NASA Technical Memorandum TM 102782

## Comparison Of Analytical Methods For Calculation Of Wind Loads

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# **Comparison Of Analytical Methods For Calculation Of Wind Loads**

Donald J. Minderman Larry L. Schultz Engineering Development Directorate

September 1989

NASA

National Aeronautics and Space Administration

John F. Kennedy Space Center

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## KSC-DM-3282 REVISION A

# COMPARISON OF ANALYTICAL METHODS FOR CALCULATION OF WIND LOADS

This Revision Supersedes All Previous Editions of This Manual

PREPARED BY:

mai

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## **SEPTEMBER 1989**

JOHN F. KENNEDY SPACE CENTER, NASA

#### ABSTRACT

The following analysis is a comparison of analytical methods for the calculation of wind load pressures. The analytical methods specified in ASCE Paper No. 3269, ANSI A58.1-1982, the Standard Building Code, and the Uniform Building Code were analyzed using various hurricane speeds to determine the differences in the calculated results. The winds used for the analysis ranged from 100 mph to 125 mph and applied inland from the shoreline of a large open body of water (i.e., an enormous lake or the ocean) a distance of 1500 feet or ten times the height of the building or structure considered. For a building or structure less than or equal to 250 feet in height acted upon by a wind greater than or equal to 115 mph, it was determined that the method specified in ANSI A58.1-1982 calculates a larger wind load pressure than the other methods. For a building or structure between 250 feet and 500 feet tall acted upon by a wind ranging from 100 mph to 110 mph, there is no clear choice of which method to use; for these cases, factors that must be considered are the steady-state or peak wind velocity, the geographic location, the distance from a large open body of water, and the expected design life and its risk factor.

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#### ABBREVIATIONS AND ACRONYMS

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ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
CA	California
e.g.	for example
ft	foot
ft <sup>2</sup>	square foot
FL	Florida
i.e.	that is
KSC	John F. Kennedy Space Center
lb/ft <sup>2</sup>	pound per square foot
lb,	pound force
mph	mile per hour
NASA	National Aeronautics and Space Administration
no.	number
NY	New York
psf	pounds per square foot
SF	shape factor
STD	standard
ક્ર	percent

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#### SYMBOLS AND NOTATION

- a Coefficient alpha that depends on the exposure type
- A<sub>r</sub> Projected area normal to the wind velocity except when is given for the surface area (ft<sup>2</sup>)
- C<sub>p</sub> Shape coefficient
- C<sub>f</sub> Force coefficient
- C, External pressure coefficient
- D. Surface drag coefficient
- F. Design force at a specific height,  $Z(lb_t)$
- G<sub>h</sub> Gust response factor for main-force resisting systems evaluated at height Z=h
- G. Gust response factor to be used for components and cladding
- I Importance factor
- K. Velocity pressure exposure coefficient
- P. Steady-State total wind pressure on primary framing due to constant wind loads (lb/ft<sup>2</sup> or psf)
- $P_{z,max}$  Peak total wind pressure on primary framing due to gusting winds (lb/ft<sup>2</sup> or psf)
- q. Wind velocity pressure at a height, Z (lb/ft<sup>2</sup> or psf)
- q<sub>z,max</sub> Peak wind velocity pressure at a height, Z (lb/ft<sup>2</sup> or psf)
- SF The shape factor is a coefficient that depends on the exterior surface of the building or structure
- T. Equation variable that depends on a, D, and Z
- U Risk of occurance
- V<sub>z</sub> Wind velocity at a specific height (mph)

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V <sub>z, max</sub>	Peak wind velocity at a specific height (mph)
V30	Wind velocity at a height of 30 feet (mph)
x	A constant which linearly reduces from $x=0.3$ at $V_{30}=60$ mph to $x=0.143$ at $V_{30}=130$ mph
X <sub>max</sub>	The constant x mentioned above, which is adjusted for peak winds
Z	Height above the ground (ft)
Za	Gradient height above the ground (ft)

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#### 1. INTRODUCTION

#### 1.1 PURPOSE

The following analysis is a comparison of analytical methods for calculation of wind load pressures specified in ASCE Paper No. 3269, ANSI A58.1-1982, the Standard Building Code, and the Uniform Building Code. These methods were analyzed for various hurricane wind speeds to determine the differences between their calculated wind load pressures.

#### 1.2 FACILITIES AND EQUIPMENT

The analysis included calculations of wind load pressure for only Category III buildings and structures (as defined in ANSI A58.1-1982; see reference 1 in appendix F) because Category III buildings and structures are more closely identifiable with the space vehicle processing and launch facilities at KSC. The buildings or structures used for calculating wind load pressure had four sides with vertically oriented walls. Only Exposure D winds (as defined in ANSI A58.1-1982) were considered because Exposure D closely approximates the topography and the types of winds experienced at KSC. For a detailed description of the building or structural constraints that were followed see 2.1.

#### **1.3 DEFINITIONS**

For the purpose of this report, the following definitions shall apply:

<u>Category III Building or Structure</u>: Buildings or structures designated as essential facilities including, but not limited to, hospitals, fire stations, disaster operations centers, and national defense centers.

**Exposure D:** Flat, unobstructed areas exposed to wind flowing over large bodies of water. Exposure D applies only from the shoreline a distance of 1500 feet or ten times the height of the building or structure under consideration, whichever is greater.

<u>Ground Wind</u>: Wind that affects facilities and space vehicles during ground operations and immediately after a launch. These winds exist below a height of 500 feet. Ground winds are sometimes referred to as surface winds.

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<u>Gust</u>: A sudden increase in the ground wind speed. A gust is frequently expressed as a deviation from a mean wind speed.

Importance Factor: A factor that accounts for the degree of hazard to human life and damage to property.

<u>Peak Wind Speed</u>: The maximum (essentially, instantaneous) wind speed measured during a specified reference period, such as a hour, day, or month, at a given reference height.

Primary Frames and Systems: An assemblage of major structural elements assigned to provide support for secondary members and cladding. Examples of primary frames and systems include rigid and braced frames, space trusses, roof and floor diaphragms, shear walls, and rod-braced frames.

<u>Shape Factor</u>: A coefficient that accounts for the geometry and orientation of the building or structure.

<u>Steady-State or Average Wind Speed</u>: The mean, over a period of approximately 10 minutes, of the ground wind speed measured at a fixed reference height. Steady-State or average wind speed is usually assumed to be constant as, for example, in spectral calculations.

2. ANALYSIS

#### 2.1 PROBLEM STATEMENT

The objective of the analysis is to compare analytical methods for calculation of the steady-state total wind pressure, peak total wind pressure, and wind velocity profiles of ASCE Paper No. ANSI A58.1-1982, the Standard Building Code, and the 3269, Uniform Building Code. The type of structure considered in the analysis is a Category III building that has four sides with vertically oriented walls. The report compared neither thin and wide (e.g., like a billboard) nor tall and slender (e.g., like a smokestack) buildings or structures. Only primary frames and systems are taken into account and only the windward and leeward sides are analyzed. The roof is not included in this report in order to reduce the number of graphs produced. A steady-state Exposure D wind varying from 100 mph to 125 mph in 5-mph increments is used in the analysis, and the elevation above the ground ranges from 30 feet to 500 feet.

#### 2.2 COMPARISON OF ANALYTICAL METHODS

The following subsections present the formulas used in ASCE Paper No. 3269, ANSI A58.1-1982, the Standard Building Code, and the Uniform Building Code.

