

ExxonMobil DESIGN PRACTICES	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	Section	Page
		XXIX-A	1 of 36
		December, 2002	

Changes shown by ↕

CONTENTS

Section	Page
SCOPE	3
REFERENCES	3
GLOBAL PRACTICES.....	3
DESIGN PRACTICES	3
OTHER REFERENCES	3
BACKGROUND.....	3
WIND DESIGN CONSIDERATIONS	4
WIND DATA.....	5
EFFECT OF HEIGHT AND GROUND SURFACE ROUGHNESS.....	5
WIND SPEED AVERAGING PERIOD.....	8
MEAN RECURRENCE INTERVAL	9
WIND RISK	9
WIND SPEED CALCULATION PROCEDURES	11
DERIVING DESIGN WIND SPEED	11
STATISTICAL ANALYSIS OF WIND SPEEDS	11
EARTHQUAKE DESIGN CONSIDERATIONS.....	12
EARTHQUAKE GROUND MOTION.....	13
MAGNITUDE AND INTENSITY	14
GLOBAL SEISMICITY	16
MEASURES OF GROUND SHAKING FOR USE IN DESIGN	18
UBC-94 Seismic Zone Factor, Z	18
IBC 2000 & ASCE 7-98 Spectral Response Accelerations S_s , S_1	18
EARTHQUAKE DESIGN PROCEDURES.....	20
IMPORTANCE FACTOR (I) FOR USE IN WIND AND SEISMIC DESIGN	20
NOMENCLATURE	23
APPENDIX A DESIGN WIND SPEEDS FOR EXXONMOBIL LOCATIONS.....	24
APPENDIX B HISTORIC SEISMIC ZONES (OBSOLETE) FOR EXXONMOBIL LOCATIONS	28
APPENDIX C EXAMPLE PROBLEMS.....	32
EXAMPLE PROBLEM 1 - VARIATION OF WIND SPEED BY HEIGHT AND EXPOSURE TYPE	32
EXAMPLE PROBLEM 2 - CONVERTING FASTEST-MILE WIND SPEED TO 3-SECOND GUST.....	34
EXAMPLE PROBLEM 3 - STATISTICAL ANALYSIS OF WIND SPEED DATA.....	35



Section XXIX-A	Page 2 of 36	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	ExxonMobil DESIGN PRACTICES
December, 2002			

TABLES

TABLE B-1 SEISMIC COEFFICIENTS	31
--------------------------------------	----

FIGURES

Figure 1 3-Second Gust Vs. Fastest-Mile Wind Speed	4
Figure 2 Profiles Of Wind Speed Over Terrains Of Differing Roughness	7
Figure 3 Ratio Of Probable Maximum Speed Averaged Over T Sec To Hourly Mean Speed	8
Figure 4 Common Earthquake-Related Terms	13
Figure 5 Reflection, Refraction, And Transformation Of Seismic Waves	14
Figure 6 Modified Mercalli Intensity Scale With Corresponding Approximate Ground Accelerations	15
Figure 7 Earthquake Accelerograph Plot With Corresponding Velocity And Displacement Plots	16
Figure 8 Techtonic Plates And Map Of Global Seismicity.....	17
Figure 9 Maximum Considered Earthquake Ground Motion For The Conterminous United States Of 0.2 Sec Spectral Response Acceleration (5 5 Of Critical Damping), Site Class B.....	19
Figure 10 Maximum Considered Earthquake Ground Motion For The Conterminous United States Of 1.0 Sec Sptcal Response Acceleration (5 5 Of Critical Damping), Site Class B.....	20
FIGURE B-1 Effective Peak Velocity and Acceleration.....	31

Revision Memo

- 12/02** Technical update. Highlight of this revision are:
1. Update sesimic design provision to ASCE7-98
 2. Added sites to appendix A & B from merger. Provided data basis in Appendix A and marked Appendix B table 1 obsolete.

ExxonMobil DESIGN PRACTICES	CIVIL WORKS CIVIL DESIGN DATA	Section XXIX-A	Page 3 of 36
	PROPRIETARY INFORMATION - For Authorized Company Use Only	December, 2002	

SCOPE

This subsection covers procedures for developing or obtaining the meteorological and other data needed for the civil engineering design of land-based facilities. Methods for converting these data into environmental loads are given in [DP XXIX-D](#).

