.5	-53.0	-43.5	-29.6	-23.9	-36.7	-32.7	-26.8
		2	14.3	-14.7	0.0	0.0	0.0	16.6	-17.0	0.0	0.0	0.0	10.2	-10.5	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-33.2	-33.4	-51.3	-45.7	-37.5	-38.5	-38.7	-59.5	-53.0	-43.5	-23.8	-23.9	-36.7	-32.7	-26.8
		2	19.1	-16.0	0.0	0.0	0.0	22.1	-18.5	0.0	0.0	0.0	13.6	-11.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-26.6	-33.4	-51.3	-45.7	-37.5	-30.9	-38.7	-59.5	-53.0	-43.5	-19.1	-23.9	-36.7	-32.7	-26.8
		2	21.0	-16.0	0.0	0.0	0.0	24.4	-18.5	0.0	0.0	0.0	15.1	-11.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-15.4	-33.4	-51.3	-45.7	-37.5	-17.9	-38.7	-59.5	-53.0	-43.5	-11.0	-23.9	-36.7	-32.7	-26.8
		2	25.1	-16.0	0.0	0.0	0.0	29.2	-18.5	0.0	0.0	0.0	18.0	-11.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.7	-33.4	-51.3	-45.7	-37.5	-10.1	-38.7	-59.5	-53.0	-43.5	-6.2	-23.9	-36.7	-32.7	-26.8
		2	25.1	-16.0	0.0	0.0	0.0	29.2	-18.5	0.0	0.0	0.0	18.0	-11.4	0.0	0.0	0.0
110	Flat < 2:12 (9.46 deg)	1	NA	NA	-50.3	-44.9	-36.8	NA	NA	-58.4	-52.0	-42.7	NA	NA	-36.0	-32.1	-26.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-49.4	-33.6	-50.3	-44.9	-36.8	-57.3	-38.9	-58.4	-52.0	-42.7	-35.4	-24.0	-36.0	-32.1	-26.3
		2	7.1	-10.0	0.0	0.0	0.0	8.3	-11.6	0.0	0.0	0.0	5.1	-7.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-40.6	-32.8	-50.3	-44.9	-36.8	-47.1	-38.0	-58.4	-52.0	-42.7	-29.1	-23.5	-36.0	-32.1	-26.3
		2	14.1	-14.4	0.0	0.0	0.0	16.3	-16.7	0.0	0.0	0.0	10.1	-10.3	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-32.6	-32.8	-50.3	-44.9	-36.8	-37.8	-38.0	-58.4	-52.0	-42.7	-23.3	-23.5	-36.0	-32.1	-26.3
		2	18.7	-15.7	0.0	0.0	0.0	21.7	-18.2	0.0	0.0	0.0	13.4	-11.2	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-26.2	-32.8	-50.3	-44.9	-36.8	-30.3	-38.0	-58.4	-52.0	-42.7	-18.7	-23.5	-36.0	-32.1	-26.3
		2	20.7	-15.7	0.0	0.0	0.0	24.0	-18.2	0.0	0.0	0.0	14.8	-11.2	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-15.1	-32.8	-50.3	-44.9	-36.8	-17.6	-38.0	-58.4	-52.0	-42.7	-10.8	-23.5	-36.0	-32.1	-26.3
		2	24.7	-15.7	0.0	0.0	0.0	28.6	-18.2	0.0	0.0	0.0	17.7	-11.2	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.5	-32.8	-50.3	-44.9	-36.8	-9.9	-38.0	-58.4	-52.0	-42.7	-6.1	-23.5	-36.0	-32.1	-26.3
		2	24.7	-15.7	0.0	0.0	0.0	28.6	-18.2	0.0	0.0	0.0	17.7	-11.2	0.0	0.0	0.0
100	Flat < 2:12 (9.46 deg)	1	NA	NA	-49.3	-44.0	-36.1	NA	NA	-57.2	-51.0	-41.8	NA	NA	-35.3	-31.5	-25.8
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-48.4	-32.9	-49.3	-44.0	-36.1	-56.1	-38.2	-57.2	-51.0	-41.8	-34.7	-23.6	-35.3	-31.5	-25.8
		2	7.0	-9.8	0.0	0.0	0.0	8.1	-11.4	0.0	0.0	0.0	5.0	-7.0	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-39.8	-32.1	-49.3	-44.0	-36.1	-46.2	-37.2	-57.2	-51.0	-41.8	-28.5	-23.0	-35.3	-31.5	-25.8
		2	13.8	-14.1	0.0	0.0	0.0	16.0	-16.4	0.0	0.0	0.0	9.9	-10.1	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-31.9	-32.1	-49.3	-44.0	-36.1	-37.0	-37.2	-57.2	-51.0	-41.8	-22.9	-23.0	-35.3	-31.5	-25.8
		2	18.3	-15.4	0.0	0.0	0.0	21.3	-17.8	0.0	0.0	0.0	13.1	-11.0	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-25.6	-32.1	-49.3	-44.0	-36.1	-29.7	-37.2	-57.2	-51.0	-41.8	-18.4	-23.0	-35.3	-31.5	-25.8
		2	20.2	-15.4	0.0	0.0	0.0	23.5	-17.8	0.0	0.0	0.0	14.5	-11.0	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-14.8	-32.1	-49.3	-44.0	-36.1	-17.2	-37.2	-57.2	-51.0	-41.8	-10.6	-23.0	-35.3	-31.5	-25.8
		2	24.2	-15.4	0.0	0.0	0.0	28.1	-17.8	0.0	0.0	0.0	17.3	-11.0	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.4	-32.1	-49.3	-44.0	-36.1	-9.7	-37.2	-57.2	-51.0	-41.8	-6.0	-23.0	-35.3	-31.5	-25.8
		2	24.2	-15.4	0.0	0.0	0.0	28.1	-17.8	0.0	0.0	0.0	17.3	-11.0	0.0	0.0	0.0
90	Flat < 2:12 (9.46 deg)	1	NA	NA	-48.3	-43.0	-35.3	NA	NA	-56.0	-49.9	-40.9	NA	NA	-34.5	-30.8	-25.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-47.3	-32.2	-48.3	-43.0	-35.3	-54.9	-37.3	-56.0	-49.9	-40.9	-33.9	-23.0	-34.5	-30.8	-25.3
		2	6.8	-9.6	0.0	0.0	0.0	7.9	-11.1	0.0	0.0	0.0	4.9	-6.9	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-38.9	-31.4	-48.3	-43.0	-35.3	-45.1	-36.4	-56.0	-49.9	-40.9	-27.9	-22.5	-34.5	-30.8	-25.3
		2	13.5	-13.8	0.0	0.0	0.0	15.6	-16.0	0.0	0.0	0.0	9.6	-9.9	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-31.2	-31.4	-48.3	-43.0	-35.3	-36.2	-36.4	-56.0	-49.9	-40.9	-22.4	-22.5	-34.5	-30.8	-25.3
		2	17.9	-15.0	0.0	0.0	0.0	20.8	-17.4	0.0	0.0	0.0	12.8	-10.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-25.1	-31.4	-48.3	-43.0	-35.3	-29.1	-36.4	-56.0	-49.9	-40.9	-18.0	-22.5	-34.5	-30.8	-25.3
		2	19.8	-15.0	0.0	0.0	0.0	23.0	-17.4	0.0	0.0	0.0	14.2	-10.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-14.5	-31.4	-48.3	-43.0	-35.3	-16.8	-36.4	-56.0	-49.9	-40.9	-10.4	-22.5	-34.5	-30.8	-25.3
		2	23.7	-15.0	0.0	0.0	0.0	27.5	-17.4	0.0	0.0	0.0	16.9	-10.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.2	-31.4	-48.3	-43.0	-35.3	-9.5	-36.4	-56.0	-49.9	-40.9	-5.9	-22.5	-34.5	-30.8	-25.3
		2	23.7	-15.0	0.0	0.0	0.0	27.5	-17.4	0.0	0.0	0.0	16.9	-10.8	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 160–200 mph
h = 90–120 ft.

V (MPH)			160					180					200				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat < 2:12 (9.46 deg)	1	NA	NA	-77.7	-69.2	-56.8	NA	NA	-98.3	-87.6	-71.9	NA	NA	-121.3	-108.2	-88.7
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-76.2	-54.8	-77.7	-69.2	-56.8	-96.4	-65.6	-98.3	-87.6	-71.9	-119.0	-80.9	-121.3	-108.2	-88.7
		2	11.0	-15.5	0.0	0.0	0.0	13.9	-19.6	0.0	0.0	0.0	17.2	-24.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-62.6	-50.5	-77.7	-69.2	-56.8	-79.3	-64.0	-98.3	-87.6	-71.9	-97.9	-79.0	-121.3	-108.2	-88.7
		2	21.7	-22.2	0.0	0.0	0.0	27.4	-28.1	0.0	0.0	0.0	33.9	-34.7	0.0	0.0	0.0
120	5:12 (22.6 deg)	1	-50.3	-50.5	-77.7	-69.2	-56.8	-63.6	-64.0	-98.3	-87.6	-71.9	-78.5	-79.0	-121.3	-108.2	-88.7
		2	28.9	-24.2	0.0	0.0	0.0	36.5	-30.6	0.0	0.0	0.0	45.1	-37.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-40.4	-50.5	-77.7	-69.2	-56.8	-51.1	-64.0	-98.3	-87.6	-71.9	-63.1	-79.0	-121.3	-108.2	-88.7
		2	31.9	-24.2	0.0	0.0	0.0	40.3	-30.6	0.0	0.0	0.0	49.8	-37.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-23.4	-50.5	-77.7	-69.2	-56.8	-29.6	-64.0	-98.3	-87.6	-71.9	-36.5	-79.0	-121.3	-108.2	-88.7
		2	38.1	-24.2	0.0	0.0	0.0	48.2	-30.6	0.0	0.0	0.0	59.5	-37.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-13.2	-50.5	-77.7	-69.2	-56.8	-16.7	-64.0	-98.3	-87.6	-71.9	-20.6	-79.0	-121.3	-108.2	-88.7
		2	38.1	-24.2	0.0	0.0	0.0	48.2	-30.6	0.0	0.0	0.0	59.5	-37.8	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-76.2	-68.0	-55.7	NA	NA	-96.5	-86.0	-70.6	NA	NA	-119.1	-106.2	-87.1
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-74.8	-53.8	-76.2	-68.0	-55.7	-94.7	-64.4	-96.5	-86.0	-70.6	-116.9	-79.5	-119.1	-106.2	-87.1
		2	10.8	-15.2	0.0	0.0	0.0	13.7	-19.2	0.0	0.0	0.0	16.9	-23.7	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-61.5	-49.6	-76.2	-68.0	-55.7	-77.8	-62.8	-96.5	-86.0	-70.6	-96.1	-77.6	-119.1	-106.2	-87.1
		2	21.3	-21.8	0.0	0.0	0.0	26.9	-27.6	0.0	0.0	0.0	33.3	-34.1	0.0	0.0	0.0
110	5:12 (22.6 deg)	1	-49.3	-49.6	-76.2	-68.0	-55.7	-62.5	-62.8	-96.5	-86.0	-70.6	-77.1	-77.6	-119.1	-106.2	-87.1
		2	28.3	-23.7	0.0	0.0	0.0	35.9	-30.0	0.0	0.0	0.0	44.3	-37.1	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-39.6	-49.6	-76.2	-68.0	-55.7	-50.2	-62.8	-96.5	-86.0	-70.6	-61.9	-77.6	-119.1	-106.2	-87.1
		2	31.3	-23.7	0.0	0.0	0.0	39.6	-30.0	0.0	0.0	0.0	48.9	-37.1	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-22.9	-49.6	-76.2	-68.0	-55.7	-29.0	-62.8	-96.5	-86.0	-70.6	-35.9	-77.6	-119.1	-106.2	-87.1
		2	37.4	-23.7	0.0	0.0	0.0	47.3	-30.0	0.0	0.0	0.0	58.4	-37.1	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-12.9	-49.6	-76.2	-68.0	-55.7	-16.4	-62.8	-96.5	-86.0	-70.6	-20.2	-77.6	-119.1	-106.2	-87.1
		2	37.4	-23.7	0.0	0.0	0.0	47.3	-30.0	0.0	0.0	0.0	58.4	-37.1	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-74.7	-66.6	-54.6	NA	NA	-94.6	-84.3	-69.2	NA	NA	-116.8	-104.1	-85.4
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-73.3	-52.8	-74.7	-66.6	-54.6	-92.8	-63.1	-94.6	-84.3	-69.2	-114.6	-77.9	-116.8	-104.1	-85.4
		2	10.6	-14.9	0.0	0.0	0.0	13.4	-18.8	0.0	0.0	0.0	16.5	-23.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-60.3	-48.6	-74.7	-66.6	-54.6	-76.3	-61.6	-94.6	-84.3	-69.2	-94.2	-76.0	-116.8	-104.1	-85.4
		2	20.9	-21.4	0.0	0.0	0.0	26.4	-27.0	0.0	0.0	0.0	32.6	-33.4	0.0	0.0	0.0
100	5:12 (22.6 deg)	1	-48.4	-48.6	-74.7	-66.6	-54.6	-61.2	-61.6	-94.6	-84.3	-69.2	-75.6	-76.0	-116.8	-104.1	-85.4
		2	27.8	-23.3	0.0	0.0	0.0	35.2	-29.4	0.0	0.0	0.0	43.4	-36.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-38.8	-48.6	-74.7	-66.6	-54.6	-49.2	-61.6	-94.6	-84.3	-69.2	-60.7	-76.0	-116.8	-104.1	-85.4
		2	30.7	-23.3	0.0	0.0	0.0	38.8	-29.4	0.0	0.0	0.0	47.9	-36.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-22.5	-48.6	-74.7	-66.6	-54.6	-28.5	-61.6	-94.6	-84.3	-69.2	-35.1	-76.0	-116.8	-104.1	-85.4
		2	36.7	-23.3	0.0	0.0	0.0	46.4	-29.4	0.0	0.0	0.0	57.3	-36.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-12.7	-48.6	-74.7	-66.6	-54.6	-16.1	-61.6	-94.6	-84.3	-69.2	-19.8	-76.0	-116.8	-104.1	-85.4
		2	36.7	-23.3	0.0	0.0	0.0	46.4	-29.4	0.0	0.0	0.0	57.3	-36.4	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-73.1	-65.2	-53.4	NA	NA	-92.5	-82.5	-67.6	NA	NA	-114.2	-101.8	-83.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-71.7	-51.6	-73.1	-65.2	-53.4	-90.8	-61.7	-92.5	-82.5	-67.6	-112.1	-76.2	-114.2	-101.8	-83.5
		2	10.3	-14.5	0.0	0.0	0.0	13.1	-18.4	0.0	0.0	0.0	16.2	-22.7	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-59.0	-47.6	-73.1	-65.2	-53.4	-74.6	-60.2	-92.5	-82.5	-67.6	-92.1	-74.3	-114.2	-101.8	-83.5
		2	20.4	-20.9	0.0	0.0	0.0	25.8	-26.4	0.0	0.0	0.0	31.9	-32.6	0.0	0.0	0.0
90	5:12 (22.6 deg)	1	-47.3	-47.6	-73.1	-65.2	-53.4	-59.9	-60.2	-92.5	-82.5	-67.6	-73.9	-74.3	-114.2	-101.8	-83.5
		2	27.2	-22.8	0.0	0.0	0.0	34.4	-28.8	0.0	0.0	0.0	42.5	-35.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-38.0	-47.6	-73.1	-65.2	-53.4	-48.1	-60.2	-92.5	-82.5	-67.6	-59.4	-74.3	-114.2	-101.8	-83.5
		2	30.0	-22.8	0.0	0.0	0.0	38.0	-28.8	0.0	0.0	0.0	46.9	-35.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-22.0	-47.6	-73.1	-65.2	-53.4	-27.8	-60.2	-92.5	-82.5	-67.6	-34.4	-74.3	-114.2	-101.8	-83.5
		2	35.9	-22.8	0.0	0.0	0.0	45.4	-28.8	0.0	0.0	0.0	56.0	-35.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-12.4	-47.6	-73.1	-65.2	-53.4	-15.7	-60.2	-92.5	-82.5	-67.6	-19.4	-74.3	-114.2	-101.8	-83.5
		2	35.9	-22.8	0.0	0.0	0.0	45.4	-28.8	0.0	0.0	0.0	56.0	-35.6	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 110–120 mph
h = 130–160 ft.

V (MPH)			110					115					120				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
160	Flat < 2:12 (9.46 deg)	1	NA	NA	-39.0	-34.8	-28.5	NA	NA	-42.6	-38.0	-31.2	NA	NA	-46.4	-41.4	-33.9
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-38.3	-26.0	-39.0	-34.8	-28.5	-41.8	-30.1	-42.6	-38.0	-31.2	-45.5	-31.0	-46.4	-41.4	-33.9
		2	5.5	-7.8	0.0	0.0	0.0	6.0	-8.5	0.0	0.0	0.0	6.6	-9.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-31.5	-25.4	-39.0	-34.8	-28.5	-34.4	-27.7	-42.6	-38.0	-31.2	-37.4	-30.2	-46.4	-41.4	-33.9
		2	10.9	-11.1	0.0	0.0	0.0	11.9	-12.2	0.0	0.0	0.0	13.0	-13.3	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-25.2	-25.4	-39.0	-34.8	-28.5	-27.6	-27.7	-42.6	-38.0	-31.2	-30.0	-30.2	-46.4	-41.4	-33.9
		2	14.5	-12.1	0.0	0.0	0.0	15.8	-13.3	0.0	0.0	0.0	17.3	-14.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-20.3	-25.4	-39.0	-34.8	-28.5	-22.2	-27.7	-42.6	-38.0	-31.2	-24.1	-30.2	-46.4	-41.4	-33.9
		2	16.0	-12.1	0.0	0.0	0.0	17.5	-13.3	0.0	0.0	0.0	19.0	-14.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-11.7	-25.4	-39.0	-34.8	-28.5	-12.8	-27.7	-42.6	-38.0	-31.2	-14.0	-30.2	-46.4	-41.4	-33.9
		2	19.1	-12.1	0.0	0.0	0.0	20.9	-13.3	0.0	0.0	0.0	22.8	-14.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.6	-25.4	-39.0	-34.8	-28.5	-7.2	-27.7	-42.6	-38.0	-31.2	-7.9	-30.2	-46.4	-41.4	-33.9
		2	19.1	-12.1	0.0	0.0	0.0	20.9	-13.3	0.0	0.0	0.0	22.8	-14.4	0.0	0.0	0.0
150	Flat < 2:12 (9.46 deg)	1	NA	NA	-38.5	-34.3	-28.1	NA	NA	-42.0	-37.5	-30.7	NA	NA	-45.8	-40.8	-33.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-37.7	-25.7	-38.5	-34.3	-28.1	-41.3	-29.7	-42.0	-37.5	-30.7	-44.9	-30.5	-45.8	-40.8	-33.5
		2	5.4	-7.7	0.0	0.0	0.0	6.0	-8.4	0.0	0.0	0.0	6.5	-9.1	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-31.0	-25.0	-38.5	-34.3	-28.1	-33.9	-27.4	-42.0	-37.5	-30.7	-36.9	-29.8	-45.8	-40.8	-33.5
		2	10.7	-11.0	0.0	0.0	0.0	11.7	-12.0	0.0	0.0	0.0	12.8	-13.1	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-24.9	-25.0	-38.5	-34.3	-28.1	-27.2	-27.4	-42.0	-37.5	-30.7	-29.6	-29.8	-45.8	-40.8	-33.5
		2	14.3	-12.0	0.0	0.0	0.0	15.6	-13.1	0.0	0.0	0.0	17.0	-14.3	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-20.0	-25.0	-38.5	-34.3	-28.1	-21.9	-27.4	-42.0	-37.5	-30.7	-23.8	-29.8	-45.8	-40.8	-33.5
		2	15.8	-12.0	0.0	0.0	0.0	17.3	-13.1	0.0	0.0	0.0	18.8	-14.3	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-11.6	-25.0	-38.5	-34.3	-28.1	-12.7	-27.4	-42.0	-37.5	-30.7	-13.8	-29.8	-45.8	-40.8	-33.5
		2	18.9	-12.0	0.0	0.0	0.0	20.6	-13.1	0.0	0.0	0.0	22.5	-14.3	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.5	-25.0	-38.5	-34.3	-28.1	-7.1	-27.4	-42.0	-37.5	-30.7	-7.8	-29.8	-45.8	-40.8	-33.5
		2	18.9	-12.0	0.0	0.0	0.0	20.6	-13.1	0.0	0.0	0.0	22.5	-14.3	0.0	0.0	0.0
140	Flat < 2:12 (9.46 deg)	1	NA	NA	-37.9	-33.8	-27.7	NA	NA	-41.4	-36.9	-30.3	NA	NA	-45.1	-40.2	-33.0
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-37.2	-25.3	-37.9	-33.8	-27.7	-40.7	-29.3	-41.4	-36.9	-30.3	-44.3	-30.1	-45.1	-40.2	-33.0
		2	5.4	-7.5	0.0	0.0	0.0	5.9	-8.2	0.0	0.0	0.0	6.4	-9.0	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-30.6	-24.7	-37.9	-33.8	-27.7	-33.4	-27.0	-41.4	-36.9	-30.3	-36.4	-29.4	-45.1	-40.2	-33.0
		2	10.6	-10.8	0.0	0.0	0.0	11.6	-11.8	0.0	0.0	0.0	12.6	-12.9	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-24.5	-24.7	-37.9	-33.8	-27.7	-26.8	-27.0	-41.4	-36.9	-30.3	-29.2	-29.4	-45.1	-40.2	-33.0
		2	14.1	-11.8	0.0	0.0	0.0	15.4	-12.9	0.0	0.0	0.0	16.8	-14.0	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-19.7	-24.7	-37.9	-33.8	-27.7	-21.5	-27.0	-41.4	-36.9	-30.3	-23.5	-29.4	-45.1	-40.2	-33.0
		2	15.6	-11.8	0.0	0.0	0.0	17.0	-12.9	0.0	0.0	0.0	18.5	-14.0	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-11.4	-24.7	-37.9	-33.8	-27.7	-12.5	-27.0	-41.4	-36.9	-30.3	-13.6	-29.4	-45.1	-40.2	-33.0
		2	18.6	-11.8	0.0	0.0	0.0	20.3	-12.9	0.0	0.0	0.0	22.1	-14.0	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.4	-24.7	-37.9	-33.8	-27.7	-7.0	-27.0	-41.4	-36.9	-30.3	-7.7	-29.4	-45.1	-40.2	-33.0
		2	18.6	-11.8	0.0	0.0	0.0	20.3	-12.9	0.0	0.0	0.0	22.1	-14.0	0.0	0.0	0.0
130	Flat < 2:12 (9.46 deg)	1	NA	NA	-37.3	-33.3	-27.3	NA	NA	-40.8	-36.4	-29.8	NA	NA	-44.4	-39.6	-32.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-36.6	-24.9	-37.3	-33.3	-27.3	-40.0	-28.8	-40.8	-36.4	-29.8	-43.6	-29.6	-44.4	-39.6	-32.5
		2	5.3	-7.4	0.0	0.0	0.0	5.8	-8.1	0.0	0.0	0.0	6.3	-8.8	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-30.1	-24.3	-37.3	-33.3	-27.3	-32.9	-26.6	-40.8	-36.4	-29.8	-35.8	-28.9	-44.4	-39.6	-32.5
		2	10.4	-10.7	0.0	0.0	0.0	11.4	-11.7	0.0	0.0	0.0	12.4	-12.7	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-24.2	-24.3	-37.3	-33.3	-27.3	-26.4	-26.6	-40.8	-36.4	-29.8	-28.7	-28.9	-44.4	-39.6	-32.5
		2	13.9	-11.6	0.0	0.0	0.0	15.2	-12.7	0.0	0.0	0.0	16.5	-13.8	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-19.4	-24.3	-37.3	-33.3	-27.3	-21.2	-26.6	-40.8	-36.4	-29.8	-23.1	-28.9	-44.4	-39.6	-32.5
		2	15.3	-11.6	0.0	0.0	0.0	16.7	-12.7	0.0	0.0	0.0	18.2	-13.8	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-11.2	-24.3	-37.3	-33.3	-27.3	-12.3	-26.6	-40.8	-36.4	-29.8	-13.4	-28.9	-44.4	-39.6	-32.5
		2	18.3	-11.6	0.0	0.0	0.0	20.0	-12.7	0.0	0.0	0.0	21.8	-13.8	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-6.3	-24.3	-37.3	-33.3	-27.3	-6.9	-26.6	-40.8	-36.4	-29.8	-7.5	-28.9	-44.4	-39.6	-32.5
		2	18.3	-11.6	0.0	0.0	0.0	20.0	-12.7	0.0	0.0	0.0	21.8	-13.8	0.0	0.0	0.0

Table 27.6-2
MWFRS- Part 2: Wind Loads - Roof
Exposure C

MWFRS – Roof
V = 130–150 mph
h = 130–160 ft.