2.2.1 AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE) PAPER NO. 3269. The method specified in ASCE Paper No. 3269 has been used in KSC-STD-Z-0004 to calculate wind loads on John F. Kennedy Space Center (KSC) facilities since the early 1960's. The following three subsections present formulas for the steady-state total wind pressure, peak total wind pressure, and steady-state wind velocity profile for ASCE Paper No. 3269, conforming to the criteria of 2.1 of this report (see references 2, 3, and 4 in appendix F).

2.2.1.1 <u>Steady-State Total Wind Pressure, P.</u> This subsection presents the formulas for the steady-state total wind pressure. Formula (6) is the complete formula for the steady-state total wind pressure.

P.	$= q_{r}C_{r}$	(psf)		(1)
	7270	15/		• •

 $q_{*} = 0.002558V_{*}^{2}$  (psf) (2)

 $V_{r} = V_{v_{0}} (Z/30)^{*}$  (mph) (3)

x linearly reduces from:

x = 0.3 at  $V_{30}=60$  mph to x=0.143 at  $V_{30}=130$  mph

 $x = 0.3 - (0.3 - 0.143) [(V_z - 60) / (130 - 60)]$ 

$$\mathbf{x} = 0.3 - 0.157[(\mathbf{V}_{-60})/70] \tag{4}$$

The shape coefficient,  $C_{p}$ , represents the summation of the pressure contributions from the windward and leeward sides.

$$C_{p} = 1.3$$
 (5)

Substitute (2), (3), (4), and (5) into (1)

$$P_{-} = 0.002558 [V_{10} (Z/30)^{(0.3-0.157((Vz-60)/70))}]^{2} (1.3)$$
 (psf) (6)

2.2.1.2 <u>Peak Total Wind Pressure, P., max</u>. This subsection presents the formulas for the peak total wind pressure. The peak

total wind pressure is the maximum wind measured over a period of time.

 $\mathbf{P}_{\mathbf{z},\mathbf{max}} = \mathbf{q}_{\mathbf{z},\mathbf{max}} \mathbf{C}_{\mathbf{p}} \quad (\mathbf{psf}) \tag{7}$ 

To account for the peak wind speed,  $V_{z,max}$ , a gust factor is multiplied by the steady-state velocity. A gust factor of 1.10 allows for gusts of approximately 10 seconds in duration. The peak wind velocity pressure is then derived again in order to show the limitations of the formulas.

 $q_{x,max} = 0.002558V_{z,max}^{2} \text{ (psf)}$ (8)  $V_{z,max} = V_{30}(1.10) (Z/30)^{Xmax} \text{ (mph)}$ (9)  $X_{max} \text{ linearly reduces from:}$   $x=0.3 \text{ at } V_{30}=60 \text{ mph to } x=0.143 \text{ at } V_{30}=130 \text{ mph}$  $X_{max} = 0.3-(0.3-0.143) [(V_{z,max}-60)/(130-60)]$ (10)

The limitation in equation (10) is that whenever  $V_{z,max}$  exceeds 130 mph an error will be present. When the steady-state wind velocity is 125 mph then:

 $V_{z,max} = 125 \text{ mph} (1.10) = 137.5 \text{ mph}$ 

Using a peak wind velocity of 137.5 mph yields an error of 5.8 percent. An error this size should be accounted for only when dealing with a steady-state 125-mph wind in peak velocity pressure calculations. Substituting (8), (9), (10), and (5) into (7) yields:

$$P_{z,max} = 0.002558 [(V_{30}) (1.10) (Z/30)^{[0.3-0.157[((Vz) (1.10)-60)/70]]^2} (1.3)$$
(psf)
(11)

2.2.1.3 <u>Steady-State Wind Velocity Profile, V</u>. The following formula is the wind velocity profile for 0 to 500 feet.

 $V_x = V_{30} (Z/30)^x$  (mph) (12)

$$V_{z} = V_{30} \left( \frac{Z}{30} \right)^{0.3 - 0.157 \left( \frac{Vz}{50} \right) / 70 \right]} \quad (mph)$$
(13)

2.2.2 AMERICAN NATIONAL STANDARD INSTITUTE (ANSI) A58.1-1982. The following three subsections present the formulas for the steady-state total wind pressure, peak total wind pressure, and steady-state wind velocity profile for ANSI A58.1-1982, conforming to the criteria of 2.1 in this report (see references 1, 5, and 6).

2.2.2.1 <u>Steady-State Total Wind Pressure, P.</u> This subsection presents the formulas for the steady-state total wind pressure. Formula (19) is the complete formula for the steady-state total wind pressure.

 $\mathbf{P}_{\mathbf{z}} = \mathbf{q}_{\mathbf{z}} \mathbf{C}_{\mathbf{p}} \qquad (\mathbf{psf}) \tag{14}$ 

 $q_{x} = 0.00256K_{x}(IV_{33})^{2}$  (psf) (15)

 $K_{z} = 2.58 (Z/Z_{g})^{2/a}$  for 15 ft $\leq Z \leq Z_{g}$  (16)

I = 1.11 (17)

The external pressure coefficient,  $C_p$ , is the sum of the windward and leeward sides.

$$C_{n} = 1.3$$
 (18)

Substituting (15), (16), (17), and (18) into (14) yields:

$$P_{r} = 0.00256[2.58(Z/Z_{r})^{2/a}]\{1.11V_{33}\}^{2}(1.3) \text{ (psf)}$$
(19)

For an Exposure D: a=10.0 and  $Z_{g}=700$  feet

2.2.2.2 <u>Peak Total Wind Pressure,  $P_{r,max}$ </u>. This subsection presents the formulas for the peak total wind pressure. Formula (24) is the complete formula for the peak total wind pressure.

$$P_{z,max} = q_{z,max}G_zC_p \quad (psf) \tag{20}$$

Equation (20) was modified by substituting G, for  $G_h$ . This had to be done in order to vary the building height from 30 feet to 500 feet.

$$q_{z,max} = 0.00256K_z(IV_z)^2$$
 (psf) (21)

$$G_{z} = 0.65 + 3.65 T_{z}$$
 (22)

$$T_{.} = 2.35 D_{a}^{0.5} / (Z/30)^{1/a}$$
(23)

Substituting (21), (22), (23), and (18) into (20) yields:

$$P_{z,max} = 0.00256[2.58(Z/Z_g)^{2/a}][1.11V_{33}]^2(0.65) +3.65[2.35D_o^{0.5}/(Z/30)^{1/a}] + (1.3) \quad (psf)$$
(24)

For an Exposure D: D<sub>o</sub>=0.003

2.2.2.3 <u>Steady-State Wind Velocity Profile, V</u>. The following formula is the wind velocity profile for 0 to 500 feet.

 $V_{x} = V_{33} (Z_{g}/33)^{1/a} (Z/Z_{g})^{1/a}$  (mph) for Z > 0 (25)

2.2.3 STANDARD BUILDING CODE. The Standard Building Code addresses only the steady-state total wind pressure which is present in the following subsection (see reference 7).

2.2.3.1 <u>Steady-State Total Wind Pressure, P.</u>. This subsection presents the formula for the steady-state total wind pressure, conforming to the criteria of 2.1 in this report. Formula (26) is the complete formula for the steady-state total wind pressure.

 $P_{.} = 0.00256V_{30}^{2}(Z/30)^{2/7}$  (psf) for 30 ft $\leq Z \leq 1000$  ft

The Standard Building Code multiplies the wind pressure by various shape factors (SF), in order to produce the total wind pressure. The shape factor is a constant that depends on the exterior surface of the building or structure. The total wind pressure is:

 $P_{x} = 0.00256V_{30}^{2}(Z/30)^{2/7}SF$  (psf)

For a vertically oriented four-wall building or structure, the shape factor is 1.3.

$$P_{*} = 0.00256 V_{30}^{2} (Z/30)^{2/7} (1.3) \quad (psf)$$
<sup>(26)</sup>

2.2.4 UNIFORM BUILDING CODE. The Uniform Building Code (1982 edition) was considered in this analysis. Upon investigation, it was determined that the code did not encompass Exposure D winds and, therefore, was excluded on the basis of nonconformity to the problem statement in 2.1 (see reference 8).