REFERENCES

GLOBAL PRACTICES

GP 04-01-03 Structural Design Loads

DESIGN PRACTICES

[Section XXIX-D](#) [Design Loads](#)

OTHER REFERENCES

1. ASCE 7 (Formerly ANSI A58.1), "Minimum Design Loads for Buildings and Other Structures," 1998.
2. British Standard, CP-3, "Code of Basic Data for the Design of Buildings," Chapter V: Loading, Part 2, Wind Loads,
3. Batts, M.E., et al, "Hurricane Windspeeds in the UB," NBS Report No. BSS-124, May 1990.
4. Naeim, F., et al "Seismic Design Handbook," 1989.
5. International Building Code (IBC), 2000.
6. Simiu, E. and Scanlan, R., "Wind Effects on Structures," 3 ed., 1996.
7. National Research Council of Canada, National Building Code of Canada (NBC), 1995
8. ASCE, "Guide to the Wind Load Provisions of ASCE 7-98," 2002.
9. US Army Corps of Engineers, "Seismic Design for Buildings TI 809-04", 1998
10. Structural Engineers Association of California, "Recommended Lateral Force Requirements and Commentary" 7th edition, 1999
11. Sach, P., Wind Forces in Engineering, Chapter 2: "Wind Data," Pergamon Press, New York, 1978.

BACKGROUND

The Design Practice, [DP XXIX-D](#), provides the method for determining wind loads once the appropriate wind speed for the structural design has been defined. Historically, design wind speed has been specified in the GII portion of Job Specifications as the 50-year fastest-mile wind speed 33 feet (10 meters) above ground consistent with US National Building Codes and Standards (ASCE 7). Recent US and other National Standards and Codes, however, have been specifying design wind speeds as 3-second gusts (ASCE 7 since 1995, BS CP-3) or other wind durations. This DP will address both "fastest-mile" and "3-second gusts" design wind speeds.

[DP XXIX-D](#) also provides seismic design criteria based on the methodology and calculation procedures provided in the US Building Code (IBC) and ASCE 7. The provisions in the International Building Code (IBC), the latest code published in the US, are equivalent. The seismic loads due to earthquakes and the type of analysis required are based on the classification of the structure and the seismicity of the site where it is located. Historically, the site seismicity has been provided by a seismic probability coefficient ranging from 0 to 1.0 for US location for seismic zones 1 to 4 and from 1 to 1.5 for more seismically active areas such as Japan. This coefficient is usually specified in the GII of the Job Specification for a project. More recently the UBC and other standards (ASCE 7-95) have been specifying a seismic coefficient (Z , A_a or A_v) representative of the expected peak ground motion. The latest code ASCE 7-98, is using a spectral ordinate at 0.2 sec and 1.0 sec based on the Maximum Considered Earthquake (MCE). These ordinates combined with the site soil classification is used to determine a Seismic Design category (SDC) for the structure. The SDC classification depends not only on the seismicity of the site, but also on the occupancy of the structure and the soil type. The MCE has a 2% probability of exceedance in 50 years with an approximately 2,500 year return period. Design Specifications should make it clear which of these seismic parameters is being specified. This DP addresses these parameters and discusses the relationship between them.

Section XXIX-A	Page 4 of 36	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	ExxonMobil DESIGN PRACTICES
December, 2002			