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat < 2:12 (9.46 deg)	1	NA	NA	-54.5	-48.6	-39.8	NA	NA	-63.2	-56.3	-46.2	NA	NA	-72.5	-64.6	-53.0
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-53.4	-36.3	-54.5	-48.6	-39.8	-62.0	-42.1	-63.2	-56.3	-46.2	-71.1	-48.4	-72.5	-64.6	-53.0
		2	7.7	-10.8	0.0	0.0	0.0	8.9	-12.6	0.0	0.0	0.0	10.3	-14.4	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-43.9	-35.5	-54.5	-48.6	-39.8	-51.0	-41.1	-63.2	-56.3	-46.2	-58.5	-47.2	-72.5	-64.6	-53.0
		2	15.2	-15.6	0.0	0.0	0.0	17.6	-18.1	0.0	0.0	0.0	20.2	-20.7	0.0	0.0	0.0
160	5:12 (22.6 deg)	1	-35.2	-35.5	-54.5	-48.6	-39.8	-40.9	-41.1	-63.2	-56.3	-46.2	-46.9	-47.2	-72.5	-64.6	-53.0
		2	20.2	-17.0	0.0	0.0	0.0	23.5	-19.7	0.0	0.0	0.0	27.0	-22.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-28.3	-35.5	-54.5	-48.6	-39.8	-32.8	-41.1	-63.2	-56.3	-46.2	-37.7	-47.2	-72.5	-64.6	-53.0
		2	22.4	-17.0	0.0	0.0	0.0	25.9	-19.7	0.0	0.0	0.0	29.8	-22.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-16.4	-35.5	-54.5	-48.6	-39.8	-19.0	-41.1	-63.2	-56.3	-46.2	-21.8	-47.2	-72.5	-64.6	-53.0
		2	26.7	-17.0	0.0	0.0	0.0	31.0	-19.7	0.0	0.0	0.0	11.4	-22.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-9.2	-35.5	-54.5	-48.6	-39.8	-10.7	-41.1	-63.2	-56.3	-46.2	-12.3	-47.2	-72.5	-64.6	-53.0
		2	26.7	-17.0	0.0	0.0	0.0	31.0	-19.7	0.0	0.0	0.0	35.6	-22.6	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-53.7	-47.9	-39.3	NA	NA	-62.3	-55.6	-45.6	NA	NA	-71.5	-63.8	-52.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-52.7	-35.8	-53.7	-47.9	-39.3	-61.1	-41.6	-62.3	-55.6	-45.6	-70.2	-47.7	-71.5	-63.8	-52.3
		2	7.6	-10.7	0.0	0.0	0.0	8.8	-12.4	0.0	0.0	0.0	10.1	-14.2	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-43.3	-35.0	-53.7	-47.9	-39.3	-50.3	-40.6	-62.3	-55.6	-45.6	-57.7	-46.6	-71.5	-63.8	-52.3
		2	15.0	-15.4	0.0	0.0	0.0	17.4	-17.8	0.0	0.0	0.0	20.0	-20.4	0.0	0.0	0.0
150	5:12 (22.6 deg)	1	-34.8	-35.0	-53.7	-47.9	-39.3	-40.3	-40.6	-62.3	-55.6	-45.6	-46.3	-46.6	-71.5	-63.8	-52.3
		2	20.0	-16.7	0.0	0.0	0.0	23.2	-19.4	0.0	0.0	0.0	26.6	-22.3	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-27.9	-35.0	-53.7	-47.9	-39.3	-32.4	-40.6	-62.3	-55.6	-45.6	-37.2	-46.6	-71.5	-63.8	-52.3
		2	22.1	-16.7	0.0	0.0	0.0	25.6	-19.4	0.0	0.0	0.0	29.4	-22.3	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-16.2	-35.0	-53.7	-47.9	-39.3	-18.8	-40.6	-62.3	-55.6	-45.6	-21.5	-46.6	-71.5	-63.8	-52.3
		2	26.4	-16.7	0.0	0.0	0.0	30.6	-19.4	0.0	0.0	0.0	11.3	-22.3	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-9.1	-35.0	-53.7	-47.9	-39.3	-10.6	-40.6	-62.3	-55.6	-45.6	-12.1	-46.6	-71.5	-63.8	-52.3
		2	26.4	-16.7	0.0	0.0	0.0	30.6	-19.4	0.0	0.0	0.0	35.1	-22.3	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-53.0	-47.2	-38.7	NA	NA	-61.4	-54.8	-44.9	NA	NA	-70.5	-62.9	-51.5
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-52.0	-35.3	-53.0	-47.2	-38.7	-60.3	-41.0	-61.4	-54.8	-44.9	-69.2	-47.0	-70.5	-62.9	-51.5
		2	7.5	-10.5	0.0	0.0	0.0	8.7	-12.2	0.0	0.0	0.0	10.0	-14.0	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-42.7	-34.5	-53.0	-47.2	-38.7	-49.5	-40.0	-61.4	-54.8	-44.9	-56.9	-45.9	-70.5	-62.9	-51.5
		2	14.8	-15.1	0.0	0.0	0.0	17.2	-17.6	0.0	0.0	0.0	19.7	-20.2	0.0	0.0	0.0
140	5:12 (22.6 deg)	1	-34.3	-34.5	-53.0	-47.2	-38.7	-39.7	-40.0	-61.4	-54.8	-44.9	-45.6	-45.9	-70.5	-62.9	-51.5
		2	19.7	-16.5	0.0	0.0	0.0	22.8	-19.1	0.0	0.0	0.0	26.2	-21.9	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-27.5	-34.5	-53.0	-47.2	-38.7	-31.9	-40.0	-61.4	-54.8	-44.9	-36.6	-45.9	-70.5	-62.9	-51.5
		2	21.7	-16.5	0.0	0.0	0.0	25.2	-19.1	0.0	0.0	0.0	28.9	-21.9	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-15.9	-34.5	-53.0	-47.2	-38.7	-18.5	-40.0	-61.4	-54.8	-44.9	-21.2	-45.9	-70.5	-62.9	-51.5
		2	26.0	-16.5	0.0	0.0	0.0	30.1	-19.1	0.0	0.0	0.0	11.1	-21.9	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-9.0	-34.5	-53.0	-47.2	-38.7	-10.4	-40.0	-61.4	-54.8	-44.9	-12.0	-45.9	-70.5	-62.9	-51.5
		2	26.0	-16.5	0.0	0.0	0.0	30.1	-19.1	0.0	0.0	0.0	34.6	-21.9	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-52.1	-46.5	-38.1	NA	NA	-60.5	-53.9	-44.2	NA	NA	-69.4	-61.9	-50.7
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-51.2	-34.8	-52.1	-46.5	-38.1	-59.3	-40.3	-60.5	-53.9	-44.2	-68.1	-46.3	-69.4	-61.9	-50.7
		2	7.4	-10.4	0.0	0.0	0.0	8.6	-12.0	0.0	0.0	0.0	9.8	-13.8	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-42.1	-33.9	-52.1	-46.5	-38.1	-48.8	-39.4	-60.5	-53.9	-44.2	-56.0	-45.2	-69.4	-61.9	-50.7
		2	14.6	-14.9	0.0	0.0	0.0	16.9	-17.3	0.0	0.0	0.0	19.4	-19.8	0.0	0.0	0.0
130	5:12 (22.6 deg)	1	-33.7	-33.9	-52.1	-46.5	-38.1	-39.1	-39.4	-60.5	-53.9	-44.2	-44.9	-45.2	-69.4	-61.9	-50.7
		2	19.4	-16.2	0.0	0.0	0.0	22.5	-18.8	0.0	0.0	0.0	25.8	-21.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-27.1	-33.9	-52.1	-46.5	-38.1	-31.4	-39.4	-60.5	-53.9	-44.2	-36.1	-45.2	-69.4	-61.9	-50.7
		2	21.4	-16.2	0.0	0.0	0.0	24.8	-18.8	0.0	0.0	0.0	28.5	-21.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-15.7	-33.9	-52.1	-46.5	-38.1	-18.2	-39.4	-60.5	-53.9	-44.2	-20.9	-45.2	-69.4	-61.9	-50.7
		2	25.6	-16.2	0.0	0.0	0.0	29.7	-18.8	0.0	0.0	0.0	10.9	-21.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-8.9	-33.9	-52.1	-46.5	-38.1	-10.3	-39.4	-60.5	-53.9	-44.2	-11.8	-45.2	-69.4	-61.9	-50.7
		2	15.0	-9.5	0.0	0.0	0.0	16.4	-10.4	0.0	0.0	0.0	34.1	-21.6	0.0	0.0	0.0

Table 27.6-2
MWFRS – Part 2: Wind Loads – Roof
Exposure C

MWFRS – Roof
V = 160–200 mph
h = 130–160 ft.

V (MPH)			160					180					200				
		Load			Zone					Zone					Zone		
h (ft)	Roof Slope	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat < 2:12 (9.46 deg)	1	NA	NA	-82.5	-73.6	-60.3	NA	NA	-104.4	-93.1	-76.3	NA	NA	-128.9	-114.9	-94.3
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-80.9	-58.3	-82.5	-73.6	-60.3	-102.5	-69.6	-104.4	-93.1	-76.3	-126.5	-86.0	-128.9	-114.9	-94.3
		2	11.7	-16.4	0.0	0.0	0.0	14.8	-20.8	0.0	0.0	0.0	18.2	-25.7	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-66.5	-53.7	-82.5	-73.6	-60.3	-84.2	-68.0	-104.4	-93.1	-76.3	-104.0	-83.9	-128.9	-114.9	-94.3
		2	23.0	-23.6	0.0	0.0	0.0	29.2	-29.8	0.0	0.0	0.0	36.0	-36.8	0.0	0.0	0.0
160	5:12 (22.6 deg)	1	-53.4	-53.7	-82.5	-73.6	-60.3	-67.6	-68.0	-104.4	-93.1	-76.3	-83.4	-83.9	-128.9	-114.9	-94.3
		2	30.7	-25.7	0.0	0.0	0.0	38.8	-32.5	0.0	0.0	0.0	47.9	-40.1	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-42.9	-53.7	-82.5	-73.6	-60.3	-54.3	-68.0	-104.4	-93.1	-76.3	-67.0	-83.9	-128.9	-114.9	-94.3
		2	33.9	-25.7	0.0	0.0	0.0	42.9	-32.5	0.0	0.0	0.0	52.9	-40.1	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-24.8	-53.7	-82.5	-73.6	-60.3	-31.4	-68.0	-104.4	-93.1	-76.3	-38.8	-83.9	-128.9	-114.9	-94.3
		2	40.5	-25.7	0.0	0.0	0.0	51.2	-32.5	0.0	0.0	0.0	63.2	-40.1	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-14.0	-53.7	-82.5	-73.6	-60.3	-17.7	-68.0	-104.4	-93.1	-76.3	-21.9	-83.9	-128.9	-114.9	-94.3
		2	40.5	-25.7	0.0	0.0	0.0	51.2	-32.5	0.0	0.0	0.0	63.2	-40.1	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-81.4	-72.6	-59.5	NA	NA	-103.0	-91.8	-75.3	NA	NA	-127.2	-113.4	-93.0
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-79.9	-57.5	-81.4	-72.6	-59.5	-101.1	-68.7	-103.0	-91.8	-75.3	-124.8	-84.8	-127.2	-113.4	-93.0
		2	11.5	-16.2	0.0	0.0	0.0	14.6	-20.5	0.0	0.0	0.0	18.0	-25.3	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-65.7	-53.0	-81.4	-72.6	-59.5	-83.1	-67.1	-103.0	-91.8	-75.3	-102.6	-82.8	-127.2	-113.4	-93.0
		2	22.7	-23.3	0.0	0.0	0.0	28.8	-29.4	0.0	0.0	0.0	35.5	-36.4	0.0	0.0	0.0
150	5:12 (22.6 deg)	1	-52.7	-53.0	-81.4	-72.6	-59.5	-66.7	-67.1	-103.0	-91.8	-75.3	-82.3	-82.8	-127.2	-113.4	-93.0
		2	30.3	-25.3	0.0	0.0	0.0	38.3	-32.1	0.0	0.0	0.0	47.3	-39.6	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-42.3	-53.0	-81.4	-72.6	-59.5	-53.5	-67.1	-103.0	-91.8	-75.3	-66.1	-82.8	-127.2	-113.4	-93.0
		2	33.4	-25.3	0.0	0.0	0.0	42.3	-32.1	0.0	0.0	0.0	52.2	-39.6	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-24.5	-53.0	-81.4	-72.6	-59.5	-31.0	-67.1	-103.0	-91.8	-75.3	-38.3	-82.8	-127.2	-113.4	-93.0
		2	39.9	-25.3	0.0	0.0	0.0	50.5	-32.1	0.0	0.0	0.0	62.4	-39.6	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-13.8	-53.0	-81.4	-72.6	-59.5	-17.5	-67.1	-103.0	-91.8	-75.3	-21.6	-82.8	-127.2	-113.4	-93.0
		2	39.9	-25.3	0.0	0.0	0.0	50.5	-32.1	0.0	0.0	0.0	62.4	-39.6	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-80.2	-71.5	-58.6	NA	NA	-101.5	-90.5	-74.2	NA	NA	-125.3	-111.7	-91.6
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-78.7	-56.7	-80.2	-71.5	-58.6	-99.6	-67.7	-101.5	-90.5	-74.2	-123.0	-83.6	-125.3	-111.7	-91.6
		2	11.4	-16.0	0.0	0.0	0.0	14.4	-20.2	0.0	0.0	0.0	17.7	-24.9	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-64.7	-52.2	-80.2	-71.5	-58.6	-81.9	-66.1	-101.5	-90.5	-74.2	-101.1	-81.6	-125.3	-111.7	-91.6
		2	22.4	-22.9	0.0	0.0	0.0	28.4	-29.0	0.0	0.0	0.0	35.0	-35.8	0.0	0.0	0.0
140	5:12 (22.6 deg)	1	-51.9	-52.2	-80.2	-71.5	-58.6	-65.7	-66.1	-101.5	-90.5	-74.2	-81.1	-81.6	-125.3	-111.7	-91.6
		2	29.8	-25.0	0.0	0.0	0.0	37.7	-31.6	0.0	0.0	0.0	46.6	-39.0	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-41.7	-52.2	-80.2	-71.5	-58.6	-52.8	-66.1	-101.5	-90.5	-74.2	-65.2	-81.6	-125.3	-111.7	-91.6
		2	32.9	-25.0	0.0	0.0	0.0	41.7	-31.6	0.0	0.0	0.0	51.4	-39.0	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-24.1	-52.2	-80.2	-71.5	-58.6	-30.6	-66.1	-101.5	-90.5	-74.2	-37.7	-81.6	-125.3	-111.7	-91.6
		2	39.4	-25.0	0.0	0.0	0.0	49.8	-31.6	0.0	0.0	0.0	61.5	-39.0	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-13.6	-52.2	-80.2	-71.5	-58.6	-17.2	-66.1	-101.5	-90.5	-74.2	-21.3	-81.6	-125.3	-111.7	-91.6
		2	39.4	-25.0	0.0	0.0	0.0	49.8	-31.6	0.0	0.0	0.0	61.5	-39.0	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-79.0	-70.4	-57.7	NA	NA	-100.0	-89.1	-73.1	NA	NA	-123.4	-110.0	-90.2
		2	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-77.5	-55.8	-79.0	-70.4	-57.7	-98.1	-66.7	-100.0	-89.1	-73.1	-121.1	-82.3	-123.4	-110.0	-90.2
		2	11.2	-15.7	0.0	0.0	0.0	14.1	-19.9	0.0	0.0	0.0	17.5	-24.6	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-63.7	-51.4	-79.0	-70.4	-57.7	-80.6	-65.1	-100.0	-89.1	-73.1	-99.5	-80.3	-123.4	-110.0	-90.2
		2	22.1	-22.6	0.0	0.0	0.0	27.9	-28.6	0.0	0.0	0.0	34.5	-35.3	0.0	0.0	0.0
130	5:12 (22.6 deg)	1	-51.1	-51.4	-79.0	-70.4	-57.7	-64.7	-65.1	-100.0	-89.1	-73.1	-79.9	-80.3	-123.4	-110.0	-90.2
		2	29.4	-24.6	0.0	0.0	0.0	37.2	-31.1	0.0	0.0	0.0	45.9	-38.4	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-41.1	-51.4	-79.0	-70.4	-57.7	-52.0	-65.1	-100.0	-89.1	-73.1	-64.1	-80.3	-123.4	-110.0	-90.2
		2	32.4	-24.6	0.0	0.0	0.0	41.0	-31.1	0.0	0.0	0.0	50.6	-38.4	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-23.8	-51.4	-79.0	-70.4	-57.7	-30.1	-65.1	-100.0	-89.1	-73.1	-37.1	-80.3	-123.4	-110.0	-90.2
		2	38.7	-24.6	0.0	0.0	0.0	49.0	-31.1	0.0	0.0	0.0	60.5	-38.4	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-13.4	-51.4	-79.0	-70.4	-57.7	-17.0	-65.1	-100.0	-89.1	-73.1	-21.0	-80.3	-123.4	-110.0	-90.2
		2	38.7	-24.6	0.0	0.0	0.0	49.0	-31.1	0.0	0.0	0.0	60.5	-38.4	0.0	0.0	0.0

Analysis and Commentary

Part 2 of Chapter 27 provides a new simplified method for determining wind loads on enclosed simple diaphragm buildings. This method is applicable to simple diaphragm buildings that have a mean roof height up to 160 ft. The tabulated loads for this method are based on the Directional Procedure which is outlined in Part 1 of Chapter 27 (traditionally known as the "rigid buildings of all heights" in ASCE 7-05 and previous editions). While ASCE 7-05 and ASCE 7-02 also contained a simplified method for enclosed simple diaphragm buildings, it was based on the Envelope Procedure that is now outlined in Part 1 of Chapter 28 (formerly known as the "low-rise buildings"). The simplified method based on the Envelope Procedure is now contained in Part 1 of Chapter 28. The Envelope Procedure is limited to buildings where the mean roof height does not exceed 60 ft or the least horizontal dimension.

The primary reason for the inclusion of simplified methods in ASCE 7 is to improve the likelihood of the designer obtaining the correct answer. Designers that have a good understanding of the wind load concepts in ASCE 7 will most likely not find the simplified methods very helpful, except as a quick follow-up check of their calculations. However, the simplified methods offer easier solutions for the occasional users and save time so the user won't rush through the solution.