#### 3. DISCUSSION

The formulas presented in section 2 were used in a spreadsheet program to produce output tables containing wind velocity at a height of 30 feet, steady-state total pressure, peak total pressure, and wind velocity at discrete heights. The output of

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the spreadsheet was then passed to a presentation/graphical program which generated the figures in appendices A, B, and D that show the differences between the wind loads calculated in ASCE Paper No. 3269, ANSI A58.1-1982, and the Standard Building Steady-state Exposure D winds ranging from 100 mph to 125 Code. mph in 5-mph increments were used. The height of the wind velocity envelop ranged from 30 feet to 500 feet. Figures A-1 through A-6 show the height versus steady-state total pressure for a steady-state wind. Figure A-1 shows that for a building or structure above 330 feet, the method in ASCE Paper No. 3269 yields larger calculated velocity pressures. As the steady-state wind increases, ANSI A58.1-1982 emerges as the standard that calculates the largest total pressure, which is apparent in figures A-1 through A-3. When the steady-state wind is 110 mph and greater, ANSI A58.1-1982 analytically produces the largest total pressure, which is apparent in figures A-3 through A-6. The Standard Building Code method consistently has the lowest total pressure for figures A-1 through A-6.

Figures B-1 through B-6 in appendix B show the height versus peak total pressure for peak wind velocities. Figure B-1 shows that, for a building or structure above 250 feet, the method in ASCE Paper No. 3269 has larger calculated peak total pressures. As the peak wind velocity increases, ANSI A58.1-1982 emerges as the standard that calculates the largest total pressure, which is apparent in figures B-1 through B-4. When the peak wind is 115 mph and greater, ANSI A58.1-1982 analytically produces the largest total pressure, which is apparent in figures B-4 through B-6.

Figure C-1 in appendix C allows the designer to consider factors, such as the number of years between occurrences and what is an acceptable risk, for determining a peak wind speed. Once a peak wind speed is ascertained, the peak total pressure can be determined from appendix B.

When trying to determine which particular method calculates larger pressure values consistently regardless of the steadystate or peak winds, there is no clear-cut choice for all altitudes. For winds of 115 mph and greater, ANSI A58.1-1982 calculates larger total pressure for both steady-state and peak winds. Below 250 feet for all wind speeds, both steady-state and peak, ANSI A58.1-1982 calculates the larger pressure. For winds between 100 mph and 110 mph and for buildings or structures between 250 feet and 500 feet tall, there is no clear-cut choice of which code produces the largest total pressure. The choice of which code to use depends on the wind type and wind speed. An

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example of this can be seen in figures A-1 and B-1 for a 275foot-tall building or structure acted upon by a 100-mph wind. Figure A-1, which uses steady-state winds, indicates that the ANSI A58.1-1982 method calculates a larger velocity pressure than the ASCE Paper No. 3269 method; however, figure B-1, which uses peak wind rather than steady-state wind, indicates that the ASCE Paper No. 3269 method should be used instead of ANSI A58.1-1982. The dilemma over which method to use can be eliminated if the question of which type of wind should a building or structure be designed for (a steady-state or peak wind) is answered.

Figures D-1 through D-6 in appendix D show the calculated wind velocity profile from the methods in ASCE Paper No. 3269 and ANSI A58.1-1982.

Appendix E contains all of the formulas used in a spreadsheet program to produce tables E-1 through E-6 that contain all of the data points used to generate the graphs in appendices A through D.

#### 4. SUMMARY OF RESULTS

This analysis used a Category III building or structure exposed to an Exposure D steady-state wind varying from 100 mph to 125 mph in 5-mph increments to compare methods of calculating wind load pressure specified in ASCE Paper no. 3269, ANSI A58.1-1982, the Standard Building Code, and the Uniform Building Code. The wind velocity envelop ranged from 30 feet to 500 feet. It was determined that the method for the calculation of wind load pressure specified in ANSI A58.1-1982 produces a larger wind load pressure for a building or structure less than or equal to 250 feet in height, acted upon by a wind greater than or equal to 115 mph, than the other methods. For a building or structure between 250 feet and 500 feet tall acted upon by a wind ranging between 100 mph and 110 mph, there is no definitive choice of which method to use. Factors that must be considered for a building or structure in this range are steady-state or peak wind velocity, geographic location, distance from a large open body of water (i.e., an ocean or enormous lake), and the expected design life It was determined that the Standard and its risk factor. Building Code consistently yielded the lowest steady-state total pressure values as compared to the other methods. The Standard Building Code did not address either the peak total pressure or The Uniform Building Code did not the wind velocity profile. encompass Exposure D winds and, therefore, was excluded on the basis of nonconformity to the specified winds.

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## APPENDIX A

## TOTAL PRESSURE FOR A STEADY-STATE WIND VELOCITY

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- STANDARD BUILDING CODE
- ----- ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure A-1. Height Versus Total Pressure: Wind Velocity 100 mph at 33 ft

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- ------ STANDARD BUILDING CODE
- ----- ANSI A58,1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure A-2. Height Versus Total Pressure: Wind Velocity 105 mph at 33 ft

A-4



----- ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure A-3. Height Versus Total Pressure: Wind Velocity 110 mph at 33 ft



EXPOSURE D, CATEGORY III BUILDING

Figure A-4. Height Versus Total Pressure: Wind Velocity 115 mph at 33 ft

A-6



------ STANDARD BUILDING CODE

----- ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure A-5. Height Versus Total Pressure: Wind Velocity 120 mph at 33 ft .



---- ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure A-6. Height Versus Total Pressure: Wind Velocity 125 mph at 33 ft

A-8

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## APPENDIX B

## PEAK TOTAL PRESSURE FOR A PEAK WIND VELOCITY

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ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure B-1. Height Versus Peak Total Pressure: Wind Velocity 100 mph at 33 ft



ASCE PAPER NO. 3269

----- ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure B-2. Height Versus Peak Total Pressure: Wind Velocity 105 mph at 33 ft



------ ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure B-3. Height Versus Peak Total Pressure: Wind Velocity 110 mph at 33 ft



ASCE PAPER NO. 3269

EXPOSURE D. CATEGORY III BUILDING

Figure B-4. Height Versus Peak Total Pressure: Wind Velocity 115 mph at 33 ft

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ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure B-5. Height Versus Peak Total Pressure: Wind Velocity 120 mph at 33 ft



ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure B-6. Height Versus Peak Total Pressure: Wind Velocity 125 mph at 33 ft

## APPENDIX C

### FACILITY DESIGN WIND FOR VARIOUS PEAK WIND SPEEDS AND LIFETIMES

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## APPENDIX D

## WIND VELOCITY PROFILE

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Figure D-1. Height Versus Wind Velocity: Velocity Profile 100 mph at 33 ft



ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure D-2. Height Versus Wind Velocity: Velocity Profile 105 mph at 33 ft



ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure D-3. Height Versus Wind Velocity: Velocity Profile 110 mph at 33 ft

D-5



ASCE PAPER NO. 3269

EXPOSURE D, CATEGORY III BUILDING

Figure D-4. Height Versus Wind Velocity: Velocity Profile 115 mph at 33 ft

D-6

KSC-DM-3282



ASCE PAPER NO. 3269

----- ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure D-5. Height Versus Wind Velocity: Velocity Profile 120 mph at 33 ft