WIND DESIGN CONSIDERATIONS

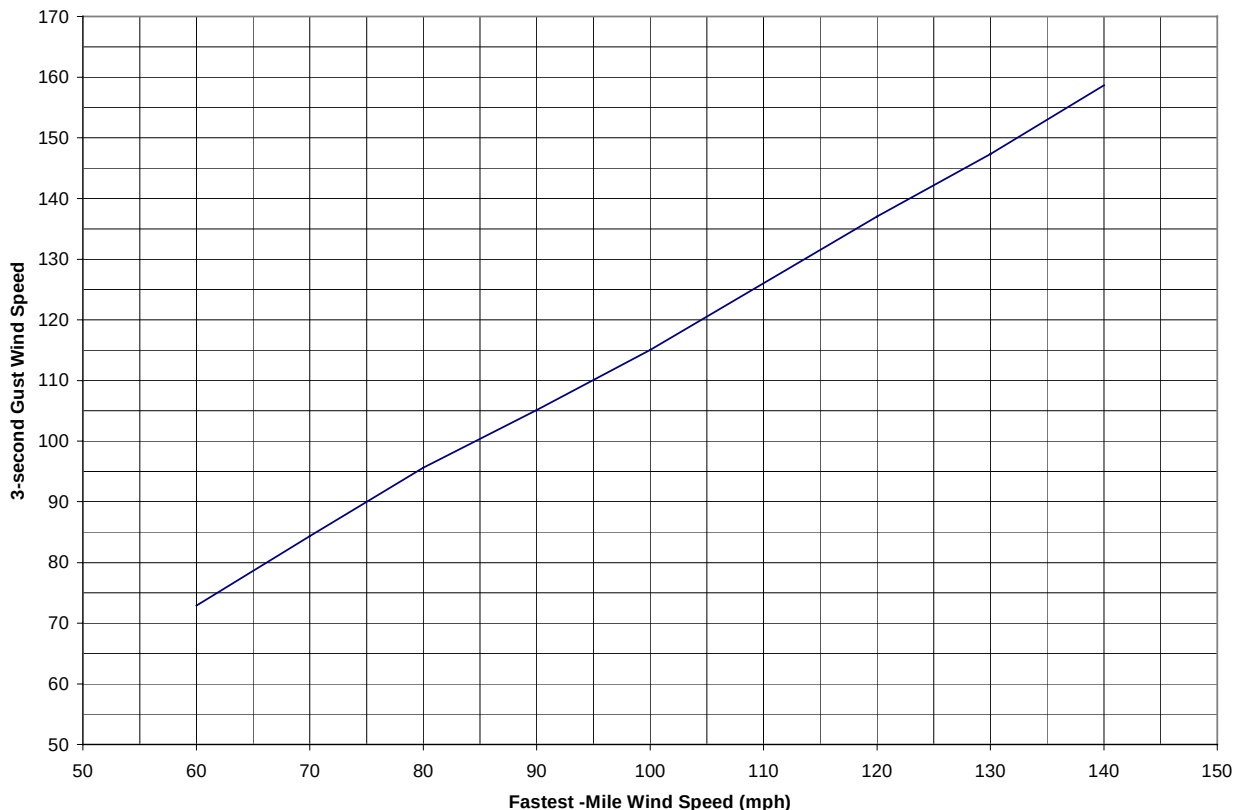
The company engineering practices and most national or local building codes require all permanent and temporary facilities be designed for the effects of wind in combination with other effects such as dead loads, live loads and operating or upset loads. Wind effects are usually expressed in terms of wind pressures or forces which depend on the extreme wind speed that may occur at the site. The site wind speed in turn depends on a meteorological and topographic factors including height above ground, terrain roughness, defined averaging time, and mean recurrence interval or return period. The effects of these factors on the wind speed at a site are discussed below.

DESIGN WIND SPEED

Historically, Exxon's wind load design criteria, has been based on US national standards, UBC, ANSI A58.1 and more recently ASCE-7, "Minimum Design Loads for Buildings and Other Structures," or on other comparable local or national building codes. The design wind speed (V) used in the Company Practice to calculate wind loads is defined as the reference value over relatively open terrain (Exposure C per ASCE-7), 33 ft (10 m) above ground level, and having a mean recurrence interval (return period, R) of 50 years. Values for V are listed in [Appendix A](#) for most refinery and chemplant locations. The values are based on national codes, historical usage or on site specific studies. The value for a specific project is normally provided in the General Instructions and Information (GII) Specification.

ASCE-7 (formerly ANSI 58.1), previously (prior to 1995) used "fastest mile" as the reference design wind speed (the speed corresponding to the shortest time interval during which one mile of air passes a measuring instrument). However, since 1995, ASCE 7 has provided design wind speed and wind load calculation procedures based on 3-second gust. The relationships between the fastest-mile and 3-second gust wind speed are shown on [Figure 1](#).

FIGURE 1
3-SECOND GUST VS. FASTEST-MILE WIND SPEED



ExxonMobil DESIGN PRACTICES	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	Section	Page
		XXIX-A	5 of 36
		December, 2002	

Fastest-mile and 3 second gust wind speeds are given in [Appendix A](#) for certain locations. In establishing new wind speeds, they should be rounded off to the nearest 5 mph. A greater degree of accuracy is not justified since setting extreme wind speeds is not precise. However, care should be exercised to use the appropriate reference wind speed with the GPs. The API standards require the use of fastest mile wind speeds in the wind related provisions.