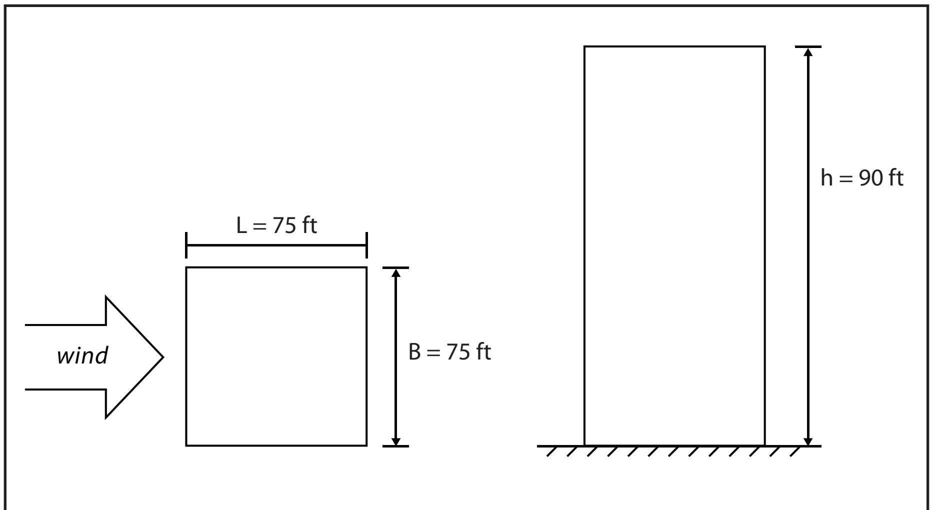
Simple diaphragm buildings are prime candidates for simplified methods. Where wind forces are delivered to the vertical MWFRS via roof and/or floor diaphragms, the windward and leeward loads are combined into a shear load at each story. The internal pressures also cancel out for this scenario. Only if members in the MWFRS are loaded directly by the wind (i.e., windward wall loads are applied directly to the windward leg of a moment frame) do the internal pressures come into play. Therefore, for tabulation purposes, the wind pressures can be resolved into a single horizontal load to be applied at each level.

For wall pressures, Table 27.6-1 is set up such that for a particular wind speed, building height and building aspect ratio, 2 pressures are obtained from the table – p_h, the along-wind pressure at the top of the building; and p_0, the along-wind pressure at the base of the building. Three tables are provided each corresponding to a different Exposure Category (B,C, and D). Note 2 provides the methodology for determining the sidewall pressures and is determined as a percentage of the along-wind pressure at the top of the building based on the L/B ratio of the building. Note 4 basically explains how to separate the windward pressures from the leeward pressures if desired. However, it is important to note that windward and leeward pressures determined by Note 4 do not include the effect of internal pressures and therefore will be of little use for simple diaphragm buildings.

It's also important to note that, for a given wind direction, only two pressures should be obtained from the Table 27.6-1 -p_h and p_0. It is not intended that the pressures be applied from the table for each height increment chosen. In other words, the mean roof heights shown in the left column of each table are not representative of height, z, above ground. For each mean roof height shown in the table, the Velocity Pressure Exposure Coefficient, K_h, is based upon the building mean roof height and is constant regardless of height, z, above ground. The following example illustrates the determination and application of the along-wind pressures on a building.

Example:

V = 140 mph
h = 90 ft
L = 75 ft
B = 75 ft
L/B = 1.0
Exposure B



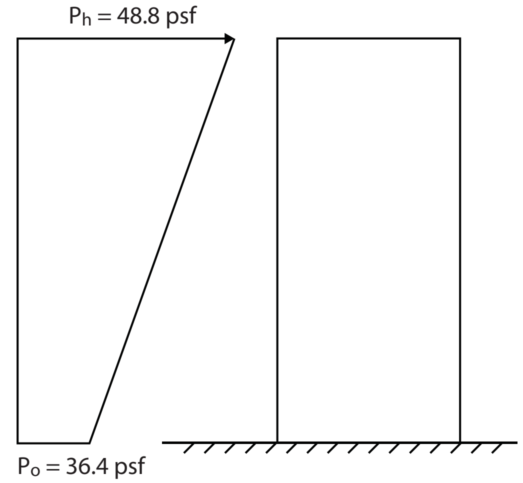
Simplified MWFRS Figure 1

Therefore, from Table 27.6-1 p_h and p_0 are determined as follows:

V(mph)	110			115			120			130			140			160		
h(ft.), L/B	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2
160	38.1	37.7	34.1	42.1	41.7	37.8	46.4	45.9	41.7	55.8	55.1	50.2	66.3	65.4	59.7	91.0	89.4	81.8
	25.6	25.4	21.0	28.3	28.1	23.3	31.2	30.9	25.7	37.5	37.1	30.9	44.6	44.0	36.8	61.2	60.1	50.4
150	36.9	36.6	33.0	40.7	40.4	36.5	44.9	44.4	40.3	53.9	53.3	48.5	63.9	63.1	57.6	87.5	86.1	78.9
	25.1	24.9	20.6	27.7	27.5	22.8	30.5	30.2	25.2	36.7	36.2	30.3	43.5	43.0	36.0	59.6	58.6	49.3
140	36.6	35.4	31.9	39.3	39.1	35.3	43.3	42.9	38.9	51.9	51.4	46.7	61.5	60.8	55.5	84.0	82.8	75.9
	24.5	24.4	20.2	27.1	26.9	22.4	29.8	29.6	24.6	35.7	35.4	29.6	42.4	41.9	35.2	57.9	57.0	48.1
130	34.4	34.2	30.8	37.9	37.7	34.0	41.7	41.4	37.4	49.9	49.5	44.9	59.1	58.5	53.3	80.5	79.5	72.8
	24.0	23.9	19.8	26.5	26.3	21.9	29.1	28.9	24.1	34.8	34.5	28.9	41.2	40.8	34.3	56.2	55.4	46.9
120	33.1	33.0	29.6	36.5	36.3	32.7	40.1	39.9	35.9	47.9	47.6	43.1	56.6	56.2	51.0	76.9	76.1	69.6
	23.4	23.3	19.4	25.8	25.7	21.4	28.4	28.2	23.6	33.9	33.7	28.3	40.1	39.7	33.5	54.4	53.8	45.6
110	31.8	31.7	28.4	35.1	34.9	31.3	38.5	38.3	34.4	45.9	45.6	41.2	54.1	53.8	48.8	73.3	72.6	66.3
	22.9	22.8	19.0	25.2	25.1	20.9	27.7	27.5	23.0	33.0	32.8	27.6	38.9	38.7	32.6	52.7	52.2	44.4
100	30.5	30.4	27.1	33.6	33.5	29.9	36.8	36.7	32.9	43.8	43.6	39.3	51.6	51.3	46.4	69.6	69.1	62.9
	22.3	22.3	18.5	24.6	24.5	20.4	26.9	26.8	22.5	32.1	31.9	26.8	37.8	37.6	31.7	50.9	50.5	43.0
90	29.2	29.1	25.9	32.1	32.0	28.5	35.1	35.0	31.2	44.7	41.6	37.3	49.1	48.8	44.0	65.9	65.5	59.5
	21.8	21.7	18.1	23.9	23.9	19.9	26.2	26.1	21.9	31.1	31.0	26.1	36.6	36.4	30.8	49.2	48.9	41.7
80	27.8	27.7	24.5	30.5	30.5	27.0	33.4	33.3	29.6	39.6	39.5	35.2	46.4	46.3	41.5	62.2	61.9	55.9
	21.2	21.2	17.7	23.3	23.2	19.4	25.5	25.4	21.3	30.2	30.1	25.4	35.4	35.3	29.9	47.4	47.2	40.3
70	26.3	26.3	23.1	28.9	28.8	25.4	31.6	31.5	27.9	37.4	37.3	33.1	43.7	43.6	38.9	58.3	58.1	52.2
	20.6	20.6	17.2	22.6	22.6	18.9	24.7	24.7	20.7	29.3	29.2	24.6	34.2	34.2	28.9	45.6	45.5	38.8

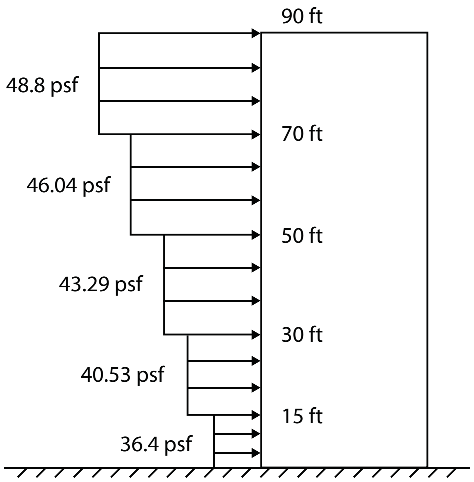
Excerpt from Table 27.6-1

p_h = 48.8 psf
p_0 = 36.4 psf



Simplified MWFRS Figure 2

Linearly interpolate between p_h and p_0 over the height of the building to establish the distribution of the along-wind pressures.



Simplified MWFRS Figure 3

For roof loads, Table 27.6-2 tabulates pressures for all the indicated wind speeds at various mean roof heights for Exposure Category C. Note 1 provides the conversion factors to convert the pressures to Exposure Category B or D. The table also includes figures that identify the zones on the roof for application of the specified roof pressures.

While Section 27.6.1 requires the MWFRS in each direction to be designed for all load cases in Figure 27.4-8 including torsion, the exception permits the omission of compliance with the torsional load cases (Case 2 and Case 4) when the building complies with Appendix D. For more information on new Appendix D, see ASCE 7-10.

Part V
Components and Cladding

Buildings with $h \leq 160$ ft (48.8 m) (Simplified) Simplified Method for Component and Cladding Loads

Roof Overhangs

30.7 Addition

Buildings with h≤160 ft (48.8 m) (Simplified)
Simplified Method for Component and Cladding Loads

At a Glance

A new simplified method for determining component and cladding loads on buildings with mean roof heights up to 160 ft has been added.

2010 Standard

PART 4: BUILDINGS WITH h≤160 ft (48.8 m) (SIMPLIFIED)

30.7 BUILDING TYPES

The provisions of Section 30.7 are applicable to an enclosed building having a mean roof height $h \leq$ 160 ft. (48.8 m) with a flat roof, gable roof, hip roof, monoslope roof, or mansard roof. The steps required for the determination of wind loads on components and cladding for these building types are shown in Table 30.7-1.

30.7.1 WIND LOADS—COMPONENTS AND CLADDING

30.7.1.1 Wall and Roof Surfaces.

Design wind pressures on the designated zones of walls and roof surfaces shall be determined from Table 30.7-2 based on the applicable basic wind speed V, mean roof height h, and roof slope θ. Tabulated pressures shall be multiplied by the exposure adjustment factor (EAF) shown in the table if exposure is different than Exposure C. Pressures in Table 30.7-2 are based on an effective wind area of 10 ft^2 (0.93 m^2). Reductions in wind pressure for larger effective wind areas may be taken based on the reduction multipliers (RF) shown in the table. Pressures are to be applied over the entire zone shown in the figures.

Final design wind pressure shall be determined from the following equation:

$$p = p_{table}(\text{EAF})(\text{RF})K_{zt} \qquad (30.7\text{-}1)$$

where:

RF = effective area reduction factor from Table 30.7-2
EAF = Exposure adjustment factor from Table 30.7-2
K_{zt} = topographic factor as defined in Section 26.8

30.7.1.2 Parapets.

Design wind pressures on parapet surfaces shall be based on wind pressures for the applicable edge and corner zones in which the parapet is located, as shown in Table 30.7-2, modified based on the following two load cases:

- Load Case A shall consist of applying the applicable positive wall pressure from the table to the front surface of the parapet while applying the applicable negative edge or corner zone roof pressure from the table to the back surface.
- Load Case B shall consist of applying the applicable positive wall pressure from the table to the back of the parapet surface and applying the applicable negative wall pressure from the table to the front surface.

Pressures in Table 30.7-2 are based on an effective wind area of 10 sf. Reduction in wind pressure for larger effective wind areas may be taken based on the reduction factor shown in the table.

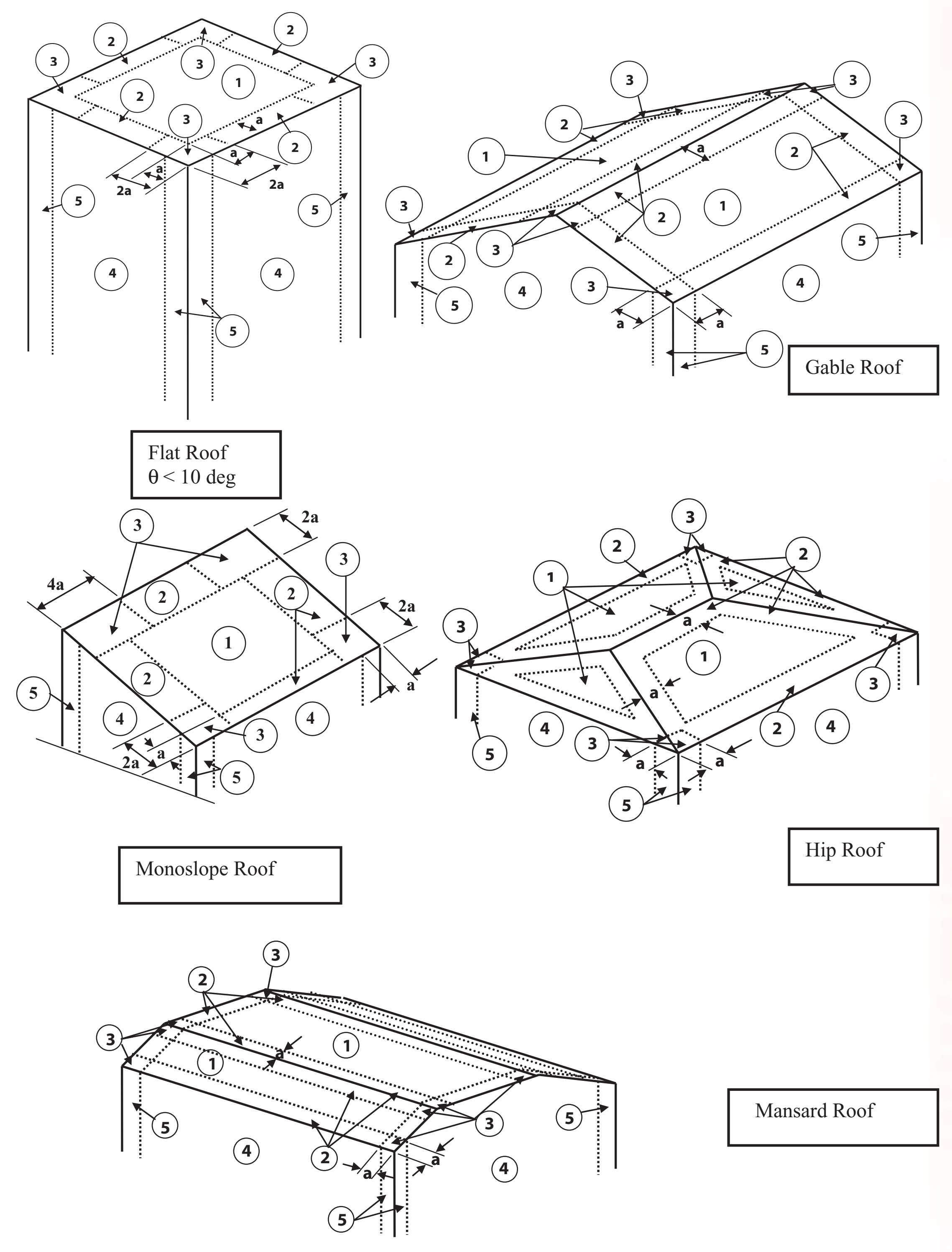
Pressures are to be applied to the parapet in accordance with Fig. 30.7-1. The height *h* to be used with Fig. 30.7-1 to determine the pressures shall be the height to the top of the parapet. Determine final pressure from Equation 30.7-1.

30.7.1.3 Roof Overhangs.

Design wind pressures on roof overhangs shall be based on wind pressures shown for the applicable zones in Table 30.7-2 modified as described herein. For Zones 1 and 2, a multiplier of 1.0 shall be used on pressures shown in the table. For Zone 3, a multiplier of 1.15 shall be used on pressures shown in the table.

Pressures in Table 30.7-2 are based on an effective wind area of 10 sf. Reductions in wind pressure for larger effective wind areas may be taken based on the reduction multiplier shown in the table. Pressures on roof overhangs include the pressure from the top and bottom surface of overhangs. Pressures on the underside of the overhangs are equal to the adjacent wall pressures. Refer to the overhang drawing shown in Fig. 30.7-2. Determine final pressure from Equation 30.7-1.

Components and Cladding – Part 4		h ≤ 160 ft.
Table 30.7-2	C & C Zones	C&C Wall and Roof Pressures
Enclosed Buildings		



Components and Cladding – Part 4		h ≤ 160 ft.
Table 30.7-2	C & C Notes	C&C Wall and Roof Pressures
Enclosed Buildings		

Notes to Component and Cladding Wind Pressure Table:

1. For each roof form, Exposure C, V and h determine roof and wall cladding pressures for the applicable zone from tables below. For other exposures B or D, multiply pressures from table by the appropriate exposure adjustment factor determined from figure below.
2. Interpolation between h values is permitted. For pressures at other V values than shown in the table, multiply table value for any given V' in the table as shown below:

   Pressure at desired V = pressure from table at V' x [V desired / V']^2

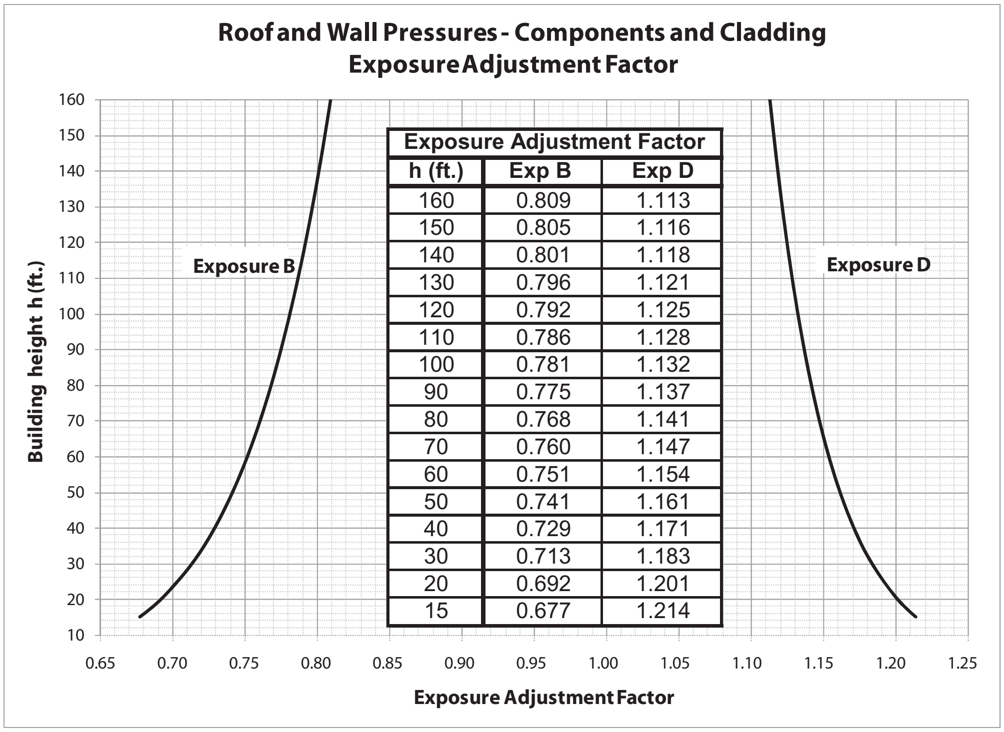
3. Where two load cases are shown, both positive and negative pressures shall be considered.
4. Pressures are shown for an effective wind area = 10 sf (0.93 m^2). For larger effective wind areas, the pressure shown may be reduced by the reduction coefficient applicable to each zone.

Notation:

h = mean roof height (ft)

V = Basic wind speed (mph)

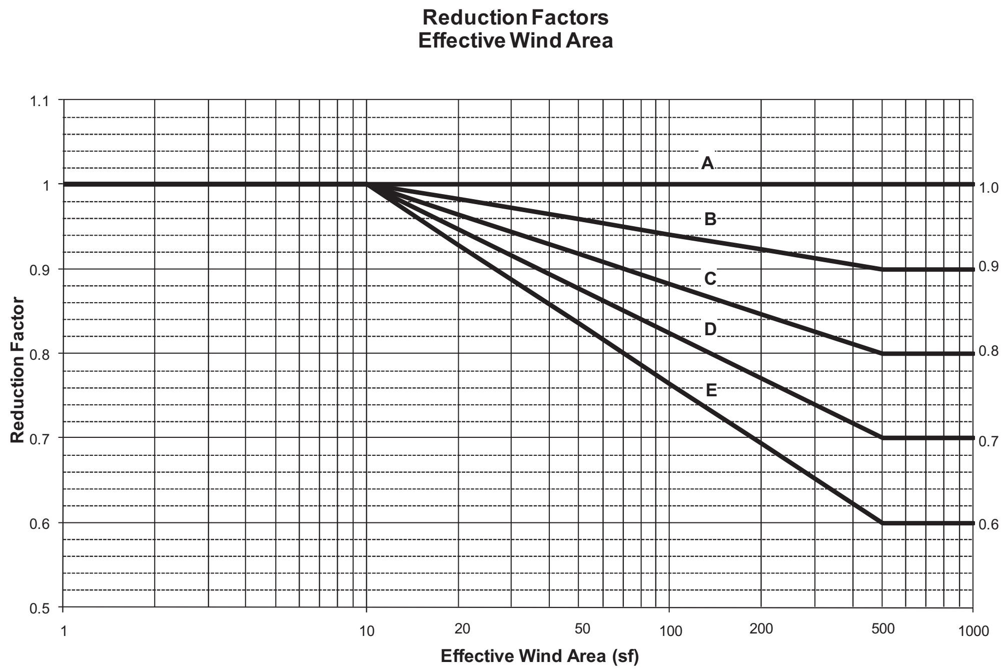
LIVE GRAPH
Click here to view



Exposure Adjustment Factor		
h (ft.)	Exp B	Exp D
160	0.809	1.113
150	0.805	1.116
140	0.801	1.118
130	0.796	1.121
120	0.792	1.125
110	0.786	1.128
100	0.781	1.132
90	0.775	1.137
80	0.768	1.141
70	0.760	1.147
60	0.751	1.154
50	0.741	1.161
40	0.729	1.171
30	0.713	1.183
20	0.692	1.201
15	0.677	1.214

LIVE GRAPH
Click here to view

Components and Cladding – Part 4		h ≤ 160 ft.
Table 30.7-2	C & C Effective Wind Area	C&C Wall and Roof Pressures
Enclosed Buildings		



Reduction Factors
Effective Wind Area

Roof Form	Sign Pressure	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Flat	Minus	D	D	D	C	E
Flat	Plus	NA	NA	NA	D	D
Gable, Mansard	Minus	B	C	C	C	E
Gable, Mansard	Plus	B	B	B	D	D
Hip	Minus	B	C	C	C	E
Hip	Plus	B	B	B	D	D
Monoslope	Plus	A	B	D	C	E
Monoslope	Minus	C	C	C	D	D
Overhangs	All	A	A	B	NA	NA

Table 30.7-2
Components and Cladding – Part 4
Exposure C

C & C
V = 110-120 mph
h = 15-80 ft.