D-7



------ ASCE PAPER NO. 3269 ------ ANSI A58.1-1982

EXPOSURE D, CATEGORY III BUILDING

Figure D-6. Height Versus Wind Velocity: Velocity Profile 125 mph at 33 ft

## APPENDIX E

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## WIND PRESSURE AND WIND VELOCITY AT VARIOUS HEIGHTS FOR SPECIFIC HURRICANE WIND SPEEDS AT 33 FEET

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FORMULAS	HSSH	SUMPT I ONS :
he inputs for all of the formulas are height (located in column A) and steady-state wind velocity (located in column D). Columns B, C, nd D are "HIDDEN" from view in order to produce a pretty print out. The formulas trued in spread sheat are located below in the order that hey appear from right to left. All of the formulas shown come from ow 12 which is the row corresponding to 30 feet.	e 1. Exposur e 1. Exposur e 2. Risks o uere 50 (a choir fateor	<ul> <li>D steady-state</li> <li>of wind resourance</li> <li>and 100 years</li> <li>ice of risks were</li> <li>wildble).</li> </ul>
oefficient X used for steady-state winds (column B): 0.3-(0.3-0.143)*((D12-60)/(130-60))	e 4. Prisary e 5. Systemy 1001 (7 D1 th	J frames and E transmit the not cladding). Te windward side
oefficient X-max used for peak winds (column C): 0.3-(0.3-0.143)x(((D12x1.1)-60)/(130-60))	e and lee buildin uere an	eward side of the ng or structure nalized. The roof
<pre>SCE Paper No. 3269 Steady-state Total Pressure (psf) (column F): 0.002558%((D12%((A12/30)^B12))^2)%(1.3)</pre>	.e was not e 6. The bui tangula	t considered. ilding is rec- ar (not thin)
NSI A58.1-1982 Steady-state Total Pressure (psf) (column M): 0.00256#2.58#((A12/700)^(2/10))#((1.11#D12)^2)#1.3	e with fo	our vertically ed walls.
<pre>tandard Building Code Steady-state Total Pressure (psf) [column J]: 0.00256#(D12^2)#((A12/30)^(2/7))#(1.3)</pre>	. 6. 6. 6	
<pre>SCE Paper No. 3269 Peak Total Pressure (psf) {column L]: 0.002558*((((D12x1.1))*(((A12/30)^C12)))^2)*1.3</pre>	1 Q1 Q1 Q	
NSI A58.1-1982 Peak Total Pressure (psf) {column N]: 0.00256#(2.58*((A12/700)^(2/10))#((1.11#D12)^2)# (0.65+(3.65#(2.35#((0.003)^0.5)/((A12/30)^(1/10)))))#1.3		
SCE Paper No. 3269 Velocity Profile (mph) (column P): D12*((A12/30)^B12)	1 Ob Ob Ob	
NSI A58.1-1982 Velocity Prafile (mph) (calumn R): (F12*((700/33)^(1/10)))*((012/700)^(1/10))	. ლ. ლ.	

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XXXXXXXXXXXXXX	EXXXXXXXXXXXXXXXXX -	KKXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	KXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
	ASCE Paper	USI BNSI	Building	ASCE Paper No 3269	A58.1-1987	ASLE Parter	ANS 1
	: No. 3209 : Stead retate	Steadurstate	Steadu-state	Peak Co	T T	Na. 3269	A58.1-1982
	Total	Total	Total	Total	Total	Velocity	Velocity
HEIGHT, Z (ft)	: Pressure : (psf)	Pressure (psf)	Pressure (psf)	Pressure (psf)	Pressure (psf)	Profile (aph)	(uph)
	33.25	56.34	33.28	40.24	63.10	100.00	50.66
00.65	34.61	57.43	34.20	41.70	64.05	102.02	100.00
40.00	37.53	59.68	36.13	44.83	66.04	106.24	101.94
60.00	44.51	: 64.72	40.57	52.21	70.44	115.69	106.16
80.00	50.23	68.56	44.04	58.17	92.E2	122.91	109.26
100.00	55.18	: 71.69	46.94	63.25	: 76.45	128.81	111.72
120.00	59.57	74.35	49.45	67.74	: 78.73	133.85	113.78
140.00	1 63.56	76.68	: 51.68	71.78	80.72	138.26	115.55
160.00	67.24	78.75	53.69	75.47	82.48	142.19	117.10
180.00	70.65	80.63	: 55.53	78.88	84.07	145.76	118.49
200,00	73.85	82.34	: 57.23	82.07	85.53	149.02	119.74
220.00	76.87	: 83.93	: 58.80	85.06	86.86	152.04	120.89
240.00	79.74	: 85.40	60.28	87.89	88.10	154.85	121.95
260.00	82.47	86.78	61.68	: 90.57	89.26	157.48	122.93
280.00	85.08	88.08	: 63.00	: 93.13	: 90.35	159.95	123.84
300.00	87.58	: 89.30	64.25	: 95.57	: 91.37	162.29	124.70
320.00	66.99	: 90.46	: 65.45	97.92	: 92.34	164.51	125.51
· 340.00	92.32	1 91.56	: 66.59	100.18	: 93.26	166.62	126.27
360.00	- 94.56	92.62	: 67.69	102.35	: 94.14	168.63	126.99
380.00	1 96.74	1 93.62	: 68.74	104.45	94.98	170.56	127.68
400.00	98.85	94.59	: 69.76	106.48	: 95.78	172.41	: 128.34
420.00	100.90	1 95.52	: 70.74	108.45	96.55	174.19	128.97
440.00	102.89	96.41	1 71.68	110.37	: 97.29	175.90	129.57
460.00	104.83	97.27	: 72.60	: 112.23	: 98.01	177.55	130.14
480.00	106.72	: 98.10	59.49	: 114.03	1 98.70	179.15	130.70
500.00	108.57	16.98.91	1 74.35	: 115.80	1 98°36	180.69	FZ IEI

Wind Pressure and Wind Velocity for 100 mph at 33 ft Figure E-1.

105.00 MPH AT 30 FEET	
I DADING PRESSURE ANALYSIS FOR A STEADY-STATE UIND =	EXPOSURE D. CATAGORY 111 BUILDING

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	Standard
	******
	IXXXXXXXXXXXXXXXXXXXXXXXXXX -

			Standard				
	ASCE Paper	ISNU	Building	ASCE Paper	BNSI STORE		ANS 1
	Na. 3269	1 A58.1-1982	Code	Post - ON	JOGI-I.BCH	No. 3269	A58.1-1982
	: Steady-state : Total	: Stemoy-state : : Total	Total	Total	Total	Velocity	Velocity
UFIGHT 7	Prese	Preser d	Pressure	Pressure	- Pressure	Profile	Profile
(ft)	(psf)	(psf)	: (psf) :	(psf)	; (psf) ;	(thom)	(udu)
		- C1 C2 -	36.69	44.36	: 69.56	105.00	104.00
00.0F			02.76	45.87	70.62	107.01	105.00
	190.00			49.08	72.81	111.19	107.04
28			EZ 74	56.58	77.66	120.54	111.47
20.00			48.56	62.60	81.32	127.64	114.72
			51.76	67.70	84,29	133.44	117.31
		10.10	54.52	72.17	86.80	138.37	119.47
			56.98	76.18	88.99	142.68	121.33
			5	79.84	90.94	146.53	122.96
160.00		10000	22.12	12.68	92.69	150.00	124.41
	20.67	82.00 82.00	60 E9	86.34	94.29	153.18	125.73
		ES 20	64.83	89.28	: 95.77	156.12	126.93
00.022		04 16	66.46	92.05	: 97.13	158.84	128.04
250.00		89 50	68.00	94.67	98.41	161.39	: 129.07
	00.04 00 21	01 20	69.46	51.75	: 99.61	163.79	: 130.03
	17.00	28 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	70.84	99.55	100.74	166.06	130.93
	94.09	E2 66	72.16	101.83	101.81	168.21	131.78
340.00	- 96-38 	100.95	73.42	104.02	102.82	170.25	132.58
	98.60	102.11	74.63	106.13	: 103.79	172.20	133.34
	52 001	22 103	52.79	108.17	104.71	174.06	134.07
	E8 201	104.28	76.91	E1.011	105.60	175.85	134.75
	104 84	105.31	66.27	112.03	106.45	177.56	135.41
440.00	106.80	106.29	E0.62	: 113.88	107.27	179.21	136.05
460.00	108.71	107.24	80.04	: 115.67	108.05	180.81	136.65
480.00	110.57	108.16	81.02	: 117.41	108.81	182.35	EZ.7EI
500.00	112.38	109.04	: 81.97	: 119.10	109.55	183.83	