The design wind speeds for some new sites not listed in [Appendix A](#) may not be available in local codes. In such cases, they must be developed from available wind data recorded at nearby locations for purposes other than structural design. Consequently, it is usually necessary to correct the data for height, duration or exposure, and to establish a mean recurrence interval. The necessary corrections are given below.

WIND DATA

Design wind speeds are usually specified by the national or local building codes and standards such as NBC and ASCE 7. When such data are not available, the design wind speed may be determined from available meteorological data based on the procedures described in this subsection. Wind records may be obtained from weather stations with anemometers to measure wind speeds at or near the site. These records usually include the annual maximum wind speeds of duration or averaging time characteristic of the anemometers at the stations. These data, together with information about length of the record and the height of the anemometer above ground can be used to estimate the maximum wind speeds at various return period intervals.

The requirements for wind data for use in establishing design wind speeds, according to ASCE 7, are the maximum 3-second gusts recorded annually for at least 10 years at a height 33 ft (10 m) above ground level in relatively open terrain. If the records are not consistent with these requirements they may still be used if the appropriate adjustments are made as discussed herein.

EFFECT OF HEIGHT AND GROUND SURFACE ROUGHNESS

Wind speed decreases, and turbulence increases, near the ground due to "surface friction." At a certain height above the ground, called the gradient height, the effect of surface friction becomes negligible even for the roughest ground surface.

The variation of wind speed with height above ground is given by **Eq. (1)**.

$$\frac{V_z}{V_{z_0}} = \left(\frac{z}{z_0} \right)^{1/\alpha} \quad \text{Eq. (1)}$$

where:

V_z = Wind speed at height, z , above ground, mph (m/sec)

V_{z_0} = Reference wind speed at a reference height, z_0 , above ground, mph (m/sec)

For the reference height of 33 ft (10 m), $z_0 = 33$ ft (10 m) and $V_{z_0} = V_{33}$ (V_{10})

z, z_0 = Height above ground in feet (m)

α = Power law coefficient

Four exposure categories based on upwind terrain conditions are usually considered. These are given below with their corresponding surface roughness factors and gradient heights. Plant sites usually have terrain conditions corresponding to Exposure C and D.

EXPOSURE TYPE	DESCRIPTION OF TERRAIN	POWER LAW COEFF. (α)		GRADIENT HEIGHT [feet (m)]
		FASTEST-MILE	3-SEC GUST	
A	Large cities or very rough, hilly terrain	3.0	5.0	1500 (457)
B	City outskirts, towns, moderately rough, wooded country, rolling terrain	4.5	7.0	1200 (366)
C	Flat, open country, coastal belts, grasslands	7.0	9.5	900 (274)
D	Flat, unobstructed coastal areas directly exposed to wind blowing over water	10	11.5	700 (213)



Section XXIX-A	Page 6 of 36	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	ExxonMobil DESIGN PRACTICES
December, 2002			

With the appropriate power law coefficient, [Eq. \(1\)](#) gives the variation of wind speed with height for each exposure category as shown on [Figure 2](#). It should be noted that α also depends on the reference wind. A gust has a flatter height distribution (larger α) than a sustained fastest-mile wind. Both the gradient height and the power law coefficient may be interpolated for intermediate terrain conditions between the ones listed.

The wind speed at the gradient height is termed the gradient wind speed, V_g . With surface roughness being the only variable, the gradient wind speed is the same over each category of exposure, however, at elevations below the gradient height the wind speeds are different for each exposure type.

Since the data used in developing the "Design Wind Speed" corresponds to exposure type C, wind speed for other exposures can be obtained from the wind speed at the gradient height for exposure C. As a result, the wind speed at any height and for any exposure type can be determined from the following:

$$V_z = \left[V_{33} \left(\frac{900}{33} \right)^{1/\alpha_c} \right] \left(\frac{z}{z_g} \right)^{1/\alpha} \text{ mph}$$

$$V_z = \left[V_{10} \left(\frac{274}{10} \right)^{1/\alpha_c} \right] \left(\frac{z}{z_g} \right)^{1/\alpha} \text{ m/sec}$$

Eq. (2)