V (MPH)			110					115					120				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
80	Flat Roof	1	-50.2	-78.8	-107.5	-34.3	-63.0	-54.9	-86.2	-117.5	-37.5	-68.8	-59.8	-93.8	-127.9	-40.9	-74.9
		2	NA	NA	NA	34.3	34.3	NA	NA	NA	37.5	37.5	NA	NA	NA	40.9	40.9
	Gable Roof	1	-37.5	-63.0	-94.7	-40.7	-63.0	-41.0	-68.8	-103.6	-44.5	-68.8	-44.6	-74.9	-112.8	-48.4	-74.9
	Mansard Roof	2	21.6	21.6	21.6	37.5	34.3	23.6	23.6	23.6	41.0	37.5	25.7	25.7	25.7	44.6	40.9
	Hip Roof	1	-34.3	-59.8	-88.4	-40.7	-63.0	-37.5	-65.3	-96.6	-44.5	-68.8	-40.9	-71.1	-105.2	-48.4	-74.9
		2	21.6	21.6	21.6	37.5	34.3	23.6	23.6	23.6	41.0	37.5	25.7	25.7	25.7	44.6	40.9
	Monoslope Roof	1	-43.9	-56.6	-97.9	-40.7	-63.0	-48.0	-61.9	-107.0	-44.5	-68.8	-52.2	-67.4	-116.5	-48.4	-74.9
		2	18.4	18.4	18.4	37.5	37.5	20.2	20.2	20.2	41.0	41.0	21.9	21.9	21.9	44.6	44.6
70	Flat Roof	1	-48.8	-76.7	-104.5	-33.4	-61.2	-53.4	-83.8	-114.2	-36.5	-66.9	-58.1	-91.2	-124.3	-39.7	-72.8
		2	NA	NA	NA	33.4	33.4	NA	NA	NA	36.5	36.5	NA	NA	NA	39.7	39.7
	Gable Roof	1	-36.5	-61.2	-92.1	-39.6	-61.2	-39.9	-66.9	-100.7	-43.2	-66.9	-43.4	-72.8	-109.6	-47.1	-72.8
	Mansard Roof	2	21.0	21.0	21.0	36.5	33.4	23.0	23.0	23.0	39.9	36.5	25.0	25.0	25.0	43.4	39.7
	Hip Roof	1	-33.4	-58.1	-85.9	-39.6	-61.2	-36.5	-63.5	-93.9	-43.2	-66.9	-39.7	-69.2	-102.3	-47.1	-72.8
		2	21.0	21.0	21.0	36.5	33.4	23.0	23.0	23.0	39.9	36.5	25.0	25.0	25.0	43.4	39.7
	Monoslope Roof	1	-42.7	-55.0	-95.2	-39.6	-61.2	-46.6	-60.1	-104.1	-43.2	-66.9	-50.8	-65.5	-113.3	-47.1	-72.8
		2	17.9	17.9	17.9	36.5	36.5	19.6	19.6	19.6	39.9	39.9	21.3	21.3	21.3	43.4	43.4
60	Flat Roof	1	-47.3	-74.2	-101.1	-32.3	-59.3	-51.7	-81.1	-110.6	-35.3	-64.8	-56.3	-88.3	-120.4	-38.5	-70.5
		2	NA	NA	NA	32.3	32.3	NA	NA	NA	35.3	35.3	NA	NA	NA	38.5	38.5
	Gable Roof	1	-35.3	-59.3	-89.2	-38.3	-59.3	-38.6	-64.8	-97.5	-41.9	-64.8	-42.0	-70.5	-106.1	-45.6	-70.5
	Mansard Roof	2	20.3	20.3	20.3	35.3	32.3	22.2	22.2	22.2	38.6	35.3	24.2	24.2	24.2	42.0	38.5
	Hip Roof	1	-32.3	-56.3	-83.2	-38.3	-59.3	-35.3	-61.5	-90.9	-41.9	-64.8	-38.5	-67.0	-99.0	-45.6	-70.5
		2	20.3	20.3	20.3	35.3	32.3	22.2	22.2	22.2	38.6	35.3	24.2	24.2	24.2	42.0	38.5
	Monoslope Roof	1	-41.3	-53.3	-92.2	-38.3	-59.3	-45.1	-58.2	-100.7	-41.9	-64.8	-49.1	-63.4	-109.7	-45.6	-70.5
		2	17.4	17.4	17.4	35.3	35.3	19.0	19.0	19.0	38.6	38.6	20.7	20.7	20.7	42.0	42.0
50	Flat Roof	1	-45.5	-71.4	-97.3	-31.1	-57.0	-49.7	-78.1	-106.4	-34.0	-62.3	-54.2	-85.0	-115.8	-37.0	-67.9
		2	NA	NA	NA	31.1	31.1	NA	NA	NA	34.0	34.0	NA	NA	NA	37.0	37.0
	Gable Roof	1	-34.0	-57.0	-85.8	-36.9	-57.0	-37.1	-62.3	-93.8	-40.3	-62.3	-40.4	-67.9	-102.1	-43.9	-67.9
	Mansard Roof	2	19.6	19.6	19.6	34.0	31.1	21.4	21.4	21.4	37.1	34.0	23.3	23.3	23.3	40.4	37.0
	Hip Roof	1	-31.1	-54.1	-80.1	-36.9	-57.0	-34.0	-59.2	-87.5	-40.3	-62.3	-37.0	-64.4	-95.3	-43.9	-67.9
		2	19.6	19.6	19.6	34.0	31.1	21.4	21.4	21.4	37.1	34.0	23.3	23.3	23.3	40.4	37.0
	Monoslope Roof	1	-39.7	-51.3	-88.7	-36.9	-57.0	-43.4	-56.0	-96.9	-40.3	-62.3	-47.3	-61.0	-105.6	-43.9	-67.9
		2	16.7	16.7	16.7	34.0	34.0	18.3	18.3	18.3	37.1	37.1	19.9	19.9	19.9	40.4	40.4
40	Flat Roof	1	-43.4	-68.1	-92.9	-29.7	-54.4	-47.5	-74.5	-101.5	-32.4	-59.5	-51.7	-81.1	-110.5	-35.3	-64.7
		2	NA	NA	NA	29.7	29.7	NA	NA	NA	32.4	32.4	NA	NA	NA	35.3	35.3
	Gable Roof	1	-32.4	-54.4	-81.9	-35.2	-54.4	-35.4	-59.5	-89.5	-38.4	-59.5	-38.6	-64.7	-97.4	-41.9	-64.7
	Mansard Roof	2	18.7	18.7	18.7	32.4	29.7	20.4	20.4	20.4	35.4	32.4	22.2	22.2	22.2	38.6	35.3
	Hip Roof	1	-29.7	-51.7	-76.4	-35.2	-54.4	-32.4	-56.5	-83.5	-38.4	-59.5	-35.3	-61.5	-90.9	-41.9	-64.7
		2	18.7	18.7	18.7	32.4	29.7	20.4	20.4	20.4	35.4	32.4	22.2	22.2	22.2	38.6	35.3
	Monoslope Roof	1	-37.9	-48.9	-84.6	-35.2	-54.4	-41.4	-53.5	-92.5	-38.4	-59.5	-45.1	-58.2	-100.7	-41.9	-64.7
		2	15.9	15.9	15.9	32.4	32.4	17.4	17.4	17.4	35.4	35.4	19.0	19.0	19.0	38.6	38.6
30	Flat Roof	1	-40.9	-64.1	-87.4	-27.9	-51.2	-44.7	-70.1	-95.5	-30.5	-56.0	-48.6	-76.3	-104.0	-33.2	-60.9
		2	NA	NA	NA	27.9	27.9	NA	NA	NA	30.5	30.5	NA	NA	NA	33.2	33.2
	Gable Roof	1	-30.5	-51.2	-77.1	-33.1	-51.2	-33.4	-56.0	-84.2	-36.2	-56.0	-36.3	-60.9	-91.7	-39.4	-60.9
	Mansard Roof	2	17.6	17.6	17.6	30.5	27.9	19.2	19.2	19.2	33.4	30.5	20.9	20.9	20.9	36.3	33.2
	Hip Roof	1	-27.9	-48.6	-71.9	-33.1	-51.2	-30.5	-53.1	-78.6	-36.2	-56.0	-33.2	-57.9	-85.6	-39.4	-60.9
		2	17.6	17.6	17.6	30.5	27.9	19.2	19.2	19.2	33.4	30.5	20.9	20.9	20.9	36.3	33.2
	Monoslope Roof	1	-35.7	-46.0	-79.7	-33.1	-51.2	-39.0	-50.3	-87.1	-36.2	-56.0	-42.5	-54.8	-94.8	-39.4	-60.9
		2	15.0	15.0	15.0	30.5	30.5	16.4	16.4	16.4	33.4	33.4	17.9	17.9	17.9	36.3	36.3
20	Flat Roof	1	-37.5	-58.9	-80.3	-25.6	-47.0	-41.0	-64.4	-87.7	-28.0	-51.4	-44.7	-70.1	-95.5	-30.5	-56.0
		2	NA	NA	NA	25.6	25.6	NA	NA	NA	28.0	28.0	NA	NA	NA	30.5	30.5
	Gable Roof	1	-28.0	-47.0	-70.8	-30.4	-47.0	-30.6	-51.4	-77.3	-33.2	-51.4	-33.3	-56.0	-84.2	-36.2	-56.0
	Mansard Roof	2	16.1	16.1	16.1	28.0	25.6	17.6	17.6	17.6	30.6	28.0	19.2	19.2	19.2	33.3	30.5
	Hip Roof	1	-25.6	-44.6	-66.0	-30.4	-47.0	-28.0	-48.8	-72.2	-33.2	-51.4	-30.5	-53.1	-78.6	-36.2	-56.0
		2	16.1	16.1	16.1	28.0	25.6	17.6	17.6	17.6	30.6	28.0	19.2	19.2	19.2	33.3	30.5
	Monoslope Roof	1	-32.8	-42.3	-73.1	-30.4	-47.0	-35.8	-46.2	-79.9	-33.2	-51.4	-39.0	-50.3	-87.0	-36.2	-56.0
		2	13.8	13.8	13.8	28.0	28.0	15.1	15.1	15.1	30.6	30.6	16.4	16.4	16.4	33.3	33.3
15	Flat Roof	1	-35.3	-55.4	-75.5	-24.1	-44.3	-38.6	-60.6	-82.6	-26.4	-48.4	-42.0	-66.0	-89.9	-28.7	-52.7
		2	NA	NA	NA	24.1	24.1	NA	NA	NA	26.4	26.4	NA	NA	NA	28.7	28.7
	Gable Roof	1	-26.4	-44.3	-66.6	-28.6	-44.3	-28.8	-48.4	-72.8	-31.3	-48.4	-31.4	-52.7	-79.3	-34.0	-52.7
	Mansard Roof	2	15.2	15.2	15.2	26.4	24.1	16.6	16.6	16.6	28.8	26.4	18.1	18.1	18.1	31.4	28.7
	Hip Roof	1	-24.1	-42.0	-62.1	-28.6	-44.3	-26.4	-45.9	-67.9	-31.3	-48.4	-28.7	-50.0	-73.9	-34.0	-52.7
		2	15.2	15.2	15.2	26.4	24.1	16.6	16.6	16.6	28.8	26.4	18.1	18.1	18.1	31.4	28.7
	Monoslope Roof	1	-30.8	-39.8	-68.8	-28.6	-44.3	-33.7	-43.5	-75.2	-31.3	-48.4	-36.7	-47.3	-81.9	-34.0	-52.7
		2	13.0	13.0	13.0	26.4	26.4	14.2	14.2	14.2	28.8	28.8	15.4	15.4	15.4	31.4	31.4

Table 30.7-2
Components and Cladding – Part 4
Exposure C

C & C
V = 130-150 mph
h = 15-80 ft.

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat Roof	1	-70.2	-110.1	-150.1	-48.0	-87.9	-81.4	-127.7	-174.1	-55.6	-102.0	-93.4	-146.6	-199.8	-63.9	-117.1
		2	NA	NA	NA	48.0	48.0	NA	NA	NA	55.6	55.6	NA	NA	NA	63.9	63.9
	Gable Roof	1	-52.4	-87.9	-132.3	-56.8	-87.9	-60.8	-102.0	-153.5	-65.9	-102.0	-69.8	-117.1	-176.2	-75.7	-117.1
80	Mansard Roof	2	30.2	30.2	30.2	52.4	48.0	35.0	35.0	35.0	60.8	55.6	40.2	40.2	40.2	69.8	63.9
	Hip Roof	1	-48.0	-83.5	-123.5	-56.8	-87.9	-55.6	-96.8	-143.2	-65.9	-102.0	-63.9	-111.1	-164.4	-75.7	-117.1
		2	30.2	30.2	30.2	52.4	48.0	35.0	35.0	35.0	60.8	55.6	40.2	40.2	40.2	69.8	63.9
	Monoslope Roof	1	-61.3	-79.0	-136.8	-56.8	-87.9	-71.1	-91.7	-158.6	-65.9	-102.0	-81.6	-105.2	-182.1	-75.7	-117.1
		2	25.8	25.8	25.8	52.4	52.4	29.9	29.9	29.9	60.8	60.8	34.3	34.3	34.3	69.8	69.8
	Flat Roof	1	-68.2	-107.1	-145.9	-46.6	-85.5	-79.1	-124.2	-169.2	-54.1	-99.1	-90.8	-142.6	-194.3	-62.1	-113.8
		2	NA	NA	NA	46.6	46.6	NA	NA	NA	54.1	54.1	NA	NA	NA	62.1	62.1
	Gable Roof	1	-50.9	-85.5	-128.7	-55.3	-85.5	-59.1	-99.1	-149.2	-64.1	-99.1	-67.8	-113.8	-171.3	-73.6	-113.8
70	Mansard Roof	2	29.4	29.4	29.4	50.9	46.6	34.0	34.0	34.0	59.1	54.1	39.1	39.1	39.1	67.8	62.1
	Hip Roof	1	-46.6	-81.2	-120.0	-55.3	-85.5	-54.1	-94.1	-139.2	-64.1	-99.1	-62.1	-108.1	-159.8	-73.6	-113.8
		2	29.4	29.4	29.4	50.9	46.6	34.0	34.0	34.0	59.1	54.1	39.1	39.1	39.1	67.8	62.1
	Monoslope Roof	1	-59.6	-76.9	-133.0	-55.3	-85.5	-69.1	-89.1	-154.2	-64.1	-99.1	-79.3	-102.3	-177.0	-73.6	-113.8
		2	25.0	25.0	25.0	50.9	50.9	29.0	29.0	29.0	59.1	59.1	33.3	33.3	33.3	67.8	67.8
	Flat Roof	1	-66.0	-103.7	-141.3	-45.1	-82.8	-76.6	-120.2	-163.8	-52.4	-96.0	-87.9	-138.0	-188.1	-60.1	-110.2
		2	NA	NA	NA	45.1	45.1	NA	NA	NA	52.4	52.4	NA	NA	NA	60.1	60.1
	Gable Roof	1	-49.3	-82.8	-124.6	-53.5	-82.8	-57.2	-96.0	-144.5	-62.0	-96.0	-65.7	-110.2	-165.8	-71.2	-110.2
60	Mansard Roof	2	28.4	28.4	28.4	49.3	45.1	33.0	33.0	33.0	57.2	52.4	37.8	37.8	37.8	65.7	60.1
	Hip Roof	1	-45.1	-78.6	-116.2	-53.5	-82.8	-52.4	-91.1	-134.8	-62.0	-96.0	-60.1	-104.6	-154.7	-71.2	-110.2
		2	28.4	28.4	28.4	49.3	45.1	33.0	33.0	33.0	57.2	52.4	37.8	37.8	37.8	65.7	60.1
	Monoslope Roof	1	-57.7	-74.4	-128.7	-53.5	-82.8	-66.9	-86.3	-149.3	-62.0	-96.0	-76.8	-99.1	-171.4	-71.2	-110.2
		2	24.2	24.2	24.2	49.3	49.3	28.1	28.1	28.1	57.2	57.2	32.3	32.3	32.3	65.7	65.7
	Flat Roof	1	-63.6	-99.8	-136.0	-43.4	-79.6	-73.7	-115.7	-157.7	-50.4	-92.4	-84.6	-132.8	-181.0	-57.8	-106.0
		2	NA	NA	NA	43.4	43.4	NA	NA	NA	50.4	50.4	NA	NA	NA	57.8	57.8
	Gable Roof	1	-47.5	-79.6	-119.9	-51.5	-79.6	-55.0	-92.4	-139.0	-59.7	-92.4	-63.2	-106.0	-159.6	-68.5	-106.0
50	Mansard Roof	2	27.4	27.4	27.4	47.5	43.4	31.7	31.7	31.7	55.0	50.4	36.4	36.4	36.4	63.2	57.8
	Hip Roof	1	-43.4	-75.6	-111.8	-51.5	-79.6	-50.4	-87.7	-129.7	-59.7	-92.4	-57.8	-100.7	-148.9	-68.5	-106.0
		2	27.4	27.4	27.4	47.5	43.4	31.7	31.7	31.7	55.0	50.4	36.4	36.4	36.4	63.2	57.8
	Monoslope Roof	1	-55.5	-71.6	-123.9	-51.5	-79.6	-64.4	-83.0	-143.7	-59.7	-92.4	-73.9	-95.3	-164.9	-68.5	-106.0
		2	23.3	23.3	23.3	47.5	47.5	27.1	27.1	27.1	55.0	55.0	31.1	31.1	31.1	63.2	63.2
	Flat Roof	1	-60.6	-95.2	-129.7	-41.4	-76.0	-70.3	-110.4	-150.4	-48.1	-88.1	-80.7	-126.7	-172.7	-55.2	-101.2
		2	NA	NA	NA	41.4	41.4	NA	NA	NA	48.1	48.1	NA	NA	NA	55.2	55.2
	Gable Roof	1	-45.3	-76.0	-114.4	-49.1	-76.0	-52.5	-88.1	-132.6	-57.0	-88.1	-60.3	-101.2	-152.3	-65.4	-101.2
40	Mansard Roof	2	26.1	26.1	26.1	45.3	41.4	30.3	30.3	30.3	52.5	48.1	34.7	34.7	34.7	60.3	55.2
	Hip Roof	1	-41.4	-72.1	-106.7	-49.1	-76.0	-48.1	-83.7	-123.7	-57.0	-88.1	-55.2	-96.1	-142.0	-65.4	-101.2
		2	26.1	26.1	26.1	45.3	41.4	30.3	30.3	30.3	52.5	48.1	34.7	34.7	34.7	60.3	55.2
	Monoslope Roof	1	-53.0	-68.3	-118.2	-49.1	-76.0	-61.4	-79.2	-137.1	-57.0	-88.1	-70.5	-90.9	-157.4	-65.4	-101.2
		2	22.3	22.3	22.3	45.3	45.3	25.8	25.8	25.8	52.5	52.5	29.6	29.6	29.6	60.3	60.3
	Flat Roof	1	-57.1	-89.6	-122.1	-39.0	-71.5	-66.2	-103.9	-141.6	-45.2	-82.9	-76.0	-119.3	-162.5	-51.9	-95.2
		2	NA	NA	NA	39.0	39.0	NA	NA	NA	45.2	45.2	NA	NA	NA	51.9	51.9
	Gable Roof	1	-42.6	-71.5	-107.6	-46.2	-71.5	-49.4	-82.9	-124.8	-53.6	-82.9	-56.7	-95.2	-143.3	-61.6	-95.2
30	Mansard Roof	2	24.6	24.6	24.6	42.6	39.0	28.5	28.5	28.5	49.4	45.2	32.7	32.7	32.7	56.7	51.9
	Hip Roof	1	-39.0	-67.9	-100.4	-46.2	-71.5	-45.2	-78.8	-116.5	-53.6	-82.9	-51.9	-90.4	-133.7	-61.6	-95.2
		2	24.6	24.6	24.6	42.6	39.0	28.5	28.5	28.5	49.4	45.2	32.7	32.7	32.7	56.7	51.9
	Monoslope Roof	1	-49.8	-64.3	-111.3	-46.2	-71.5	-57.8	-74.6	-129.0	-53.6	-82.9	-66.4	-85.6	-148.1	-61.6	-95.2
		2	21.0	21.0	21.0	42.6	42.6	24.3	24.3	24.3	49.4	49.4	27.9	27.9	27.9	56.7	56.7
	Flat Roof	1	-52.4	-82.3	-112.1	-35.8	-65.7	-60.8	-95.4	-130.0	-41.5	-76.2	-69.8	-109.5	-149.2	-47.7	-87.4
		2	NA	NA	NA	35.8	35.8	NA	NA	NA	41.5	41.5	NA	NA	NA	47.7	47.7
	Gable Roof	1	-39.1	-65.7	-98.8	-42.5	-65.7	-45.4	-76.2	-114.6	-49.2	-76.2	-52.1	-87.4	-131.6	-56.5	-87.4
20	Mansard Roof	2	22.6	22.6	22.6	39.1	35.8	26.2	26.2	26.2	45.4	41.5	30.0	30.0	30.0	52.1	47.7
	Hip Roof	1	-35.8	-62.4	-92.2	-42.5	-65.7	-41.5	-72.3	-106.9	-49.2	-76.2	-47.7	-83.0	-122.8	-56.5	-87.4
		2	22.6	22.6	22.6	39.1	35.8	26.2	26.2	26.2	45.4	41.5	30.0	30.0	30.0	52.1	47.7
	Monoslope Roof	1	-45.8	-59.0	-102.2	-42.5	-65.7	-53.1	-68.5	-118.5	-49.2	-76.2	-60.9	-78.6	-136.0	-56.5	-87.4
		2	19.2	19.2	19.2	39.1	39.1	22.3	22.3	22.3	45.4	45.4	25.6	25.6	25.6	52.1	52.1
	Flat Roof	1	-49.3	-77.4	-105.5	-33.7	-61.8	-57.2	-89.8	-122.4	-39.1	-71.7	-65.7	-103.1	-140.5	-44.9	-82.3
		2	NA	NA	NA	33.7	33.7	NA	NA	NA	39.1	39.1	NA	NA	NA	44.9	44.9
	Gable Roof	1	-36.8	-61.8	-93.0	-40.0	-61.8	-42.7	-71.7	-107.9	-46.3	-71.7	-49.0	-82.3	-123.9	-53.2	-82.3
15	Mansard Roof	2	21.2	21.2	21.2	36.8	33.7	24.6	24.6	24.6	42.7	39.1	28.3	28.3	28.3	49.0	44.9
	Hip Roof	1	-33.7	-58.7	-86.8	-40.0	-61.8	-39.1	-68.1	-100.6	-46.3	-71.7	-44.9	-78.1	-115.5	-53.2	-82.3
		2	21.2	21.2	21.2	36.8	33.7	24.6	24.6	24.6	42.7	39.1	28.3	28.3	28.3	49.0	44.9
	Monoslope Roof	1	-43.1	-55.6	-96.1	-40.0	-61.8	-50.0	-64.4	-111.5	-46.3	-71.7	-57.4	-74.0	-128.0	-53.2	-82.3
		2	18.1	18.1	18.1	36.8	36.8	21.0	21.0	21.0	42.7	42.7	24.1	24.1	24.1	49.0	49.0

Table 30.7-2
Components and Cladding – Part 4
Exposure C

C & C
V = 160-200 mph
h = 15-80 ft.