Т жижжежесе	ANSI PS8.1-1982 Velocity	: Profile : (mph)	108.96		116.78	120.19	122.90	125.16	127.10	128.81			86.7F1 1	134.14	77.cf1	FZ-9F1	71.7E1						141.80	142.22	91.E41		144.30
H AT 30 FEE	ASCE Paper No. 3269 Velocity	Profile (mph)	110.00	111.99	1155.30	132.26	137.92	142.72	146.92	150.65	154.02	157.10	159.94	162.57	165.03	167.35	169.53	171.60	or FL	12.4	EZ 221	178.95	180.59	182.18	12.E81	185.18	186.61
110.00 MP	ANSI A58.1-1982 Peak Total	Pressure (psf)	76.35	77.50	52.28	89.25	92.51	95.27	97.67	66.66	E7.101	103.49	105.10	106.60	108.00	109.32	110.56	E.1.1	112.85	113.91	114.92	115.89	116.83	117.72	118.59	119.42	EZ.021
-STATE UIND = 111 BUILDING	ASCE Paper No. 3269 Peak Total	Pressure (psf)	48.69	50.23	53.48	67.06	72.12	76.54	80.49	84.08	87.37 ¦	90.43	<b>93.29</b>	95.97	98.52	100.93	103.23	105.42	107.53	109.55	111.50	113.39	115.21	116.97	118.68	120.34	121.95
IS FOR A STEADY KE D, CATAGORY	Standard Building Code Steady-state Total	Pressure (psf)	40.27 :	41.38	22.E4	53.29	56.80	59.84	62.53	64.97	67.19 :	69.24 :	71.15	72.94 :	74.63	76.23	: 52.75	79.19	80.58	81.90 :	83.18	84.41	85.59	86.74	87.85	88.92	89.96
PRESSURE ANALYSI	ANSI AS8.1-1982 Steedy-state Total	Pressure (psf)	68.18 :	69.49	72.21	82.95	86.74	89.96	92.78	95.29 :	97.56	99.64	101.55 :	103.34 :	105.00 :	106.57	108.05 :	109.46	110.79 :	112.07	113.28 :	114.45 :	115.58 :	116.66 :	117.70	118.70	119.68
NIND LONDING	ASCE Paper No. 3269 Steadystate Total	Pressure (psf)	40.24	41.70	- FC C3	58.17	63.25	67.74 :	71.78	75.47	78.88	82.07	85.06	82.89	90.57 :	93.13 :	95.57 :	97.92	100.18	102.35 :	104.45	106.48	108.45	110.37	: 112.23	114.03 :	115.80
	<pre></pre>	HEIGHT, Z : (ft) :	: 00.0E	33.00	40.00 00.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00E	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00

Wind Pressure and Wind Velocity for 110 mph at 33 ft Figure E-3.

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			Standard	Dere Daren	BNSI		
	Taper and	1-1982		No. 3269	A58.1-1982	ASCE Paper	<b>RNSI</b>
	Steadurstate	Steadurstate	Steady-state	Peak	Peak	No. 3269	A58.1-1982
	Total	Total	Total :	Total 1	Total	Velocity	Velocity
HEIGHT, Z	Pressure	Pressure	Pressure :	Pressure	Pressure	Profile	Profile
(ft)	: (psf)	: (psf)	: (psf)	(psf)	(psf)	(tigh)	(udu)
	41.08	74 57	44.01	53.21	83.44	115.00	113.91
25	41.14 84		45.23	54.77	84.71	116.95	115.00
	48 58	E6 82	47.78	58.04	EE.78	120.99	117.23
60 00	56.18	85.60	53.65	62.29	93.16	129.98	122.08
80.00	62 19	90.67	58.25	71.54	97.55	136.75	125.65
00.001	67.29	94.80	62.08	76.52	101.11	142.25	128.48
	22.12	98.32	65.40	80.85	104.12	146.91	130.85
140.00	62.52	101.40	68.35	84.70	106.75	150.96	132.88
160.00	57.62	104.15	71.01	88.18	109.08	154.57	134.67
180.00	82.82	106.63	73.44	91.37	111.19	157.82	136.26
200.00	85.96	108.90	75.68	94.32	113.11	160.78	137.70
220.00	88.91	111.00	77.77	97.07	114.87	163.51	139.02
240.00	91.68	112.95	E2.67	99.65	116.51	166.04	140.24
260.00	1E.96	114.77	81.57	102.09	118.05	168.41	141.37
280.00	96.81	116.48	83.32	104.40	119.48	: 170.63	142.42
300° 00E	99.20	118.10	84.98	106.59	120.84	172.72	143.40
320, 00	101.49	119.63	86.56	: 108.69	122.12	174.70	144.33
340,00	103.69	121.09	88.07	: 110.69	123.34	176.58	145.21
360,00	105.80	122.49	89.52	112.62	124.50	178.37	146.04
UO UBE	107.84	123.82	90.91	114.47	125.61	180.08	146.83
	109.82	125.09	92.26	116.25	: 126.67	181.72	147.59
420.00	111.72	126.32	93.55	117.58	127.69	183.30	148.31
440.00	113.58	127.50	94.80	: 119.65	128.67	184.81	149.00
460.00	115.37	128.64	96.01	: 121.26	129.61	: 186.27	149.67
480,00	117.12	129.74	97.19	: 122.83	130.52	187.67	150.30
500.00	: 118.82	130.80	: 38°.33	124.35	: 131.40	: 189.03	150.92

KSC-DM-3282

<ul> <li>D LOHDING PR</li> <li>KKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKK</li></ul>	ANSI Stand ANSI Stand A58.1-1982 Code Leady-state Steady- Total Pressure (psf) (psf)	International No. addrate No. Total To ressure Pres (psf) (ps	ASCE Paper No. 3269 Teak Prestre	69   ANSI 69   ANSI 72   -1982   72   Feak	RKKKKKKKKKKKKK FSCE Paper No. 3269 Velocity Profile (aph)
	81.14 1 47		(psf) :	re : Pressure : (psf) :	: 120.00
		47.92 : 5	(psf) : 57.94 :	re : Pressure : : (psf) : 94 : 90.86 :	: 121.91 :
w	32.70 : 45	47.92 : 5	57.94	re : Pressure : (psf) : 94 : 90.86 : 49 : 92.24 :	125.85
6	2.70 - 45 5.94 - 52	47.92 : 5 49.25 : 5 52.03 : 6	57.94 59.49	Te Pressure (psf) (54 194 190.86 192.24 195 92.24 195 95.09 195.00 195.0	134.58
8	20	42.92 42.92 52.03 58.42	57.94 59.49 52.75 70.21	re Pressure (psf)	141.14
103.	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	42.92 49.25 52.92 58.42 53.42 53.42	(psf) 57.94 59.49 62.75 70.21 70.21	Te Pressure (psf) 94 90.86 75 92.24 75 95.09 21 101.44	140.40
107.	5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	442 442 442 442 442 442 442 442 442 442	57.94 59.49 62.75 70.21 70.21	Pressure 94 195 75 75 75 95.09 95.09 95.09 100.09 110.09 110.09	154.83
113.	6 2 2 2 6 8 4 	26.262 26.252 26.252 26.252 26.252 26.252 27	(paf) 59.49 62.75 70.21 70.21 88.03 88.03 88.03 88.03	Te Pressure 94 (psf) 75 (psf) 75 92.24 75 92.24 75 101.44 106.22 88 110.09 78 113.38 78 116.24	: 158.29 :
116.	6 2 8 5 2 8 4 6 	22.22 22.22	(paf) 59.49 62.75 70.21 70.21 70.21 76.03 88.08 88.78 88.78 83.78	Te Pressure (psf)	161.40
118.	6 2 8 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	64675666677777 66766666777777 76766677866677777 7676677866677	(paf) 59.49 62.75 70.21 70.21 70.21 70.21 88.03 88.08 88.78 88.78 85.18	Te Pressure 94 99 90.86 75 90.86 75 92.24 75 110.09 88 110.09 118.78 118.78 118.78	164.24
120.	6 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	64738667147768	55. 94 52. 75 62. 75 70. 21 70. 21 70. 21 88. 03 95. 13 95. 18 95. 18	Pressure 94 75 75 75 78 88 110.22 101.44 110.09 110.09 1116.24 1116.24 1116.24 1116.24 1116.24 1116.23 116.22 116.22 116.22 116.22 116.22 116.23 116.24 116.25 116.25 116.25 116.25 116.25 116.25 116.25 116.	169.27
124.9	5 2 3 6 2 8 5 5 5 8 8 8 	646756666666666666666666666666666666666	(paf) 57.94 52.75 70.21 70.21 70.21 70.21 88.78 88.78 88.78 92.13 92.13 92.13 92.13 92.00 103.00	Terestina         Pressure           94         94         99           94         90         86           75         92         92           21         101         44           21         101         44           21         101         44           21         101         44           22         1106         22           13         116         24           13         116         24           13         118         118           13         121         00           123         156         25           125         125         26	: 171.53
126.8	620008-500888 	6 4 4 5 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	(paf) 57.94 52.49 62.75 70.21 70.21 70.21 70.21 88.78 85.07 95.18 95.18 95.18 95.18 95.18 103.06 103.08	Trest         Prest           94         94           94         90.86           75         92.24           75         92.24           88         9101.44           101.44         95.09           78         1116.24           113         116.23           118         1116.24           118         1116.24           118         121.07           118         125.08           121.07         126.87           122.08         128.53           128.53         128.53	173.64
128.5		C C C C C C C C C C C C C C C C C C C	(paf) 57.94 52.75 70.21 70.21 70.21 70.21 70.21 70.21 70.21 95.13 95.18 95.18 95.18 95.18 103.06 103.06 105.39	Tresult           94           94           94           94           94           94           95           75           95           96           97           98           111           95           96           97           91           118           118           118           118           118           121           121           121           122           123           124           125 <td></td>	
		4423         4423         4423         4433 <td< td=""><td>57.94 57.94 52.75 70.21 70.22 70.21 70.22 70.21 70.220</td><td>Tops         Tops           94         94           94         94           75         112           121         92.24           93         92.24           94         90.86           95         99.26           96         92.24           97         92.24           98         1110.22           91         101.23           95         1116.23           96         121.07           91         121.07           91         125.08           92         121.07           93         121.07           93         122.08           93         122.08           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         1</td><td>179.31</td></td<>	57.94 57.94 52.75 70.21 70.22 70.21 70.22 70.21 70.220	Tops         Tops           94         94           94         94           75         112           121         92.24           93         92.24           94         90.86           95         99.26           96         92.24           97         92.24           98         1110.22           91         101.23           95         1116.23           96         121.07           91         121.07           91         125.08           92         121.07           93         121.07           93         122.08           93         122.08           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         126.03           93         1	179.31
		6473         6675         67555         6755 <t< td=""><td>57.94 57.94 62.75 70.21 70.22 70.210</td><td>Trest         Trest           94         94           94         94           75         112           113         92.24           78         92.24           78         92.24           78         92.24           78         92.24           78         1116.24           113         116.24           113         118           114         113.38           118         1116.24           118         1118.78           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.10           119         121.10           113         121.10           113         121.10           113         121.10           113         121.10           123         121.10           <t< td=""><td>181.01 :</td></t<></td></t<>	57.94 57.94 62.75 70.21 70.22 70.210	Trest         Trest           94         94           94         94           75         112           113         92.24           78         92.24           78         92.24           78         92.24           78         92.24           78         1116.24           113         116.24           113         118           114         113.38           118         1116.24           118         1118.78           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.07           118         121.10           119         121.10           113         121.10           113         121.10           113         121.10           113         121.10           123         121.10 <t< td=""><td>181.01 :</td></t<>	181.01 :
134.8		447386621475688898989898989898989898989898989898989	57.94 57.94 62.75 70.21 70.21 70.21 70.21 70.21 70.21 70.21 70.21 95.18 95.08 95.18 95.18 95.18 103.08 103.08 103.08 103.08 103.08 103.08 113.52 113.52	Test         Presult           94         94           94         94           75         21           71         21           75         92.24           78         92.24           78         92.24           78         110.24           78         1113.38           78         1116.24           118         121.07           118         121.07           118         125.08           118         125.08           118         125.08           118.78         118.78           118         121.07           118         125.08           125.08         126.87           130.10         128.53           131.57         131.57           131.57         131.57           131.57         135.53           135.56         135.53	: 182.64 :
136.2		64733         6675         6755 <t< td=""><td>57.94 57.94 62.75 70.21 70.21 70.21 70.21 70.21 70.21 88.78 88.78 88.78 95.18 95.18 103.68 103.68 103.08 103.08 103.08 103.08 103.08 111.63 111.63 111.63</td><td>Tresult         Tresult           94         94           94         94           75         71           71         92.24           78         92.24           78         110.24           78         1113.38           78         1116.24           113         116.24           118         121.07           118         125.08           118         125.08           118         125.08           118         125.08           118         125.08           118         125.08           118         125.08           125.08         126.38           130.10         136.73           131         137.97           135.165         136.73           135.156         136.73           135.156         136.73           135.156         136.73           135.156         136.77</td><td>: 184.20 :</td></t<>	57.94 57.94 62.75 70.21 70.21 70.21 70.21 70.21 70.21 88.78 88.78 88.78 95.18 95.18 103.68 103.68 103.08 103.08 103.08 103.08 103.08 111.63 111.63 111.63	Tresult         Tresult           94         94           94         94           75         71           71         92.24           78         92.24           78         110.24           78         1113.38           78         1116.24           113         116.24           118         121.07           118         125.08           118         125.08           118         125.08           118         125.08           118         125.08           118         125.08           118         125.08           125.08         126.38           130.10         136.73           131         137.97           135.165         136.73           135.156         136.73           135.156         136.73           135.156         136.73           135.156         136.77	: 184.20 :
137.5		6473         6473 <td< td=""><td>57.94 57.94 52.45 52.45 70.21 76.03 76.03 76.03 88.08 88.08 88.09 95.13 95.13 95.13 95.00 95.13 95.00 95.13 95.00 100.62 100.62 110.53 100.62 111.63 111.63 111.63 111.63 111.63</td><td>Pressure         Pressure           94         94           94         94           75         71           71         92           78         92           78         92           78         92           78         110           78         1113           78         1116           78         1116           78         1116           78         1116           78         1116           78         1123           79         123           79         123           70         123           73         126           130         126           131         57           732         136           133         136           136         136           136         137           792         136           792         136           792         136           136         136           136         136           136         137</td><td>: 185.69 :</td></td<>	57.94 57.94 52.45 52.45 70.21 76.03 76.03 76.03 88.08 88.08 88.09 95.13 95.13 95.13 95.00 95.13 95.00 95.13 95.00 100.62 100.62 110.53 100.62 111.63 111.63 111.63 111.63 111.63	Pressure         Pressure           94         94           94         94           75         71           71         92           78         92           78         92           78         92           78         110           78         1113           78         1116           78         1116           78         1116           78         1116           78         1116           78         1123           79         123           79         123           70         123           73         126           130         126           131         57           732         136           133         136           136         136           136         137           792         136           792         136           792         136           136         136           136         136           136         137	: 185.69 :
138.8	616006166888880888888888888888888888888	4473         45475         45475         4556         4566         <	57.94 57.94 52.49 52.49 70.21 76.23 76.23 76.03 76.03 88.08 88.08 98.08 98.08 98.08 98.08 98.00 98.00 98.00 98.00 98.00 100.65 111 100.65 111.63 111.63 111.63 111.73 120.37	Pressure         Pressure           94         94           94         94           775         71           71         92.24           70         92.24           70         92.24           70         92.24           70         92.24           70         92.24           70         110.23           70         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1116.24           111         1118.78           112         1118.78           112         1118.78           113         1125.08           113         112           113         113           113         113           113         113           113         113           113         113           113         113           113	
140.0	620606555388888888888888888888888888888888	4473         4545         4545         4545         4555 <td< td=""><td>57.94 57.94 52.49 52.49 52.49 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 103.08 52.13 52.13 103.08 103.08 103.08 103.08 103.08 103.08 113.55 11</td><td>Pressure         Pressure           94         94           94         94           775         71           71         95.09           78         95.09           78         95.09           78         1101.44           78         1116.24           116         126.22           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         128           118         128           123         16           125         132           130         130           131         57           132         136           132         137           133         136           134         30           135         137           136         137           137         137           137         137</td><td>: 187.12 :</td></td<>	57.94 57.94 52.49 52.49 52.49 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 52.13 103.08 52.13 52.13 103.08 103.08 103.08 103.08 103.08 103.08 113.55 11	Pressure         Pressure           94         94           94         94           775         71           71         95.09           78         95.09           78         95.09           78         1101.44           78         1116.24           116         126.22           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         126.23           118         128           118         128           123         16           125         132           130         130           131         57           132         136           132         137           133         136           134         30           135         137           136         137           137         137           137         137	: 187.12 :
141.	620606465888888888889999999999999999999999999	4423         4543 <td< td=""><td>57.94 57.94 52.75 52.49 52.75 52.75 56.07 88.08 88.78 88.78 88.78 88.78 88.78 88.78 95.01 95.113 95.018 95.018 95.018 95.013 95.01000000000000000000000000000000000</td><td>Tresult         Presult           94         94           94         95           75         95           71         95           78         95           78         95           78         110           78         111           78         1116           18         1116           18         1116           19         111           18         111           18         111           18         111           18         111           18         111           18         126           18         128           19         128           13         128           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         14           14         14  </td><td>188.50</td></td<>	57.94 57.94 52.75 52.49 52.75 52.75 56.07 88.08 88.78 88.78 88.78 88.78 88.78 88.78 95.01 95.113 95.018 95.018 95.018 95.013 95.01000000000000000000000000000000000	Tresult         Presult           94         94           94         95           75         95           71         95           78         95           78         95           78         110           78         111           78         1116           18         1116           18         1116           19         111           18         111           18         111           18         111           18         111           18         111           18         126           18         128           19         128           13         128           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         13           13         14           14         14	188.50
142.	6206084668888888888888888888888888888888	4423         4543 <td< td=""><td>57.94 57.94 52.75 52.75 52.75 52.75 56.03 85.07 88.08 85.07 95.13 95.13 95.13 95.13 95.13 95.13 95.13 100.62 100.62 113.53 100.55 113.53 113.5</td><td>Press           Press           Press<!--</td--><td>187.12 188.50 189.84</td></td></td<>	57.94 57.94 52.75 52.75 52.75 52.75 56.03 85.07 88.08 85.07 95.13 95.13 95.13 95.13 95.13 95.13 95.13 100.62 100.62 113.53 100.55 113.53 113.5	Press           Press </td <td>187.12 188.50 189.84</td>	187.12 188.50 189.84