V (MPH)			160					180					200				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
80	Flat Roof	1	-106.3	-166.8	-227.4	-72.6	-133.2	-134.5	-211.1	-287.8	-91.9	-168.6	-166.1	-260.7	-355.3	-113.5	-208.1
		2	NA	NA	NA	72.6	72.6	NA	NA	NA	91.9	91.9	NA	NA	NA	113.5	113.5
	Gable Roof Mansard Roof	1	-79.4	-133.2	-200.5	-86.1	-133.2	-100.5	-168.6	-253.7	-109.0	-168.6	-124.0	-208.1	-313.2	-134.5	-208.1
		2	45.7	45.7	45.7	79.4	72.6	57.9	57.9	57.9	100.5	91.9	71.5	71.5	71.5	124.0	113.5
	Hip Roof	1	-72.6	-126.5	-187.0	-86.1	-133.2	-91.9	-160.1	-236.7	-109.0	-168.6	-113.5	-197.6	-292.2	-134.5	-208.1
		2	45.7	45.7	45.7	79.4	72.6	57.9	57.9	57.9	100.5	91.9	71.5	71.5	71.5	124.0	113.5
	Monoslope Roof	1	-92.8	-119.7	-207.2	-86.1	-133.2	-117.5	-151.5	-262.2	-109.0	-168.6	-145.0	-187.1	-323.7	-134.5	-208.1
		2	39.0	39.0	39.0	79.4	79.4	49.4	49.4	49.4	100.5	100.5	61.0	61.0	61.0	124.0	113.5
70	Flat Roof	1	-103.3	-162.2	-221.1	-70.6	-129.5	-130.8	-205.3	-279.8	-89.4	-163.9	-161.5	-253.4	-345.4	-110.4	-202.3
		2	NA	NA	NA	70.6	70.6	NA	NA	NA	89.4	89.4	NA	NA	NA	110.4	110.4
	Gable Roof Mansard Roof	1	-77.2	-129.5	-194.9	-83.7	-129.5	-97.7	-163.9	-246.7	-106.0	-163.9	-120.6	-202.3	-304.5	-130.8	-202.3
		2	44.5	44.5	44.5	77.2	70.6	56.3	56.3	56.3	97.7	89.4	69.5	69.5	69.5	120.6	110.4
	Hip Roof	1	-70.6	-123.0	-181.8	-83.7	-129.5	-89.4	-155.6	-230.1	-106.0	-163.9	-110.4	-192.1	-284.1	-130.8	-202.3
		2	44.5	44.5	44.5	77.2	70.6	56.3	56.3	56.3	97.7	89.4	69.5	69.5	69.5	120.6	110.4
	Monoslope Roof	1	-90.3	-116.4	-201.4	-83.7	-129.5	-114.2	-147.3	-254.9	-106.0	-163.9	-141.0	-181.9	-314.7	-130.8	-202.3
		2	37.9	37.9	37.9	77.2	77.2	48.0	48.0	48.0	97.7	97.7	59.3	59.3	59.3	120.6	110.4
60	Flat Roof	1	-100.0	-157.0	-214.0	-68.4	-125.4	-126.6	-198.7	-270.8	-86.5	-158.7	-156.3	-245.3	-334.4	-106.8	-195.9
		2	NA	NA	NA	68.4	68.4	NA	NA	NA	86.5	86.5	NA	NA	NA	106.8	106.8
	Gable Roof Mansard Roof	1	-74.7	-125.4	-188.7	-81.0	-125.4	-94.6	-158.7	-238.8	-102.6	-158.7	-116.7	-195.9	-294.8	-126.6	-195.9
		2	43.1	43.1	43.1	74.7	68.4	54.5	54.5	54.5	94.6	86.5	67.3	67.3	67.3	116.7	106.8
	Hip Roof	1	-68.4	-119.0	-176.0	-81.0	-125.4	-86.5	-150.6	-222.8	-102.6	-158.7	-106.8	-186.0	-275.0	-126.6	-195.9
		2	43.1	43.1	43.1	74.7	68.4	54.5	54.5	54.5	94.6	86.5	67.3	67.3	67.3	116.7	106.8
	Monoslope Roof	1	-87.4	-112.7	-195.0	-81.0	-125.4	-110.6	-142.6	-246.8	-102.6	-158.7	-136.5	-176.1	-304.7	-126.6	-195.9
		2	36.7	36.7	36.7	74.7	74.7	46.5	46.5	46.5	94.6	94.6	57.4	57.4	57.4	116.7	106.8
50	Flat Roof	1	-96.3	-151.1	-205.9	-65.8	-120.6	-121.8	-191.2	-260.6	-83.3	-152.7	-150.4	-236.1	-321.8	-102.8	-188.5
		2	NA	NA	NA	65.8	65.8	NA	NA	NA	83.3	83.3	NA	NA	NA	102.8	102.8
	Gable Roof Mansard Roof	1	-71.9	-120.6	-181.6	-78.0	-120.6	-91.0	-152.7	-229.8	-98.7	-152.7	-112.3	-188.5	-283.7	-121.9	-188.5
		2	41.4	41.4	41.4	71.9	65.8	52.4	52.4	52.4	91.0	83.3	64.7	64.7	64.7	112.3	102.8
	Hip Roof	1	-65.8	-114.5	-169.4	-78.0	-120.6	-83.3	-145.0	-214.4	-98.7	-152.7	-102.8	-179.0	-264.7	-121.9	-188.5
		2	41.4	41.4	41.4	71.9	65.8	52.4	52.4	52.4	91.0	83.3	64.7	64.7	64.7	112.3	102.8
	Monoslope Roof	1	-84.1	-108.5	-187.7	-78.0	-120.6	-106.4	-137.3	-237.5	-98.7	-152.7	-131.4	-169.5	-293.2	-121.9	-188.5
		2	35.3	35.3	35.3	71.9	71.9	44.7	44.7	44.7	91.0	91.0	55.2	55.2	55.2	112.3	102.8
40	Flat Roof	1	-91.9	-144.2	-196.5	-62.8	-115.1	-116.2	-182.5	-248.7	-79.5	-145.7	-143.5	-225.3	-307.0	-98.1	-179.8
		2	NA	NA	NA	62.8	62.8	NA	NA	NA	79.5	79.5	NA	NA	NA	98.1	98.1
	Gable Roof Mansard Roof	1	-68.6	-115.1	-173.2	-74.4	-115.1	-86.8	-145.7	-219.3	-94.2	-145.7	-107.2	-179.8	-270.7	-116.3	-179.8
		2	39.5	39.5	39.5	68.6	62.8	50.0	50.0	50.0	86.8	79.5	61.8	61.8	61.8	107.2	98.1
	Hip Roof	1	-62.8	-109.3	-161.6	-74.4	-115.1	-79.5	-138.3	-204.5	-94.2	-145.7	-98.1	-170.8	-252.5	-116.3	-179.8
		2	39.5	39.5	39.5	68.6	62.8	50.0	50.0	50.0	86.8	79.5	61.8	61.8	61.8	107.2	98.1
	Monoslope Roof	1	-80.2	-103.5	-179.1	-74.4	-115.1	-101.5	-131.0	-226.6	-94.2	-145.7	-125.3	-161.7	-279.8	-116.3	-179.8
		2	33.7	33.7	33.7	68.6	68.6	42.7	42.7	42.7	86.8	86.8	52.7	52.7	52.7	107.2	98.1
30	Flat Roof	1	-86.5	-135.7	-184.9	-59.1	-108.3	-109.4	-171.7	-234.1	-74.8	-137.1	-135.1	-212.0	-289.0	-92.3	-169.3
		2	NA	NA	NA	59.1	59.1	NA	NA	NA	74.8	74.8	NA	NA	NA	92.3	92.3
	Gable Roof Mansard Roof	1	-64.6	-108.3	-163.1	-70.0	-108.3	-81.7	-137.1	-206.4	-88.6	-137.1	-100.9	-169.3	-254.8	-109.4	-169.3
		2	37.2	37.2	37.2	64.6	59.1	47.1	47.1	47.1	81.7	74.8	58.1	58.1	58.1	100.9	92.3
	Hip Roof	1	-59.1	-102.9	-152.1	-70.0	-108.3	-74.8	-130.2	-192.5	-88.6	-137.1	-92.3	-160.7	-237.7	-109.4	-169.3
		2	37.2	37.2	37.2	64.6	59.1	47.1	47.1	47.1	81.7	74.8	58.1	58.1	58.1	100.9	92.3
	Monoslope Roof	1	-75.5	-97.4	-168.5	-70.0	-108.3	-95.6	-123.3	-213.3	-88.6	-137.1	-118.0	-152.2	-263.3	-109.4	-169.3
		2	31.7	31.7	31.7	64.6	64.6	40.2	40.2	40.2	81.7	81.7	49.6	49.6	49.6	100.9	92.3
20	Flat Roof	1	-79.4	-124.6	-169.8	-54.3	-99.5	-100.5	-157.7	-214.9	-68.7	-125.9	-124.0	-194.7	-265.3	-84.8	-155.4
		2	NA	NA	NA	54.3	54.3	NA	NA	NA	68.7	68.7	NA	NA	NA	84.8	84.8
	Gable Roof Mansard Roof	1	-59.3	-99.5	-149.7	-64.3	-99.5	-75.0	-125.9	-189.5	-81.4	-125.9	-92.6	-155.4	-233.9	-100.5	-155.4
		2	34.2	34.2	34.2	59.3	54.3	43.2	43.2	43.2	75.0	68.7	53.4	53.4	53.4	92.6	84.8
	Hip Roof	1	-54.3	-94.5	-139.7	-64.3	-99.5	-68.7	-119.5	-176.8	-81.4	-125.9	-84.8	-147.6	-218.2	-100.5	-155.4
		2	34.2	34.2	34.2	59.3	54.3	43.2	43.2	43.2	75.0	68.7	53.4	53.4	53.4	92.6	84.8
	Monoslope Roof	1	-69.3	-89.4	-154.7	-64.3	-99.5	-87.7	-113.2	-195.8	-81.4	-125.9	-108.3	-139.7	-241.8	-100.5	-155.4
		2	29.1	29.1	29.1	59.3	59.3	36.9	36.9	36.9	75.0	75.0	45.5	45.5	45.5	92.6	84.8
15	Flat Roof	1	-74.7	-117.3	-159.8	-51.1	-93.6	-94.6	-148.4	-202.3	-64.6	-118.5	-116.7	-183.2	-249.7	-79.8	-146.3
		2	NA	NA	NA	51.1	51.1	NA	NA	NA	64.6	64.6	NA	NA	NA	79.8	79.8
	Gable Roof Mansard Roof	1	-55.8	-93.6	-140.9	-60.5	-93.6	-70.6	-118.5	-178.3	-76.6	-118.5	-87.2	-146.3	-220.2	-94.6	-146.3
		2	32.2	32.2	32.2	55.8	51.1	40.7	40.7	40.7	70.6	64.6	50.2	50.2	50.2	87.2	79.8
	Hip Roof	1	-51.1	-88.9	-131.5	-60.5	-93.6	-64.6	-112.5	-166.4	-76.6	-118.5	-79.8	-138.9	-205.4	-94.6	-146.3
		2	32.2	32.2	32.2	55.8	51.1	40.7	40.7	40.7	70.6	64.6	50.2	50.2	50.2	87.2	79.8
	Monoslope Roof	1	-65.3	-84.2	-145.6	-60.5	-93.6	-82.6	-106.5	-184.3	-76.6	-118.5	-102.0	-131.5	-227.6	-94.6	-146.3
		2	27.4	27.4	27.4	55.8	55.8	34.7	34.7	34.7	70.6	70.6	42.9	42.9	42.9	87.2	79.8

Table 30.7-2
Components and Cladding – Part 4
Exposure C

C & C
V = 110-120 mph
h = 90-160 ft.

V (MPH)			110					115					120				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat Roof	1	-58.1	-91.2	-124.3	-39.7	-72.8	-63.5	-99.7	-135.9	-43.4	-79.6	-69.2	-108.6	-148.0	-47.3	-86.7
		2	NA	NA	NA	39.7	39.7	NA	NA	NA	43.4	43.4	NA	NA	NA	47.3	47.3
	Gable Roof	1	-43.4	-72.8	-109.6	-47.1	-72.8	-47.4	-79.6	-119.8	-51.5	-79.6	-51.7	-86.7	-130.5	-56.0	-86.7
160	Mansard Roof	2	25.0	25.0	25.0	43.4	39.7	27.3	27.3	27.3	47.4	43.4	29.8	29.8	29.8	51.7	47.3
	Hip Roof	1	-39.7	-69.2	-102.3	-47.1	-72.8	-43.4	-75.6	-111.8	-51.5	-79.6	-47.3	-82.3	-121.7	-56.0	-86.7
		2	25.0	25.0	25.0	43.4	39.7	27.3	27.3	27.3	47.4	43.4	29.8	29.8	29.8	51.7	47.3
	Monoslope Roof	1	-50.8	-65.5	-113.3	-47.1	-72.8	-55.5	-71.6	-123.8	-51.5	-79.6	-60.4	-77.9	-134.8	-56.0	-86.7
		2	21.3	21.3	21.3	43.4	43.4	23.3	23.3	23.3	47.4	47.4	25.4	25.4	25.4	51.7	51.7
	Flat Roof	1	-57.3	-90.0	-122.7	-39.2	-71.9	-62.7	-98.4	-134.1	-42.8	-78.5	-68.2	-107.1	-146.0	-46.6	-85.5
		2	NA	NA	NA	39.2	39.2	NA	NA	NA	42.8	42.8	NA	NA	NA	46.6	46.6
	Gable Roof	1	-42.8	-71.9	-108.2	-46.5	-71.9	-46.8	-78.5	-118.2	-50.8	-78.5	-51.0	-85.5	-128.7	-55.3	-85.5
150	Mansard Roof	2	24.7	24.7	24.7	42.8	39.2	27.0	27.0	27.0	46.8	42.8	29.4	29.4	29.4	51.0	46.6
	Hip Roof	1	-39.2	-68.2	-100.9	-46.5	-71.9	-42.8	-74.6	-110.3	-50.8	-78.5	-46.6	-81.2	-120.1	-55.3	-85.5
		2	24.7	24.7	24.7	42.8	39.2	27.0	27.0	27.0	46.8	42.8	29.4	29.4	29.4	51.0	46.6
	Monoslope Roof	1	-50.1	-64.6	-111.8	-46.5	-71.9	-54.7	-70.6	-122.2	-50.8	-78.5	-59.6	-76.9	-133.0	-55.3	-85.5
		2	21.0	21.0	21.0	42.8	42.8	23.0	23.0	23.0	46.8	46.8	25.1	25.1	25.1	51.0	51.0
	Flat Roof	1	-56.5	-88.7	-120.9	-38.6	-70.8	-61.8	-97.0	-132.1	-42.2	-77.4	-67.3	-105.6	-143.9	-46.0	-84.3
		2	NA	NA	NA	38.6	38.6	NA	NA	NA	42.2	42.2	NA	NA	NA	46.0	46.0
	Gable Roof	1	-42.2	-70.8	-106.6	-45.8	-70.8	-46.1	-77.4	-116.5	-50.0	-77.4	-50.2	-84.3	-126.9	-54.5	-84.3
140	Mansard Roof	2	24.3	24.3	24.3	42.2	38.6	26.6	26.6	26.6	46.1	42.2	28.9	28.9	28.9	50.2	46.0
	Hip Roof	1	-38.6	-67.2	-99.4	-45.8	-70.8	-42.2	-73.5	-108.7	-50.0	-77.4	-46.0	-80.0	-118.3	-54.5	-84.3
		2	24.3	24.3	24.3	42.2	38.6	26.6	26.6	26.6	46.1	42.2	28.9	28.9	28.9	50.2	46.0
	Monoslope Roof	1	-49.4	-63.7	-110.2	-45.8	-70.8	-54.0	-69.6	-120.4	-50.0	-77.4	-58.7	-75.8	-131.1	-54.5	-84.3
		2	20.7	20.7	20.7	42.2	42.2	22.7	22.7	22.7	46.1	46.1	24.7	24.7	24.7	50.2	50.2
	Flat Roof	1	-55.6	-87.3	-119.0	-38.0	-69.7	-60.8	-95.5	-130.1	-41.6	-76.2	-66.2	-103.9	-141.7	-45.3	-83.0
		2	NA	NA	NA	38.0	38.0	NA	NA	NA	41.6	41.6	NA	NA	NA	45.3	45.3
	Gable Roof	1	-41.6	-69.7	-104.9	-45.1	-69.7	-45.4	-76.2	-114.7	-49.3	-76.2	-49.5	-83.0	-124.9	-53.6	-83.0
130	Mansard Roof	2	23.9	23.9	23.9	41.6	38.0	26.2	26.2	26.2	45.4	41.6	28.5	28.5	28.5	49.5	45.3
	Hip Roof	1	-38.0	-66.2	-97.9	-45.1	-69.7	-41.6	-72.4	-107.0	-49.3	-76.2	-45.3	-78.8	-116.5	-53.6	-83.0
		2	23.9	23.9	23.9	41.6	38.0	26.2	26.2	26.2	45.4	41.6	28.5	28.5	28.5	49.5	45.3
	Monoslope Roof	1	-48.6	-62.7	-108.5	-45.1	-69.7	-53.1	-68.5	-118.5	-49.3	-76.2	-57.8	-74.6	-129.1	-53.6	-83.0
		2	20.4	20.4	20.4	41.6	41.6	22.3	22.3	22.3	45.4	45.4	24.3	24.3	24.3	49.5	49.5
	Flat Roof	1	-54.7	-85.9	-117.0	-37.4	-68.6	-59.8	-93.9	-127.9	-40.9	-74.9	-65.1	-102.2	-139.3	-44.5	-81.6
		2	NA	NA	NA	37.4	37.4	NA	NA	NA	40.9	40.9	NA	NA	NA	44.5	44.5
	Gable Roof	1	-40.9	-68.6	-103.2	-44.3	-68.6	-44.7	-74.9	-112.8	-48.4	-74.9	-48.6	-81.6	-122.8	-52.7	-81.6
120	Mansard Roof	2	23.5	23.5	23.5	40.9	37.4	25.7	25.7	25.7	44.7	40.9	28.0	28.0	28.0	48.6	44.5
	Hip Roof	1	-37.4	-65.1	-96.3	-44.3	-68.6	-40.9	-71.2	-105.2	-48.4	-74.9	-44.5	-77.5	-114.6	-52.7	-81.6
		2	23.5	23.5	23.5	40.9	37.4	25.7	25.7	25.7	44.7	40.9	28.0	28.0	28.0	48.6	44.5
	Monoslope Roof	1	-47.8	-61.6	-106.7	-44.3	-68.6	-52.2	-67.4	-116.6	-48.4	-74.9	-56.9	-73.4	-126.9	-52.7	-81.6
		2	20.1	20.1	20.1	40.9	40.9	22.0	22.0	22.0	44.7	44.7	23.9	23.9	23.9	48.6	48.6
	Flat Roof	1	-53.7	-84.3	-114.9	-36.7	-67.3	-58.7	-92.2	-125.6	-40.1	-73.6	-63.9	-100.3	-136.8	-43.7	-80.1
		2	NA	NA	NA	36.7	36.7	NA	NA	NA	40.1	40.1	NA	NA	NA	43.7	43.7
	Gable Roof	1	-40.1	-67.3	-101.3	-43.5	-67.3	-43.8	-73.6	-110.7	-47.6	-73.6	-47.7	-80.1	-120.6	-51.8	-80.1
110	Mansard Roof	2	23.1	23.1	23.1	40.1	36.7	25.3	25.3	25.3	43.8	40.1	27.5	27.5	27.5	47.7	43.7
	Hip Roof	1	-36.7	-63.9	-94.5	-43.5	-67.3	-40.1	-69.9	-103.3	-47.6	-73.6	-43.7	-76.1	-112.5	-51.8	-80.1
		2	23.1	23.1	23.1	40.1	36.7	25.3	25.3	25.3	43.8	40.1	27.5	27.5	27.5	47.7	43.7
	Monoslope Roof	1	-46.9	-60.5	-104.7	-43.5	-67.3	-51.3	-66.1	-114.5	-47.6	-73.6	-55.8	-72.0	-124.6	-51.8	-80.1
		2	19.7	19.7	19.7	40.1	40.1	21.6	21.6	21.6	43.8	43.8	23.5	23.5	23.5	47.7	47.7
	Flat Roof	1	-52.7	-82.6	-112.6	-36.0	-66.0	-57.5	-90.3	-123.1	-39.3	-72.1	-62.7	-98.4	-134.0	-42.8	-78.5
		2	NA	NA	NA	36.0	36.0	NA	NA	NA	39.3	39.3	NA	NA	NA	42.8	42.8
	Gable Roof	1	-39.3	-66.0	-99.3	-42.7	-66.0	-43.0	-72.1	-108.5	-46.6	-72.1	-46.8	-78.5	-118.2	-50.8	-78.5
100	Mansard Roof	2	22.7	22.7	22.7	39.3	36.0	24.8	24.8	24.8	43.0	39.3	27.0	27.0	27.0	46.8	42.8
	Hip Roof	1	-36.0	-62.6	-92.6	-42.7	-66.0	-39.3	-68.5	-101.3	-46.6	-72.1	-42.8	-74.6	-110.2	-50.8	-78.5
		2	22.7	22.7	22.7	39.3	36.0	24.8	24.8	24.8	43.0	39.3	27.0	27.0	27.0	46.8	42.8
	Monoslope Roof	1	-46.0	-59.3	-102.6	-42.7	-66.0	-50.3	-64.8	-112.2	-46.6	-72.1	-54.7	-70.6	-122.1	-50.8	-78.5
		2	19.3	19.3	19.3	39.3	39.3	21.1	21.1	21.1	43.0	43.0	23.0	23.0	23.0	46.8	46.8
	Flat Roof	1	-51.5	-80.8	-110.2	-35.2	-64.5	-56.3	-88.3	-120.4	-38.5	-70.5	-61.3	-96.2	-131.1	-41.9	-76.8
		2	NA	NA	NA	35.2	35.2	NA	NA	NA	38.5	38.5	NA	NA	NA	41.9	41.9
	Gable Roof	1	-38.5	-64.5	-97.1	-41.7	-64.5	-42.0	-70.5	-106.2	-45.6	-70.5	-45.8	-76.8	-115.6	-49.6	-76.8
90	Mansard Roof	2	22.2	22.2	22.2	38.5	35.2	24.2	24.2	24.2	42.0	38.5	26.4	26.4	26.4	45.8	41.9
	Hip Roof	1	-35.2	-61.3	-90.6	-41.7	-64.5	-38.5	-67.0	-99.0	-45.6	-70.5	-41.9	-72.9	-107.8	-49.6	-76.8
		2	22.2	22.2	22.2	38.5	35.2	24.2	24.2	24.2	42.0	38.5	26.4	26.4	26.4	45.8	41.9
	Monoslope Roof	1	-45.0	-58.0	-100.4	-41.7	-64.5	-49.2	-63.4	-109.7	-45.6	-70.5	-53.5	-69.0	-119.5	-49.6	-76.8
		2	18.9	18.9	18.9	38.5	38.5	20.7	20.7	20.7	42.0	42.0	22.5	22.5	22.5	45.8	45.8