Wind Pressure and Wind Velocity for 120 mph at 33 ft Figure E-5.

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E-8

125.00 MPH AT 30 FEET

UIND LOADING PRESSURE ANALYSIS FOR A STEADY-STATE UIND = EXPOSURE D, CATAGORY III BUILDING

			Standard				
	RSCE Paper No. 3269	RNSI R58.1-1982	Building	ASCE Paper No. 3269	ANS	ASCE Paper	<b>BNSI</b>
	Steady-state	Steadystate	Steadyratate	n N N N N N	Peek	Na. 3269	R58.1-1982
HEIGHT, 2	Pressure	Pressure	Pressure	Pressure	Pressure	Profile	Profile
(ft)	(psf)	(psf)	(psf)	(psf)	; (psf) ;	(mph)	(aph)
30.00	: 51.96	88.04	52.00	62.87	98.59	125.00	123.81
<b>33.00</b>	: 53.51	E2.68	53.44	64.40	100.08	126.85	125.00
<b>4</b> 0.00	56.78	: 33.25 :	56.45	67.60	103.18	130.67	127.43
60.00	1 64.04	101.13	: 69.39	74.89	110.06	139.10	132.70
80.00	1E-07 1	107.12	68.82	80.53	115.25	145.41	136.57
100.00	: 75.32	112.01	73.35	85.19	119.46	150.50	139.66
120.00	79.68	116.17	77.27	89.20	: 123.02	154.79	142.23
140.00	: 83.56	119.81	80.75	92.74	: 126.12	158.52	144.43
160.00	87.07	123.05	: 68.68	95.92	: 128.88	161.82	146.38
180.00	06.02	125.98	86.76	98.81	: 131.37 :	164.78	148.11
200.00	: 93.28	128.66	89.41	101.48	: 133.63	167.48	149.68
220.00	. 96.06	131.14	91.88	103.95	135.72	169.96	151.11
240.00	: 98.67	133.44	94.20	106.26	137.66	172.26	152.43
260.00	101.14	135.60	: 76.37 :	108.42	139.47	174.40	153.66
280.00	: 103.48	137.62	98.44	110.47	141.17	176.40	154.80
300.00	: 105.70	139.53	100.40	112.41	142.77	178.29	155.87
320.00	: 107.83	141.34	102.26	- 114.26	144.28	180.07	156.88
340.00	: 109.86	143.07	104.05 :	116.02	145.72	181.76	157.84
360.00	: 111.82	144.71	105.76	117.70	: 147.09	183.37	158.74
380.00	: 113.70	146.29	107.41	119.32	148.40	184.91	159.60
400.00	: 115.51	147.80	109.00	120.87	149.66	186.38	160.42
420.00	: 117.26	149.24	110.53 :	122.37	150.86	187.78	161.21
440.00	118.96	150.64	112.01	123.82	152.02	189.14	161.96
460.00	: 120.60	151.99	113.44	125.21	153.14	190.44	162.68
480.00	: 122.19	153.28	114.83	126.57	154.21	191.69	: 163.37
500.00	123.74	154.54	116.17	127.88	155.25	192.90	164.04
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E-9/E-10