Table 30.7-2
Components and Cladding – Part 4
Exposure C

C & C
V = 130-150 mph
h = 90-160 ft.

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat Roof	1	-81.2	-127.4	-173.7	-55.5	-101.7	-94.2	-147.8	-201.4	-64.4	-118.0	-108.1	-169.7	-231.2	-73.9	-135.5
		2	NA	NA	NA	55.5	55.5	NA	NA	NA	64.4	64.4	NA	NA	NA	73.9	73.9
	Gable Roof	1	-60.6	-101.7	-153.1	-65.8	-101.7	-70.3	-118.0	-177.6	-76.3	-118.0	-80.7	-135.5	-203.9	-87.6	-135.5
160	Mansard Roof	2	34.9	34.9	34.9	60.6	55.5	40.5	40.5	40.5	70.3	64.4	46.5	46.5	46.5	80.7	73.9
	Hip Roof	1	-55.5	-96.6	-142.8	-65.8	-101.7	-64.4	-112.0	-165.7	-76.3	-118.0	-73.9	-128.6	-190.2	-87.6	-135.5
		2	34.9	34.9	34.9	60.6	55.5	40.5	40.5	40.5	70.3	64.4	46.5	46.5	46.5	80.7	73.9
	Monoslope Roof	1	-70.9	-91.5	-158.3	-65.8	-101.7	-82.2	-106.1	-183.5	-76.3	-118.0	-94.4	-121.8	-210.7	-87.6	-135.5
		2	29.8	29.8	29.8	60.6	60.6	34.6	34.6	34.6	70.3	70.3	39.7	39.7	39.7	80.7	80.7
	Flat Roof	1	-80.1	-125.7	-171.3	-54.7	-100.4	-92.9	-145.8	-198.7	-63.5	-116.4	-106.6	-167.4	-228.1	-72.9	-133.6
		2	NA	NA	NA	54.7	54.7	NA	NA	NA	63.5	63.5	NA	NA	NA	72.9	72.9
	Gable Roof	1	-59.8	-100.4	-151.1	-64.9	-100.4	-69.4	-116.4	-175.2	-75.2	-116.4	-79.6	-133.6	-201.1	-86.4	-133.6
150	Mansard Roof	2	34.5	34.5	34.5	59.8	54.7	40.0	40.0	40.0	69.4	63.5	45.9	45.9	45.9	79.6	72.9
	Hip Roof	1	-54.7	-95.3	-140.9	-64.9	-100.4	-63.5	-110.5	-163.4	-75.2	-116.4	-72.9	-126.9	-187.6	-86.4	-133.6
		2	34.5	34.5	34.5	59.8	54.7	40.0	40.0	40.0	69.4	63.5	45.9	45.9	45.9	79.6	72.9
	Monoslope Roof	1	-70.0	-90.2	-156.1	-64.9	-100.4	-81.1	-104.6	-181.1	-75.2	-116.4	-93.1	-120.1	-207.9	-86.4	-133.6
		2	29.4	29.4	29.4	59.8	59.8	34.1	34.1	34.1	69.4	69.4	39.1	39.1	39.1	79.6	79.6
	Flat Roof	1	-78.9	-123.9	-168.9	-54.0	-98.9	-91.5	-143.7	-195.8	-62.6	-114.7	-105.1	-165.0	-224.8	-71.8	-131.7
		2	NA	NA	NA	54.0	54.0	NA	NA	NA	62.6	62.6	NA	NA	NA	71.8	71.8
	Gable Roof	1	-59.0	-98.9	-148.9	-63.9	-98.9	-68.4	-114.7	-172.7	-74.2	-114.7	-78.5	-131.7	-198.2	-85.1	-131.7
140	Mansard Roof	2	34.0	34.0	34.0	59.0	54.0	39.4	39.4	39.4	68.4	62.6	45.2	45.2	45.2	78.5	71.8
	Hip Roof	1	-54.0	-93.9	-138.9	-63.9	-98.9	-62.6	-108.9	-161.1	-74.2	-114.7	-71.8	-125.0	-184.9	-85.1	-131.7
		2	34.0	34.0	34.0	59.0	54.0	39.4	39.4	39.4	68.4	62.6	45.2	45.2	45.2	78.5	71.8
	Monoslope Roof	1	-68.9	-88.9	-153.9	-63.9	-98.9	-80.0	-103.1	-178.5	-74.2	-114.7	-91.8	-118.4	-204.9	-85.1	-131.7
		2	29.0	29.0	29.0	59.0	59.0	33.6	33.6	33.6	68.4	68.4	38.6	38.6	38.6	78.5	78.5
	Flat Roof	1	-77.7	-122.0	-166.2	-53.1	-97.4	-90.1	-141.5	-192.8	-61.6	-112.9	-103.5	-162.4	-221.3	-70.7	-129.7
		2	NA	NA	NA	53.1	53.1	NA	NA	NA	61.6	61.6	NA	NA	NA	70.7	70.7
	Gable Roof	1	-58.0	-97.4	-146.6	-63.0	-97.4	-67.3	-112.9	-170.0	-73.0	-112.9	-77.3	-129.7	-195.1	-83.8	-129.7
130	Mansard Roof	2	33.4	33.4	33.4	58.0	53.1	38.8	38.8	38.8	67.3	61.6	44.5	44.5	44.5	77.3	70.7
	Hip Roof	1	-53.1	-92.5	-136.7	-63.0	-97.4	-61.6	-107.2	-158.6	-73.0	-112.9	-70.7	-123.1	-182.0	-83.8	-129.7
		2	33.4	33.4	33.4	58.0	53.1	38.8	38.8	38.8	67.3	61.6	44.5	44.5	44.5	77.3	70.7
	Monoslope Roof	1	-67.9	-87.6	-151.5	-63.0	-97.4	-78.7	-101.5	-175.7	-73.0	-112.9	-90.4	-116.6	-201.7	-83.8	-129.7
		2	28.5	28.5	28.5	58.0	58.0	33.1	33.1	33.1	67.3	67.3	38.0	38.0	38.0	77.3	77.3
	Flat Roof	1	-76.4	-119.9	-163.5	-52.2	-95.8	-88.6	-139.1	-189.6	-60.6	-111.1	-101.7	-159.7	-217.6	-69.5	-127.5
		2	NA	NA	NA	52.2	52.2	NA	NA	NA	60.6	60.6	NA	NA	NA	69.5	69.5
	Gable Roof	1	-57.1	-95.8	-144.1	-61.9	-95.8	-66.2	-111.1	-167.1	-71.8	-111.1	-76.0	-127.5	-191.9	-82.4	-127.5
120	Mansard Roof	2	32.9	32.9	32.9	57.1	52.2	38.1	38.1	38.1	66.2	60.6	43.8	43.8	43.8	76.0	69.5
	Hip Roof	1	-52.2	-90.9	-134.5	-61.9	-95.8	-60.6	-105.4	-155.9	-71.8	-111.1	-69.5	-121.1	-179.0	-82.4	-127.5
		2	32.9	32.9	32.9	57.1	52.2	38.1	38.1	38.1	66.2	60.6	43.8	43.8	43.8	76.0	69.5
	Monoslope Roof	1	-66.7	-86.1	-149.0	-61.9	-95.8	-77.4	-99.8	-172.8	-71.8	-111.1	-88.9	-114.6	-198.3	-82.4	-127.5
		2	28.1	28.1	28.1	57.1	57.1	32.5	32.5	32.5	66.2	66.2	37.3	37.3	37.3	76.0	76.0
	Flat Roof	1	-75.0	-117.8	-160.5	-51.3	-94.0	-87.0	-136.6	-186.1	-59.5	-109.0	-99.9	-156.8	-213.7	-68.3	-125.2
		2	NA	NA	NA	51.3	51.3	NA	NA	NA	59.5	59.5	NA	NA	NA	68.3	68.3
	Gable Roof	1	-56.0	-94.0	-141.5	-60.8	-94.0	-65.0	-109.0	-164.1	-70.5	-109.0	-74.6	-125.2	-188.4	-80.9	-125.2
110	Mansard Roof	2	32.3	32.3	32.3	56.0	51.3	37.4	37.4	37.4	65.0	59.5	43.0	43.0	43.0	74.6	68.3
	Hip Roof	1	-51.3	-89.3	-132.0	-60.8	-94.0	-59.5	-103.5	-153.1	-70.5	-109.0	-68.3	-118.9	-175.8	-80.9	-125.2
		2	32.3	32.3	32.3	56.0	51.3	37.4	37.4	37.4	65.0	59.5	43.0	43.0	43.0	74.6	68.3
	Monoslope Roof	1	-65.5	-84.5	-146.3	-60.8	-94.0	-76.0	-98.0	-169.6	-70.5	-109.0	-87.2	-112.5	-194.7	-80.9	-125.2
		2	27.5	27.5	27.5	56.0	56.0	31.9	31.9	31.9	65.0	65.0	36.7	36.7	36.7	74.6	74.6
	Flat Roof	1	-73.5	-115.4	-157.3	-50.3	-92.2	-85.3	-133.9	-182.4	-58.3	-106.9	-97.9	-153.7	-209.4	-66.9	-122.7
		2	NA	NA	NA	50.3	50.3	NA	NA	NA	58.3	58.3	NA	NA	NA	66.9	66.9
	Gable Roof	1	-54.9	-92.2	-138.7	-59.6	-92.2	-63.7	-106.9	-160.9	-69.1	-106.9	-73.1	-122.7	-184.7	-79.3	-122.7
100	Mansard Roof	2	31.6	31.6	31.6	54.9	50.3	36.7	36.7	36.7	63.7	58.3	42.1	42.1	42.1	73.1	66.9
	Hip Roof	1	-50.3	-87.5	-129.4	-59.6	-92.2	-58.3	-101.5	-150.1	-69.1	-106.9	-66.9	-116.5	-172.3	-79.3	-122.7
		2	31.6	31.6	31.6	54.9	50.3	36.7	36.7	36.7	63.7	58.3	42.1	42.1	42.1	73.1	66.9
	Monoslope Roof	1	-64.2	-82.8	-143.4	-59.6	-92.2	-74.5	-96.1	-166.3	-69.1	-106.9	-85.5	-110.3	-190.9	-79.3	-122.7
		2	27.0	27.0	27.0	54.9	54.9	31.3	31.3	31.3	63.7	63.7	35.9	35.9	35.9	73.1	73.1
	Flat Roof	1	-71.9	-112.9	-153.9	-49.2	-90.1	-83.4	-130.9	-178.4	-57.0	-104.5	-95.8	-150.3	-204.8	-65.5	-120.0
		2	NA	NA	NA	49.2	49.2	NA	NA	NA	57.0	57.0	NA	NA	NA	65.5	65.5
	Gable Roof	1	-53.7	-90.1	-135.7	-58.3	-90.1	-62.3	-104.5	-157.3	-67.6	-104.5	-71.5	-120.0	-180.6	-77.6	-120.0
90	Mansard Roof	2	31.0	31.0	31.0	53.7	49.2	35.9	35.9	35.9	62.3	57.0	41.2	41.2	41.2	71.5	65.5
	Hip Roof	1	-49.2	-85.6	-126.5	-58.3	-90.1	-57.0	-99.3	-146.8	-67.6	-104.5	-65.5	-113.9	-168.5	-77.6	-120.0
		2	31.0	31.0	31.0	53.7	49.2	35.9	35.9	35.9	62.3	57.0	41.2	41.2	41.2	71.5	65.5
	Monoslope Roof	1	-62.8	-81.0	-140.2	-58.3	-90.1	-72.9	-94.0	-162.6	-67.6	-104.5	-83.6	-107.9	-186.7	-77.6	-120.0
		2	26.4	26.4	26.4	53.7	53.7	30.6	30.6	30.6	62.3	62.3	35.2	35.2	35.2	71.5	71.5

Table 30.7-2
Components and Cladding – Part 4
Exposure C

C & C
V = 160-200 mph
h = 90-160 ft.

V (MPH)			160					180					200				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Flat Roof	1	-123.0	-193.0	-263.1	-84.1	-154.1	-155.6	-244.3	-333.0	-106.4	-195.0	-192.2	-301.6	-411.1	-131.3	-240.8
		2	NA	NA	NA	84.1	84.1	NA	NA	NA	106.4	106.4	NA	NA	NA	131.3	131.3
	Gable Roof	1	-91.8	-154.1	-231.9	-99.6	-154.1	-116.2	-195.0	-293.6	-126.1	-195.0	-143.5	-240.8	-362.4	-155.7	-240.8
160	Mansard Roof	2	52.9	52.9	52.9	91.8	84.1	67.0	67.0	67.0	116.2	106.4	82.7	82.7	82.7	143.5	131.3
	Hip Roof	1	-84.1	-146.3	-216.4	-99.6	-154.1	-106.4	-185.2	-273.9	-126.1	-195.0	-131.3	-228.6	-338.1	-155.7	-240.8
		2	52.9	52.9	52.9	91.8	84.1	67.0	67.0	67.0	116.2	106.4	82.7	82.7	82.7	143.5	131.3
	Monoslope Roof	1	-107.4	-138.5	-239.7	-99.6	-154.1	-135.9	-175.3	-303.4	-126.1	-195.0	-167.8	-216.5	-374.6	-155.7	-240.8
		2	45.1	45.1	45.1	91.8	91.8	57.1	57.1	57.1	116.2	116.2	70.5	70.5	70.5	143.5	131.3
	Flat Roof	1	-121.3	-190.4	-259.5	-82.9	-152.0	-153.5	-241.0	-328.5	-105.0	-192.4	-189.6	-297.5	-405.5	-129.6	-237.6
		2	NA	NA	NA	82.9	82.9	NA	NA	NA	105.0	105.0	NA	NA	NA	129.6	129.6
	Gable Roof	1	-90.6	-152.0	-228.8	-98.3	-152.0	-114.7	-192.4	-289.6	-124.4	-192.4	-141.6	-237.6	-357.5	-153.6	-237.6
150	Mansard Roof	2	52.2	52.2	52.2	90.6	82.9	66.1	66.1	66.1	114.7	105.0	81.6	81.6	81.6	141.6	129.6
	Hip Roof	1	-82.9	-144.4	-213.5	-98.3	-152.0	-105.0	-182.7	-270.2	-124.4	-192.4	-129.6	-225.6	-333.5	-153.6	-237.6
		2	52.2	52.2	52.2	90.6	82.9	66.1	66.1	66.1	114.7	105.0	81.6	81.6	81.6	141.6	129.6
	Monoslope Roof	1	-106.0	-136.7	-236.5	-98.3	-152.0	-134.1	-173.0	-299.3	-124.4	-192.4	-165.6	-213.6	-369.5	-153.6	-237.6
		2	44.5	44.5	44.5	90.6	90.6	56.4	56.4	56.4	114.7	114.7	69.6	69.6	69.6	141.6	129.6
	Flat Roof	1	-119.6	-187.7	-255.8	-81.7	-149.8	-151.3	-237.5	-323.7	-103.4	-189.6	-186.8	-293.2	-399.7	-127.7	-234.1
		2	NA	NA	NA	81.7	81.7	NA	NA	NA	103.4	103.4	NA	NA	NA	127.7	127.7
	Gable Roof	1	-89.3	-149.8	-225.5	-96.9	-149.8	-113.0	-189.6	-285.4	-122.6	-189.6	-139.5	-234.1	-352.4	-151.4	-234.1
140	Mansard Roof	2	51.5	51.5	51.5	89.3	81.7	65.1	65.1	65.1	113.0	103.4	80.4	80.4	80.4	139.5	127.7
	Hip Roof	1	-81.7	-142.3	-210.4	-96.9	-149.8	-103.4	-180.1	-266.3	-122.6	-189.6	-127.7	-222.3	-328.7	-151.4	-234.1
		2	51.5	51.5	51.5	89.3	81.7	65.1	65.1	65.1	113.0	103.4	80.4	80.4	80.4	139.5	127.7
	Monoslope Roof	1	-104.4	-134.7	-233.1	-96.9	-149.8	-132.2	-170.5	-295.0	-122.6	-189.6	-163.2	-210.5	-364.2	-151.4	-234.1
		2	43.9	43.9	43.9	89.3	89.3	55.6	55.6	55.6	113.0	113.0	68.6	68.6	68.6	139.5	127.7
	Flat Roof	1	-117.7	-184.8	-251.8	-80.5	-147.5	-149.0	-233.9	-318.7	-101.8	-186.7	-183.9	-288.7	-393.5	-125.7	-230.5
		2	NA	NA	NA	80.5	80.5	NA	NA	NA	101.8	101.8	NA	NA	NA	125.7	125.7
	Gable Roof	1	-87.9	-147.5	-222.0	-95.4	-147.5	-111.3	-186.7	-281.0	-120.7	-186.7	-137.4	-230.5	-346.9	-149.0	-230.5
130	Mansard Roof	2	50.7	50.7	50.7	87.9	80.5	64.1	64.1	64.1	111.3	101.8	79.2	79.2	79.2	137.4	125.7
	Hip Roof	1	-80.5	-140.1	-207.1	-95.4	-147.5	-101.8	-177.3	-262.1	-120.7	-186.7	-125.7	-218.9	-323.6	-149.0	-230.5
		2	50.7	50.7	50.7	87.9	80.5	64.1	64.1	64.1	111.3	101.8	79.2	79.2	79.2	137.4	125.7
	Monoslope Roof	1	-102.8	-132.6	-229.5	-95.4	-147.5	-130.1	-167.8	-290.4	-120.7	-186.7	-160.7	-207.2	-358.6	-149.0	-230.5
		2	43.2	43.2	43.2	87.9	87.9	54.7	54.7	54.7	111.3	111.3	67.5	67.5	67.5	137.4	125.7
	Flat Roof	1	-115.8	-181.7	-247.6	-79.1	-145.1	-146.5	-229.9	-313.4	-100.1	-183.6	-180.9	-283.9	-386.9	-123.6	-226.7
		2	NA	NA	NA	79.1	79.1	NA	NA	NA	100.1	100.1	NA	NA	NA	123.6	123.6
	Gable Roof	1	-86.4	-145.1	-218.3	-93.8	-145.1	-109.4	-183.6	-276.3	-118.7	-183.6	-135.1	-226.7	-341.1	-146.5	-226.7
120	Mansard Roof	2	49.8	49.8	49.8	86.4	79.1	63.1	63.1	63.1	109.4	100.1	77.8	77.8	77.8	135.1	123.6
	Hip Roof	1	-79.1	-137.7	-203.7	-93.8	-145.1	-100.1	-174.3	-257.8	-118.7	-183.6	-123.6	-215.2	-318.2	-146.5	-226.7
		2	49.8	49.8	49.8	86.4	79.1	63.1	63.1	63.1	109.4	100.1	77.8	77.8	77.8	135.1	123.6
	Monoslope Roof	1	-101.1	-130.4	-225.6	-93.8	-145.1	-128.0	-165.0	-285.6	-118.7	-183.6	-158.0	-203.8	-352.6	-146.5	-226.7
		2	42.5	42.5	42.5	86.4	86.4	53.8	53.8	53.8	109.4	109.4	66.4	66.4	66.4	135.1	123.6
	Flat Roof	1	-113.7	-178.4	-243.1	-77.7	-142.4	-143.8	-225.8	-307.7	-98.3	-180.3	-177.6	-278.7	-379.9	-121.4	-222.5
		2	NA	NA	NA	77.7	77.7	NA	NA	NA	98.3	98.3	NA	NA	NA	121.4	121.4
	Gable Roof	1	-84.9	-142.4	-214.4	-92.1	-142.4	-107.4	-180.3	-271.3	-116.5	-180.3	-132.6	-222.5	-334.9	-143.9	-222.5
110	Mansard Roof	2	48.9	48.9	48.9	84.9	77.7	61.9	61.9	61.9	107.4	98.3	76.4	76.4	76.4	132.6	121.4
	Hip Roof	1	-77.7	-135.2	-200.0	-92.1	-142.4	-98.3	-171.2	-253.1	-116.5	-180.3	-121.4	-211.3	-312.5	-143.9	-222.5
		2	48.9	48.9	48.9	84.9	77.7	61.9	61.9	61.9	107.4	98.3	76.4	76.4	76.4	132.6	121.4
	Monoslope Roof	1	-99.3	-128.0	-221.5	-92.1	-142.4	-125.6	-162.0	-280.4	-116.5	-180.3	-155.1	-200.1	-346.2	-143.9	-222.5
		2	41.7	41.7	41.7	84.9	84.9	52.8	52.8	52.8	107.4	107.4	65.2	65.2	65.2	132.6	121.4
	Flat Roof	1	-111.4	-174.8	-238.3	-76.1	-139.6	-141.0	-221.3	-301.6	-96.4	-176.7	-174.1	-273.2	-372.3	-119.0	-218.1
		2	NA	NA	NA	76.1	76.1	NA	NA	NA	96.4	96.4	NA	NA	NA	119.0	119.0
	Gable Roof	1	-83.2	-139.6	-210.1	-90.2	-139.6	-105.3	-176.7	-265.9	-114.2	-176.7	-130.0	-218.1	-328.3	-141.0	-218.1
100	Mansard Roof	2	47.9	47.9	47.9	83.2	76.1	60.7	60.7	60.7	105.3	96.4	74.9	74.9	74.9	130.0	119.0
	Hip Roof	1	-76.1	-132.5	-196.0	-90.2	-139.6	-96.4	-167.8	-248.1	-114.2	-176.7	-119.0	-207.1	-306.2	-141.0	-218.1
		2	47.9	47.9	47.9	83.2	76.1	60.7	60.7	60.7	105.3	96.4	74.9	74.9	74.9	130.0	119.0
	Monoslope Roof	1	-97.3	-125.5	-217.1	-90.2	-139.6	-123.1	-158.8	-274.8	-114.2	-176.7	-152.0	-196.1	-339.3	-141.0	-218.1
		2	40.9	40.9	40.9	83.2	83.2	51.8	51.8	51.8	105.3	105.3	63.9	63.9	63.9	130.0	119.0
	Flat Roof	1	-108.9	-171.0	-233.1	-74.5	-136.5	-137.9	-216.4	-295.0	-94.3	-172.8	-170.2	-267.2	-364.2	-116.4	-213.3
		2	NA	NA	NA	74.5	74.5	NA	NA	NA	94.3	94.3	NA	NA	NA	116.4	116.4
	Gable Roof	1	-81.4	-136.5	-205.5	-88.3	-136.5	-103.0	-172.8	-260.1	-111.7	-172.8	-127.1	-213.3	-321.1	-137.9	-213.3
90	Mansard Roof	2	46.9	46.9	46.9	81.4	74.5	59.3	59.3	59.3	103.0	94.3	73.3	73.3	73.3	127.1	116.4
	Hip Roof	1	-74.5	-129.6	-191.7	-88.3	-136.5	-94.3	-164.1	-242.6	-111.7	-172.8	-116.4	-202.6	-299.5	-137.9	-213.3
		2	46.9	46.9	46.9	81.4	74.5	59.3	59.3	59.3	103.0	94.3	73.3	73.3	73.3	127.1	116.4
	Monoslope Roof	1	-95.2	-122.7	-212.4	-88.3	-136.5	-120.4	-155.3	-268.8	-111.7	-172.8	-148.7	-191.8	-331.8	-137.9	-213.3
		2	40.0	40.0	40.0	81.4	81.4	50.6	50.6	50.6	103.0	103.0	62.5	62.5	62.5	127.1	116.4