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## APPENDIX F

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### REFERENCE DOCUMENTS

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#### REFERENCE DOCUMENTS

- ANSI A58.1-1982. "Minimum Design Loads for Buildings and Other Structures." American National Standards Institute, New York, NY.
- American Society of Civil Engineers. "Task Committee on Wind Forces: Wind Forces on Structures." ASCE Paper No. 3269, ASCE Transactions, Vol. 126, Part II, pp. 1124-1198, 1961.
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National Aeronautos and Space Administration	Report Documentation Page	ge
. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
TM 102782		
I. Title and Subtitle	l	5. Report Date
Comparison of An of Wind Loads.	nalytical Methods for Calculation	6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
Donald J. Minder	rman	
Larry L. Schultz	Z	KSC-DM-3282
		IO. WORK ONLE NO.
. Performing Organization Name	and Address	
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NASA, Kennedy S	pace Center, FL	13. Type of Report and Period Covered
2. Sponsoring Agency Name and	Address	
John F. Kennedy National Aeronau Kennedy Space C	Space Center utics and Space Administration enter. FL 32899	14. Sponsoring Agency Code
<ul> <li>6. Abstract</li> <li>The following analysis</li> </ul>	sis is a comparison of analytical r	methods for the calculation
<ul> <li>6. Abstract</li> <li>6. Abstract</li> <li>6. Abstract</li> <li>7. The following analysis</li> <li>6. Abstract</li> <li>6. Abstract</li> <li>7. The following analysis</li> <li>9. ANSI A58.1-1982, the analyzed using variation of wind load pressure</li> <li>9. Analyzed using variation of the second seco</li></ul>	sis is a comparison of analytical means res. The analytical methods specifies e Standard Building Code, and the Hous hurricane speeds to determine the he winds used for the analysis range from the shoreline of a large open cean) a distance of 1500 feet or to re considered. For a building or so ht acted upon by a wind greater that the method specified in ANSI A58. than the other methods. For a building et tall acted upon by a wind rangin hoice of which method to use; for the are the steady-state or peak wind water nce from a large open body of water	methods for the calculation fied in ASCE Paper No. 3269, Uniform Building Code were the differences in the cal- ged from 100 mph to 125 mph body of water (i.e., a en times the height of the structure less than or equal an or equal to 115 mph, it 1-1982 calculated a larger lding or structure between ng from 100 mph to 110 mph, these cases, factors that velocity, the geographic r, and the expected design
5. Supplementary Notes 5. Supplementary Notes 6. Abstract The following analysis of wind load pressur ANSI A58.1-1982, the analyzed using vari- culated results. The and applied inland large lake or the or- building or structur to 250 feet in heigen was determined that wind load pressure 250 feet and 500 feet there is no clear of must be considered location, the distant life and its risk for 7. Key Words (Suggested by Aug	sis is a comparison of analytical means res. The analytical methods specifies e Standard Building Code, and the Hous hurricane speeds to determine the ous hurricane speeds to determine the he winds used for the analysis range from the shoreline of a large open cean) a distance of 1500 feet or to re considered. For a building or so ht acted upon by a wind greater that the method specified in ANSI A58. than the other methods. For a buil et tall acted upon by a wind rangin hoice of which method to use; for a are the steady-state or peak wind nce from a large open body of water actor.	methods for the calculation fied in ASCE Paper No. 3269, Uniform Building Code were the differences in the cal- ged from 100 mph to 125 mph body of water (i.e., a en times the height of the structure less than or equal an or equal to 115 mph, it 1-1982 calculated a larger lding or structure between ng from 100 mph to 110 mph, these cases, factors that velocity, the geographic r, and the expected design
5. Supplementary Notes 5. Supplementary Notes 6. Abstract The following analy: of wind load pressur ANSI A58.1-1982, the analyzed using varia- culated results. The and applied inland large lake or the or building or structur to 250 feet in heig was determined that wind load pressure 250 feet and 500 feet there is no clear or must be considered location, the distantife and its risk for 7. Key Words (Suggested by Autominet WIND	sis is a comparison of analytical means. The analytical methods specifies. The analytical methods specifies of standard Building Code, and the loous hurricane speeds to determine the winds used for the analysis range from the shoreline of a large open cean) a distance of 1500 feet or to be a distance of 1500 feet or to be a distance of 1500 feet or to be a specified. For a building or so the acted upon by a wind greater that the method specified in ANSI A58. Than the other methods. For a built et tall acted upon by a wind ranging hoice of which method to use; for a are the steady-state or peak wind more from a large open body of water actor.	methods for the calculation fied in ASCE Paper No. 3269, Uniform Building Code were the differences in the cal- ged from 100 mph to 125 mph body of water (i.e., a en times the height of the structure less than or equal an or equal to 115 mph, it 1-1982 calculated a larger lding or structure between ng from 100 mph to 110 mph, these cases, factors that velocity, the geographic r, and the expected design
5. Supplementary Notes 5. Supplementary Notes 6. Abstract The following analysis of wind load pressur ANSI A58.1-1982, the analyzed using varian culated results. The and applied inland large lake or the or- building or structur to 250 feet in heig was determined that wind load pressure 250 feet and 500 feet there is no clear of must be considered location, the distan life and its risk for WIND LOADS BUILDINGS	sis is a comparison of analytical means. The analytical methods specifies. The analytical methods specifies Standard Building Code, and the loous hurricane speeds to determine the winds used for the analysis range from the shoreline of a large open cean) a distance of 1500 feet or to re considered. For a building or sht acted upon by a wind greater that the method specified in ANSI A58. Than the other methods. For a buildet tall acted upon by a wind ranging hoice of which method to use; for sare the steady-state or peak wind more from a large open body of water actor. Thor(s)) 18. Distribution S	methods for the calculation fied in ASCE Paper No. 3269, Uniform Building Code were the differences in the cal- ged from 100 mph to 125 mph body of water (i.e., a en times the height of the structure less than or equal an or equal to 115 mph, it 1-1982 calculated a larger lding or structure between ng from 100 mph to 110 mph, these cases, factors that velocity, the geographic r, and the expected design tatement ted
<ul> <li>6. Abstract</li> <li>6. Abstract</li> <li>7. Key Words (Suggested by Autors)</li> <li>7. Key Words (Suggested by Autors)</li> <li>9. Security Classif. (of this report</li> </ul>	sis is a comparison of analytical r res. The analytical methods specifies e Standard Building Code, and the U ous hurricane speeds to determine to he winds used for the analysis range from the shoreline of a large open cean) a distance of 1500 feet or to re considered. For a building or so ht acted upon by a wind greater that the method specified in ANSI A58. than the other methods. For a buil et tall acted upon by a wind rangin hoice of which method to use; for are the steady-state or peak wind y nce from a large open body of water actor. thor(s)) 18. Distribution S Unlimit	methods for the calculation fied in ASCE Paper No. 3269, Uniform Building Code were the differences in the cal- ged from 100 mph to 125 mph body of water (i.e., a en times the height of the structure less than or equal an or equal to 115 mph, it 1-1982 calculated a larger lding or structure between ng from 100 mph to 110 mph, these cases, factors that velocity, the geographic r, and the expected design tatement ted

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