Analysis and Commentary

Part 4 of Chapter 30 provides a new simplified method for determining component and cladding wind loads on enclosed buildings with mean roof heights up to 160 ft. The tabulated loads are based on the Directional Procedure from Part 3 of Chapter 30 (Section 30.6). While ASCE 7-05 and ASCE 7-02 also contained a simplified method for component and cladding wind loads on buildings, it was limited to buildings with mean roof heights of 60 ft and less. The simplified method for buildings with mean roof heights of 60 ft and less is now contained in Part 2 of Chapter 30 (Section 30.5).

The primary reason for the inclusion of simplified methods in ASCE 7 is to improve the likelihood of the designer obtaining the correct answer. Designers that have a good understanding of the wind load concepts in ASCE 7 will most likely not find the simplified methods very helpful, except as a quick follow-up check of their calculations. However, the simplified methods offer easier solutions for the occasional users and save time so the user won't rush through the solution.

This method provides components and cladding pressures for walls, roofs, parapets and roof overhangs for enclosed buildings with mean roof heights up to 160 ft. The table includes several conservative assumptions for simplicity. For windward wall pressures, q was taken as q_h instead of q_z. Additionally, pressures were selected for each zone that encompass the largest pressure coefficients for the comparable zones for the different roof shapes. Therefore, the tabulated pressures are applicable to the entire zone as shown in the figures in Table 30.7-2.

Example:

V = 140 mph
Exposure B
Flat roof building
H = 80 ft
Assume no topographic effects (K_{zt} does not apply)

Determine the applicable pressures for a window with an Effective Wind Area of 20 ft^2 located in Zone 5.

The equation for determining the applicable pressures is:

$$p = p_{table}(\text{EAF})(\text{RF})K_{zt}$$

where:

R F = effective area reduction factor from Table 30.7-2
EAF = Exposure adjustment factor from Table 30.7-2
K_{zt} = topographic factor as defined in Section 26.8

From table 30.7-2

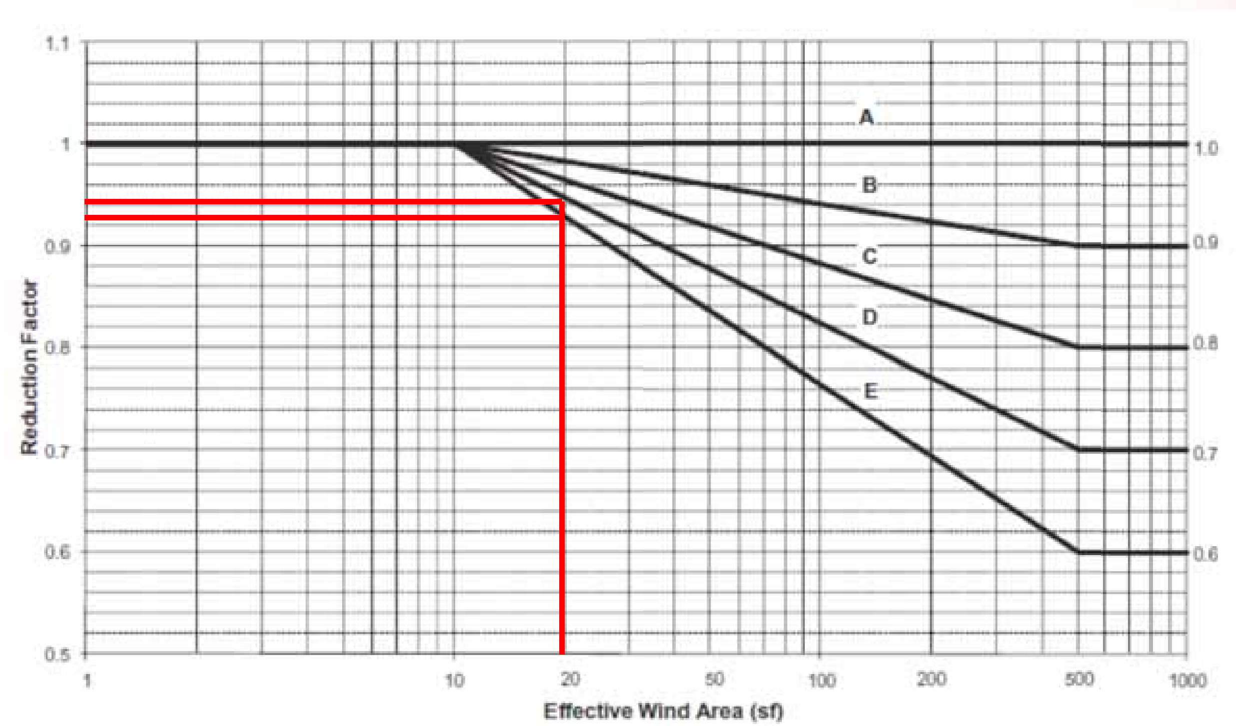
(excerpt from Table 30.7-2)

V (MPH)			130					140					150				
		Load			Zone					Zone					Zone		
h (ft)	Roof Form	Case	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
80	Flat Roof	1	-70.2	-110.1	-150.1	-48.0	-87.9	-81.4	-127.7	-174.1	-55.6	-102.0	-93.4	-146.6	-199.3	-63.9	-117.1
		2	NA	NA	NA	48.0	48.0	NA	NA	NA	55.6	55.6	NA	NA	NA	63.9	63.9
	Gable Roof / Mansard Roof	1	-52.4	-87.9	-132.3	-56.8	-87.9	-60.8	-102.0	-153.5	-65.9	-102.0	-69.8	-117.1	-176.2	-75.7	-117.1
		2	30.2	30.2	30.2	52.4	48.0	35.0	35.0	35.0	60.8	55.6	40.2	40.2	40.2	69.8	63.9
	Hip Roof	1	-48.0	-83.5	-123.5	-56.8	-87.9	-55.6	-96.8	-143.2	-65.9	-102.0	-63.9	-111.1	-164.4	-75.7	-117.1
		2	30.2	30.2	30.2	52.4	48.0	35.0	35.0	35.0	60.8	55.6	40.2	40.2	40.2	69.8	63.9
	Monoslope Roof	1	-61.3	-79.0	-136.8	-56.8	-87.9	-71.1	-91.7	-158.6	-65.9	-102.0	-81.6	-105.2	-182.1	-75.7	-117.1
		2	25.8	25.8	25.8	52.4	52.4	29.9	29.9	29.9	60.8	60.8	34.3	34.3	34.3	69.8	69.8

p_{table} = -102 psf, +55.6 psf

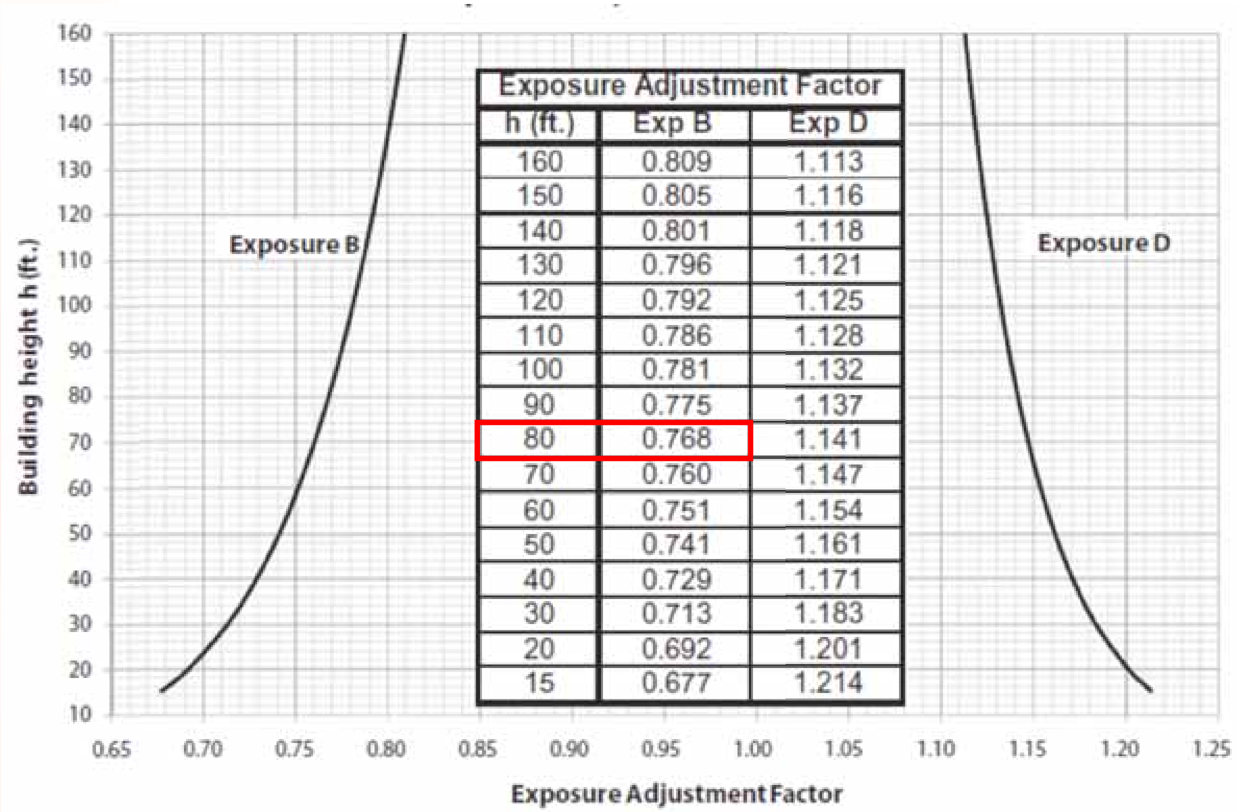
The effective area reduction factor is determined as follows:

For Zone 5 and flat roof form, use line E for negative pressures and line D for positive pressures.



RF = 0.925 (negative pressures)
RF = 0.94 (positive pressures)

The EAF is determined as follows:



Exposure Adjustment Factor		
h (ft.)	Exp B	Exp D
160	0.809	1.113
150	0.805	1.116
140	0.801	1.118
130	0.796	1.121
120	0.792	1.125
110	0.786	1.128
100	0.781	1.132
90	0.775	1.137
80	0.768	1.141
70	0.760	1.147
60	0.751	1.154
50	0.741	1.161
40	0.729	1.171
30	0.713	1.183
20	0.692	1.201
15	0.677	1.214

Therefore EAF = 0.768

The negative and positive pressures are calculated as follows:

Negative pressure:

p = -102 psf x 0.768 x 0.925 = **-72.5 psf**

Positive pressure:

p = +55.6 psf x 0.768 x 0.94 = **+40.1 psf**

30.10.1 Modification

Roof Overhangs

At a Glance

The determination and application of wind loads on roof overhangs has been revised to provide a more accurate description of how the loads are to be applied.

2010 Standard

~~**6.5.11.4.2 Components and Cladding.** For all buildings, roof overhangs shall be designed for pressures determined from pressure coefficients given in Figs. 6-11B,C,D.~~

30.10 ROOF OVERHANGS

The design wind pressure for roof overhangs of enclosed and partially enclosed buildings of all heights, except enclosed buildings with h ≤ 160 ft. for which the provisions of Part 4 are used, shall be determined from the following equation:

$$p = q_h[(GC_p) - (GC_{pi})] \text{ (lb/ft}^2\text{) (N/m}^2\text{)}$$
(30.10-1)

where

q_h = velocity pressure from Section 30.3.2 evaluated at mean roof height h using exposure defined in Section 26.7.3

(GC_p) = external pressure coefficients for overhangs given in Figures 30.4-2A to 30.4-2C (flat roofs, gable roofs, and hip roofs), including contributions from top and bottom surfaces of overhang. The external pressure coefficient for the covering on the underside of the roof overhang is the same as the external pressure coefficient on the adjacent wall surface, adjusted for effective wind area, determined from Figure 30.4-1 or Figure 30.6-1 as applicable

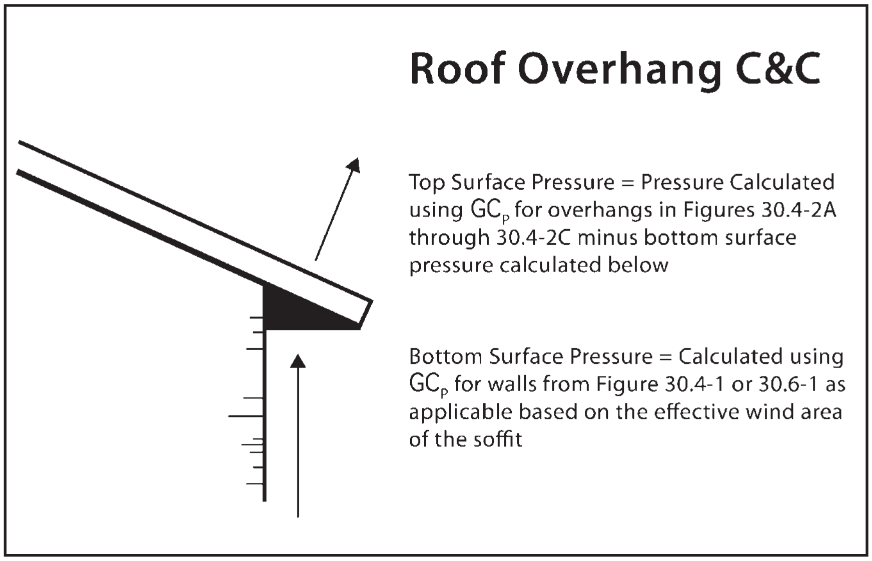
(GC_{pi}) = internal pressure coefficient given in Table 26.11-1

The steps required for the determination of wind loads on components and cladding of roof overhangs is shown in Table 30.10-1.

Analysis and Commentary

There has been considerable confusion in the past regarding the determination and application of loads on roof overhangs and soffits (underside of the roof overhang) for the MWFRS and Components and Cladding. The hurricanes of 2004 provided fresh evidence of the importance of properly designing soffits. Many buildings appeared to suffer minimal damage other than loss of the soffit material. However, due to wind and wind driven rain, there was often significant damage on the inside to gypsum ceilings and walls when soffits were damaged or removed.

As mentioned previously, proper design of the soffit covering is essential in reducing interior damage due to wind and wind driven rain in hurricanes. In previous editions of ASCE 7, the component and cladding GC_p figures provided only the total uplift across both surfaces of the overhang, essentially assuming that no soffit was present. It wasn't clear how to separate the top surface pressure from the bottom surface pressure to properly design a soffit. New language has been added to provide explicit conditions for separating the top surface pressure from the bottom surface pressure. Research and analysis has indicated that the pressure on the underside of a roof overhang is the same as the pressure on the adjacent wall. Section 30.10 (formerly Section 6.5.11.4.2) has been expanded to provide the appropriate equation for calculating roof overhang loads. Additionally, in the description of GC_p in the equation, new language has been added that states that the external pressure coefficient on the underside of the roof overhang is the same as the external pressure coefficient on the adjacent wall surface adjusted for effective wind area.



Part VI
Other Buildings and Structures

29.4 Clarification

Solid Freestanding Walls and Solid Signs

At a Glance

The provisions for design wind loads on signs have been revised to clarify the applicability of the requirements for solid attached signs.

2010 Standard

29.4 DESIGN WIND LOADS – SOLID FREESTANDING WALLS AND SOLID SIGNS

29.4.1 ~~6.5.14 Design Wind Loads on~~ Solid Freestanding Walls and Solid Freestanding Signs.

The design wind force for solid freestanding walls and solid freestanding signs shall be determined by the following formula:

$$F = q_h G C_f A_s \text{ (lb) (N)} \qquad \textbf{(29.4-1 ~~6-27~~)}$$

Where:

q_h = the velocity pressure evaluated at height h (defined in Figure 29.4-1 ~~6-20~~) as determined in accordance with Section 29.3.2 ~~6.5.6.4.1~~
G = gust-effect factor from Section 26.9 ~~6.5.8~~
C_f = net force coefficient from Figure 29.4-1 ~~6-20~~
A_s = the gross area of the solid freestanding wall or freestanding solid sign, in ft^2 (m^2)

29.4.2 Solid Attached Signs.

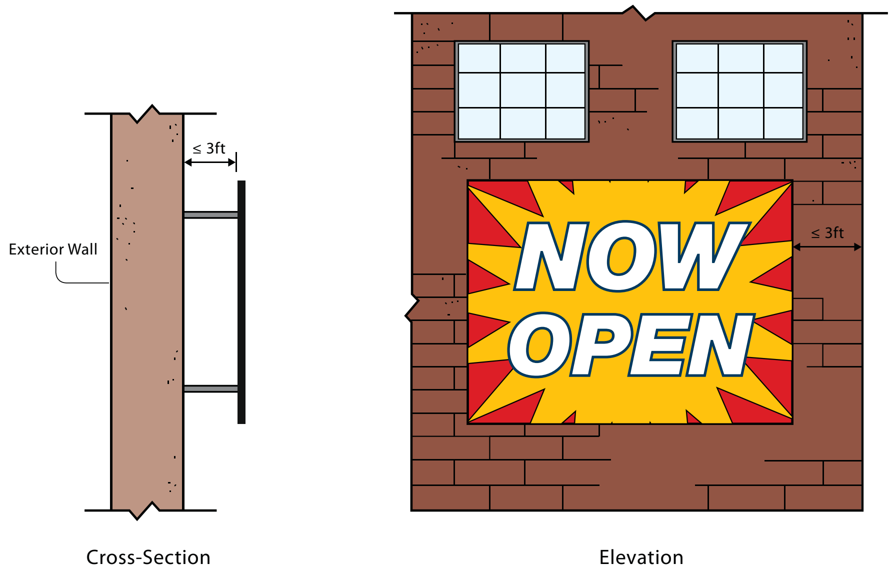
The design wind pressure on a solid sign attached to the wall of a building, where the plane of the sign is parallel to and in contact with the plane of the wall, and the sign does not extend beyond the side or top edges of the wall, shall be determined using procedures for wind pressures on walls in accordance with Chapter 30, and setting the internal pressure coefficient (GC_{pi}) equal to 0.

This procedure shall also be applicable to solid signs attached to but not in direct contact with the wall, provided the gap between the sign and wall is no more than 3 ft (0.9 m) and the edge of the sign is at least 3 ft (0.9 m) in from free edges of the wall, i.e., side and top edges and bottom edges of elevated walls.

Analysis and Commentary

Since the introduction of the new provisions for solid freestanding walls and solid signs in ASCE 7-05, there has been some confusion particularly as it relates to solid signs. The provisions of Section 29.4.1 (6.5.14) are only applicable to isolated solid freestanding signs. Solid signs attached to walls and not extending beyond the edges of the wall will experience wind pressures approximately equal to the external pressures on the wall to which they are attached. Signs attached to walls that are supported by framework, where there is a small gap between the sign and the wall will also experience wind pressures approximately equal to the external pressures on the wall to which they are attached. However, if the gap between the wall and sign is too great, the pressure distribution on the sign will approach that of a solid freestanding sign. Therefore, the use of the component and cladding loads for walls for a sign attached to a wall is limited to situations where the gap between the sign and wall is 3 feet or less, and the edges of the sign are at least 3 feet from free edges of the wall. The following figure depicts these limitations.

Solid Freestanding Sign



Solid Attached Sign with Small Gap Showing Limitations on Use of Component and Cladding Loads for Signs on Walls

29.5.1 Modification

Rooftop Structures and Equipment

At a Glance

The design wind force for rooftop structures and equipment for buildings with $h \leq 60$ ft has been revised and now also includes a vertical component. A new section has been added for determining the component and cladding loads on rooftop structures and equipment for buildings with $h \leq 60$ ft.

2010 Standard

29.5.1 ~~6.5.15.1~~ ROOFTOP STRUCTURES AND EQUIPMENT FOR BUILDINGS WITH $h \leq 60$ FT (18.3 m).

The lateral force F_h, on rooftop structures and equipment ~~with A_f less than (0.1*Bh*)~~ located on buildings with a mean roof height, $h \leq 60$ ft (18.3 m) shall be determined from Eq. 29.5-2 ~~6-28. increased by a factor of 1.9~~. ~~The factor shall be permitted to be reduced linearly from 1.9 to 1.0 as the value of A_f is increased from (0.1*Bh*) to (*Bh*).~~

$$F_h = q_h (GC_r) A_f \text{ (lb) (N)} \qquad (29.5\text{-}2)$$

where:

GC_r = 1.9 for rooftop structures and equipment with A_f less than (0.1*Bh*). GC_r shall be permitted to be reduced linearly from 1.9 to 1.0 as the value of A_f is increased from (0.1*Bh*) to (*Bh*)

q_h = velocity pressure evaluated at mean roof height of the building

A_f = vertical projected area of the rooftop structure or equipment on a plane normal to the direction of wind, in ft^2 (m^2)

The vertical uplift force, F_v, on rooftop structures and equipment shall be determined from Eq. 29.5-3:

$$F_v = q_h (GC_r) A_r \qquad (29.5\text{-}3)$$

where:

GC_r = 1.5 for rooftop structures and equipment with A_r less than (0.1*BL*). GC_r shall be permitted to be reduced linearly from 1.5 to 1.0 as the value of A_r is increased from (0.1*BL*) to (*BL*).

q_h = velocity pressure evaluated at the mean roof height of the building

A_r = horizontal projected area of roof top structure or equipment, in ft^2 (m^2)

30.11 ROOFTOP STRUCTURES AND EQUIPMENT FOR BUILDINGS WITH $h \leq 60$ ft (18.3 m)

The components and cladding pressure on each wall of the rooftop structure shall be equal to the lateral force determined in accordance with Section 29.5.1 divided by the respective wall surface area of the rooftop structure and shall be considered to act inward and outward. The components and cladding pressure on the roof shall be equal to the vertical uplift force determined in accordance with Section 29.5.1 divided by the horizontal projected area of the roof of the rooftop structure and shall be considered to act in the upward direction.

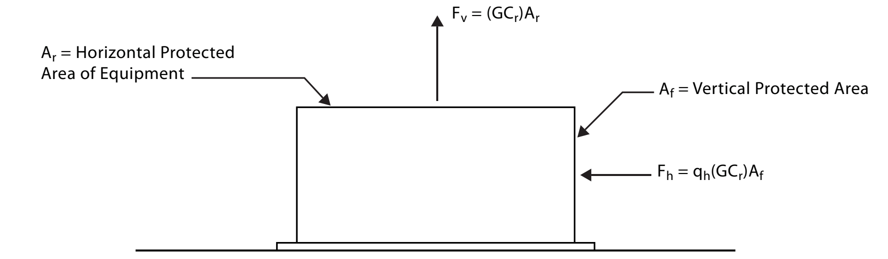
Analysis and Commentary

It is known that the wind forces on rooftop equipment and structures will be higher than those determined from the general equation for design wind loads on other structures of Eq. 29.5-1 (Eq. 6-28 in ASCE 7-05) due to the small size of the rooftop structures in comparison to the building which results in higher correlation of pressures across the structure surface, higher turbulence on the building roof, and accelerated wind speed on the roof. There is limited research available to quantify this increased force. Research from earlier in this decade provided the basis for Section 6.5.15.1 in ASCE 7-05. This new language required the design wind load determined from the general equation for wind loads on other structures, Eq. 6-28 (ASCE 7-05), to be increased by a factor of 1.9 for rooftop structures and equipment located on buildings with $h \leq 60$ ft and where the vertical frontal area of the rooftop structure or equipment normal to the wind direction was less than 10% of the vertical frontal area of the building normal to the wind direction. This factor was permitted to be reduced linearly as the vertical frontal area of the rooftop structure or equipment approached the vertical frontal area of the building. The requirement only addressed lateral loads on rooftop structures or equipment. However, the commentary alluded to the fact that high uplift loads were present and should be considered, but provided little information on the determination of the vertical component of the loads on rooftop structures and equipment. Similarly, the design of components and cladding for rooftop structures and equipment was not addressed.

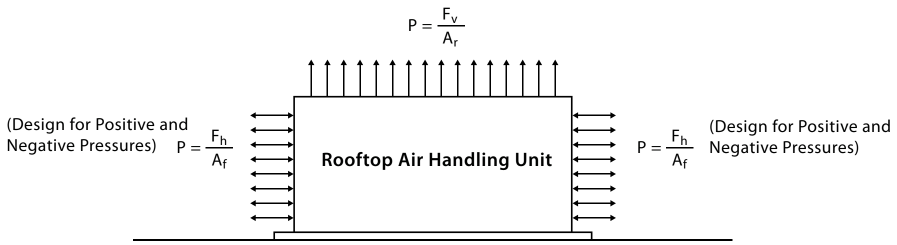
New research performed at the University of Western Ontario has provided a more accurate representation of the loads anticipated to be experienced by rooftop structures and equipment located on buildings with $h \leq 60$ ft. This research confirmed that a significant vertical component of the force on rooftop structures and equipment does exist. The data showed that the maximum net vertical uplift force coefficient (GC_r) was 1.5 on the roof of rooftop structures and equipment where the surface area of the roof of the rooftop equipment and structures was less than 10% of the building plan area ($B \times L$) than that which the structure or equipment was located on. Additionally, the data showed that the maximum net horizontal force coefficient was 1.9 on rooftop structures and equipment where the wall surface area of the rooftop equipment was less than 10% of the wall area ($B \times h$) of the building than that which the structure or equipment was located on. The net pressure coefficient (GC_r) is expected to approach 1.0 as A_f or A_r approaches the area of the applicable part of the building ($B \times h$ or $B \times L$). Therefore linear interpolation of GC_r is permitted for rooftop structures and equipment as their area approaches that of the applicable part of the building.

For clarity, two new equations were created for the determination of the horizontal and vertical components of the load respectively. A new section has been added for the determination of component and cladding loads on rooftop structures and equipment. The new section requires that component and cladding pressures are determined by dividing the horizontal and vertical forces by the applicable area, A_f or A_r. In the past, designers may have used the applicable wall and roof pressure coefficients. However, since the higher pressure coefficients for rooftop structures and equipment determined from the research were not limited to corner or perimeter areas of the building roof, using wall and roof pressures would not always be adequate.

The following figures show the application of the MWFRS loads and Component and Cladding loads on rooftop structures and equipment using Section 29.5.1 for buildings with $h \leq 60$ ft.



Rooftop Equipment MWFRS Loads



Rooftop Equipment Component and Cladding Loads

Part VII
Wind Tunnel Testing

Mean Recurrence Intervals of Load Effects

Limitations on Loads

31.4.1 Modification

Mean Recurrence Intervals of Load Effects

At a Glance

New language is added providing direction on wind-induced effects for Strength Design or Allowable stress Design for specific recurrence intervals.

2010 Standard

31.4 ~~6.6.4~~ LOAD EFFECTS ~~Limitations~~

31.4.1 Mean Recurrence Intervals of Load Effects.

The load effect required for Strength Design shall be determined for the same mean recurrence interval as for the Analytical Method, by using a rational analysis method, defined in the recognized literature, for combining the directional wind tunnel data with the directional meteorological data or probabilistic models based thereon. The load effect required for Allowable Stress Design shall be equal to the load effect required for Strength Design divided by 1.6. For buildings that are sensitive to possible variations in the values of the dynamic parameters, sensitivity studies shall be required to provide a rational basis for design recommendations.

31.4.2 ~~6.6.4.1~~ Limitations on Wind Speeds.

The ~~Variation of basic~~ wind speeds ~~with direction shall not be permitted unless the analysis for wind speeds conforms to the requirements of~~ and probabilistic estimates based thereon shall be subject to the limitations described in Section 26.5.3 ~~6.5.4.2~~.

C31.4.1 Mean Recurrence Intervals of Load Effects. Examples of analysis methods for combining directional wind tunnel data with the directional meteorological data or probabilistic models based thereon are described in Lepage and Irwin (1985), Rigato et al. (2001), Isyumov et al. (2003), Irwin et al. (2005), Simiu and Filliben (2005), and Simiu and Miyata (2006).

Analysis and Commentary

Previous editions of ASCE 7 did not contain requirements for determining the wind-induced effects for Strength Design or Allowable Stress Design for specific recurrence intervals. When combining historical wind data or probabilistic models with wind tunnel tests, the load effects for Strength Design should be based on the same mean recurrence interval as the analytical methods (Directional Procedure – Chapter 27; Envelope Procedure – Chapter 28). The commentary has been revised to include 6 new references for examples for making these determinations.

Section 31.4.2 has been revised to clarify that directional effects can be obtained by methods other than design speeds assigned to each direction. Currently, there are several methods for statistically evaluating directional effects and not all involve directional wind speeds explicitly. The new language provides a more general applicability.

31.4.3

Addition

Limitations on Loads

At a Glance

Lower limits on loads determined from wind tunnel testing are relocated from the commentary and adapted for inclusion directly in the standard.

2010 Standard

31.4.3 Limitations on Loads.

Loads for the main wind force resisting system determined by wind tunnel testing shall be limited such that the overall principal loads in the *x* and *y* directions are not less than 80 percent of those that would be obtained from Part 1 of Chapter 27 or Part 1 of Chapter 28. The overall principal load shall be based on the overturning moment for flexible buildings and the base shear for other buildings.

Pressures for components and cladding determined by wind tunnel testing shall be limited to not less than 80 percent of those calculated for Zone 4 for walls and Zone 1 for roofs using the procedure of Chapter 30. These Zones refer to those shown in Figs. 30.4-1, 30.4-2A, 30.4-2B, 30.4-2C, 30.4-3, 30.4-4, 30.4-5A, 30.4-5B, 30.4-6, 30.4-7, and 30.6-1.

The limiting values of 80 percent may be reduced to 50 percent for the main wind force resisting system and 65 percent for components and cladding if either of the following conditions applies:

1. There were no specific influential buildings or objects within the detailed proximity model.
2. Loads and pressures from supplemental tests for all significant wind directions in which specific influential buildings or objects are replaced by the roughness representative of the adjacent roughness condition, but not rougher than exposure B, are included in the test results.

Analysis and Commentary

Wind tunnel tests frequently yield wind loads that are significantly lower than those required by the analytical or simplified methods. This is due to several factors that include:

- The likelihood that the highest wind speeds occur at directions where the building's shape or pressure coefficients are less than their maximum values
- Specific buildings included in the detailed proximity model that may provide shielding in excess of that implied by the Exposure Categories
- Conservatism inherent in enveloping of load coefficients in Chapters 28 and 30.

The shielding effect can be particularly influential. In some cases, adjacent structures may shield the structure sufficiently that removal of one or two structures could significantly increase the design wind loads. It is for this reason primarily that ASCE 7-10 now specifically limits the reductions permitted from wind tunnel testing to 80% of the results obtained form Part1 of Chapter 27 (Directional Procedure for all building heights), Part 1 of Chapter 28 (Envelope Procedure for low-rise buildings), and Chapter 30 (Components and Cladding). Similar limits were identified in the commentary of ASCE 7-05.

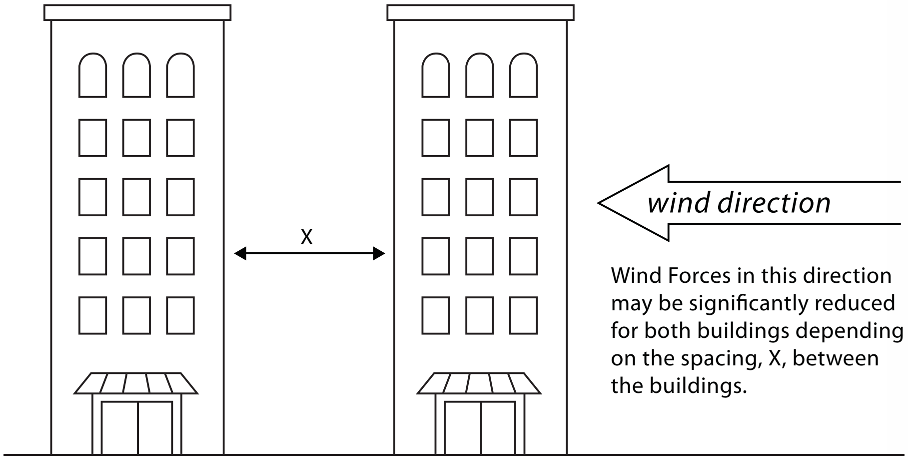
For components and cladding, the 80% limit is based on the pressures determined using Zones 1 (interior roof) and 4 (interior wall) for the applicable building configuration. The pressures on the edges are the most likely to be reduced by taking into account the specific geometry of the building in question as opposed to the rectangular prismatic buildings assumed by Chapter 30.

For MWFRS loads, the 80% limit is a little more complex because the load effects (stresses, forces, etc.) at any point are the combined effect of a vector of applied loads instead of a simple scalar value. In general the ratio of forces or moments for example, at various floors throughout the building using a wind tunnel study will not be same as those ratios determined from Chapters 27 or 28. Requiring each and every load effect from a wind tunnel test to be no less than 80% of the same effect resulting from Chapters 27 or 28 is impractical and unnecessarily complex. Therefore the limit is applied as a criterion that characterizes the overall loading. For flexible buildings, the most descriptive criterion of overall loading is the base overturning moment. For other buildings, the base shear is the recommended criterion instead.

The standard does permit the lower limits on loads from a wind tunnel study to be further reduced. Due to the significant effect of shielding, ASCE 7 permits the lower limits to be reduced if there were no influential buildings or objects located in the detailed proximity model or if supplemental tests were performed removing the influential building or object from the detailed proximity model in replacing it with roughness comparable to the adjacent roughness but no rougher than Surface Roughness B. When either of these two conditions are met, the limiting values of 80 percent may be reduced to 50 percent for the main wind force resisting system and 65 percent for components and cladding. A greater reduction is permitted for MWFRS loads because Component and Cladding loads are more sensitive to local channeling effects when surroundings change and may be dramatically increased when a new adjacent building is constructed.

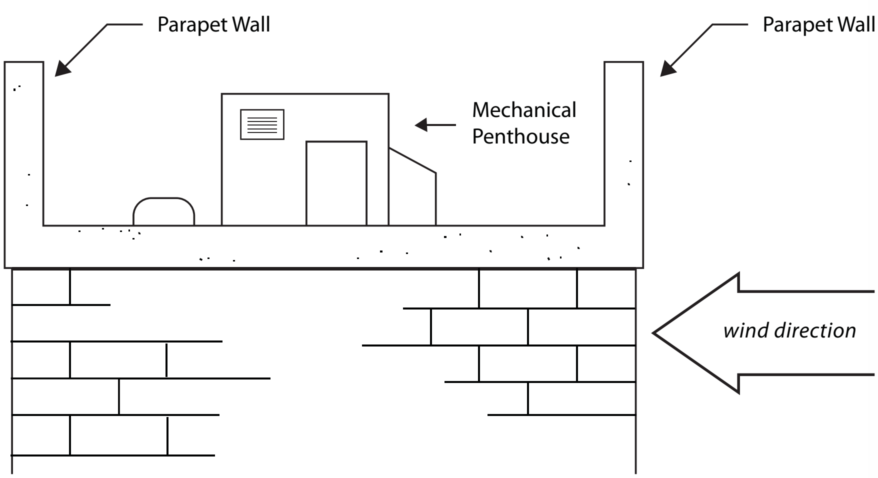
Situations where wind loads could be legitimately reduced to less than the 80-percent limit are easily conceived, particularly cases involving justifiable blockage. Consider a building having an open central atrium. The glass or cladding facing this open area is well protected, and therefore subjected to reduced loads, yet the neither the analytical method nor the simplified method address this situation. These methods would require the cladding to be designed as any other exterior cladding. The atrium needn't be completely enclosed to affect the wind loads on the cladding on the inside walls (imagine a C-shaped building). Even in this situation, the cladding on the inside walls may be subject to greatly reduced loads, because airflow through this portion is still partly obstructed.

Similar situations can occur when the blockage occurs from a separate tower, such as twin towers on a common podium, or perhaps even totally separate, but very close towers. However, this situation can be very sensitive to the exact geometry and cases of wind pressure amplification can occur. Components and cladding pressures in some areas are likely to be greatly reduced. MWFRS loads in some directions can also be greatly reduced such as in the case of in-line loads when the two buildings are aligned with the wind direction. This is not unlike the case of two race cars "drafting" in which one follows very close behind another: the total wind resistance on the two cars is similar to the resistance on a single car, but this resistance is shared between the two cars, thus allowing higher speeds for both cars.



Wind Shielding from Two Close Towers

Another case of justifiable blocking is a penthouse (mechanical overrun, etc.) on the roof of a building, where a tall parapet or screenwall exists around the perimeter of the roof. Although likely intended for visual shielding, such a wall can be very effective in shielding the penthouse from wind and thus the penthouse framework may be subjected to greatly reduced loads.



Wind Shielding from a Parapet Wall

In some shielding cases, it may not be obvious from where, exactly, the benefit is derived. The intent of the code is to allow such benefits when they are inherently derived from the shape of the building itself, or when it is at least under the control of the same owner (as in two close buildings that are part of the same project). The "additional tests" that are required to justify large load reductions are designed to demonstrate if the reduction is an inherent feature of the project itself, or whether it is due to some specific yet independent nearby project: if loads less than 80 percent only occur when such nearby projects are removed from the test area model, then the excess reduction is not allowed.

For MWFRS loads, it is also easy to conceive of building shapes that are entitled to a large reduction because of an overall shape factor that is much more "aerodynamically efficient" than the simple rectangular shapes addressed in the Standard. The simplest case is that of a circular cylinder, which has a drag coefficient of perhaps 1 or so, compared to a drag coefficient of about 2.1 for a square cylinder, and as high as 2.8 for a rectangular cylinder. Thus, it is easy to see that MWFRS loads on a circular building (of substantial height i.e. H/D >> 1) could be at least as low as that of a rectangular section as assumed in the Standard--at least in the along-wind direction (the cross-wind load may be much larger than is given by the Standard, but this result would of course be a part of the wind tunnel study). Put a domed top on the circular cylinder, and the loads may decrease even more. However, the committee determined that SOME absolute lower limit was needed, and that 0.5 was a reasonable value for MWFRS.

About the Author

T. Eric Stafford, P.E. is a registered professional engineer specializing in wind hazard mitigation and code development activities. He is currently President of T. Eric Stafford & Associates and serves as a building code consultant for various groups, including the Institute for Business and Home Safety. Stafford partnered with the International Code Council, Building Officials Association of Florida, and AIA Florida to publish a series of Commentaries on the Florida Building Codes including the Building, Existing Building, and Residential Codes. Additionally, his company produced the Commentaries on the North Carolina Building Codes. Previously, he served as Vice President/Technical Services for the Federal Alliance for Safe Homes (FLASH). He has a Bachelor Civil Engineering and a Master of Science (structural emphasis).

Stafford is a member of ASCE 7 Task Committee on Wind Loads, former member of the National Hurricane Conference Planning Committee, former Chairman of the National Hurricane Conference Engineering Topic Committee, former Staff Liaison to the SBCCI Wind Load Committee, and former Staff Liaison to the International Building Code Structural Code Development Committee. He is a national lecturer on the wind provisions of the International Building Code and ASCE 7. Prior to joining FLASH, he was Manager of Codes for the International Code Council and Director/Code Development for the Southern Building Code Congress International.