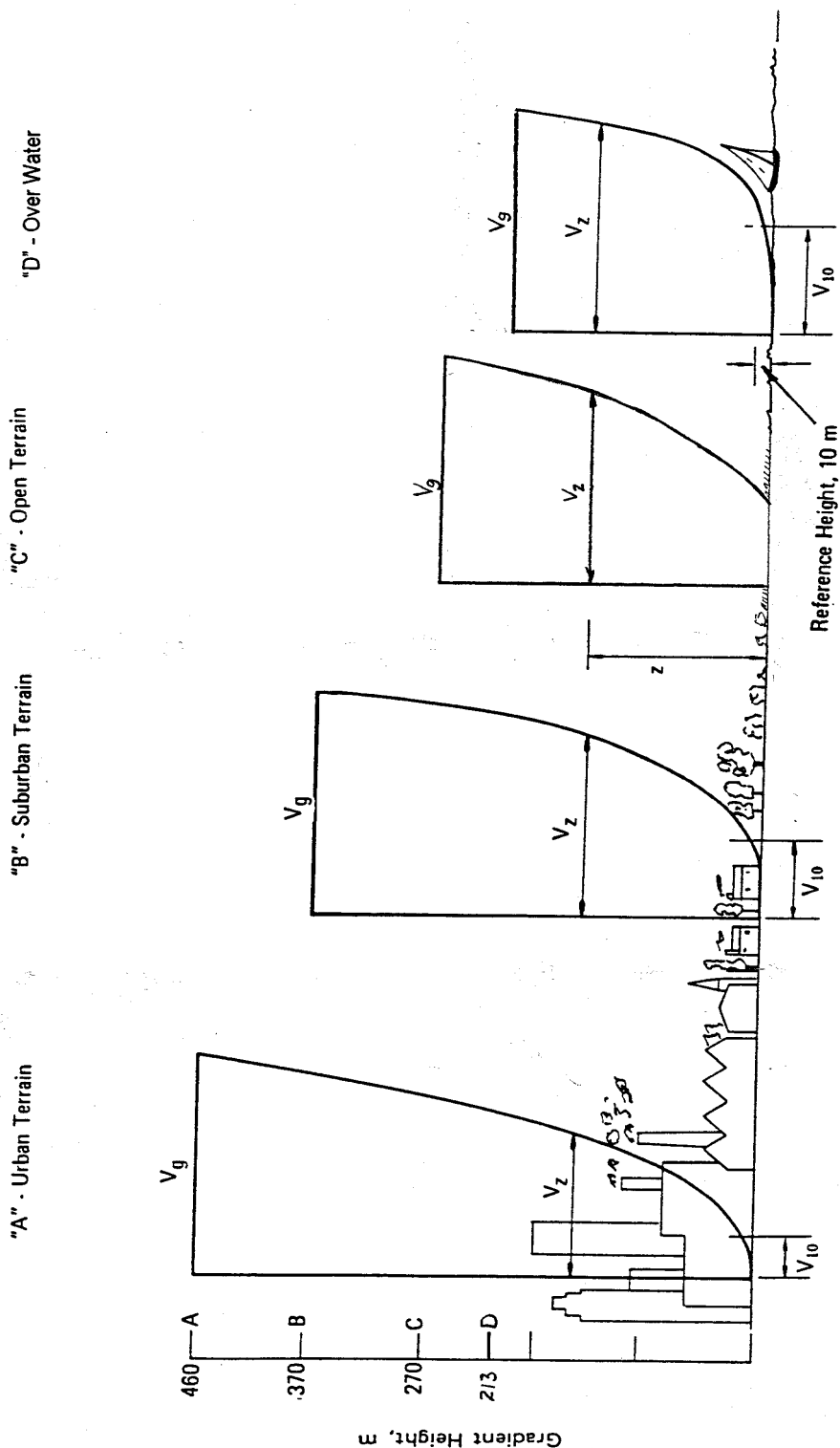
where:

- z_g = Gradient height for exposure type of interest in feet (m)
- $V_{33}(V_{10})$ = Wind speed in mph (m/s) at 33 ft (10 m)
- α = Power law coefficient for exposure type of interest
- α_c = 7.0 for fastest mile; 9.5 for 3-second gust

In the equations above, the term within the brackets converts the basic wind speed to gradient wind speed and the second term (in parenthesis) converts the gradient wind speed to the wind speed at any height z and exposure.

Example Problem 1 illustrates the use of [Eq. \(1\)](#) and [Eq. \(2\)](#). It shows the importance of including a full description of terrain conditions and wind elevations when reporting a wind speed. Use of undefined wind data can result in structural over-design or under-design, depending on the extent to which the adjustments discussed above are omitted or misapplied.

FIGURE 2
PROFILES OF WIND SPEED OVER TERRAINS OF DIFFERING ROUGHNESS

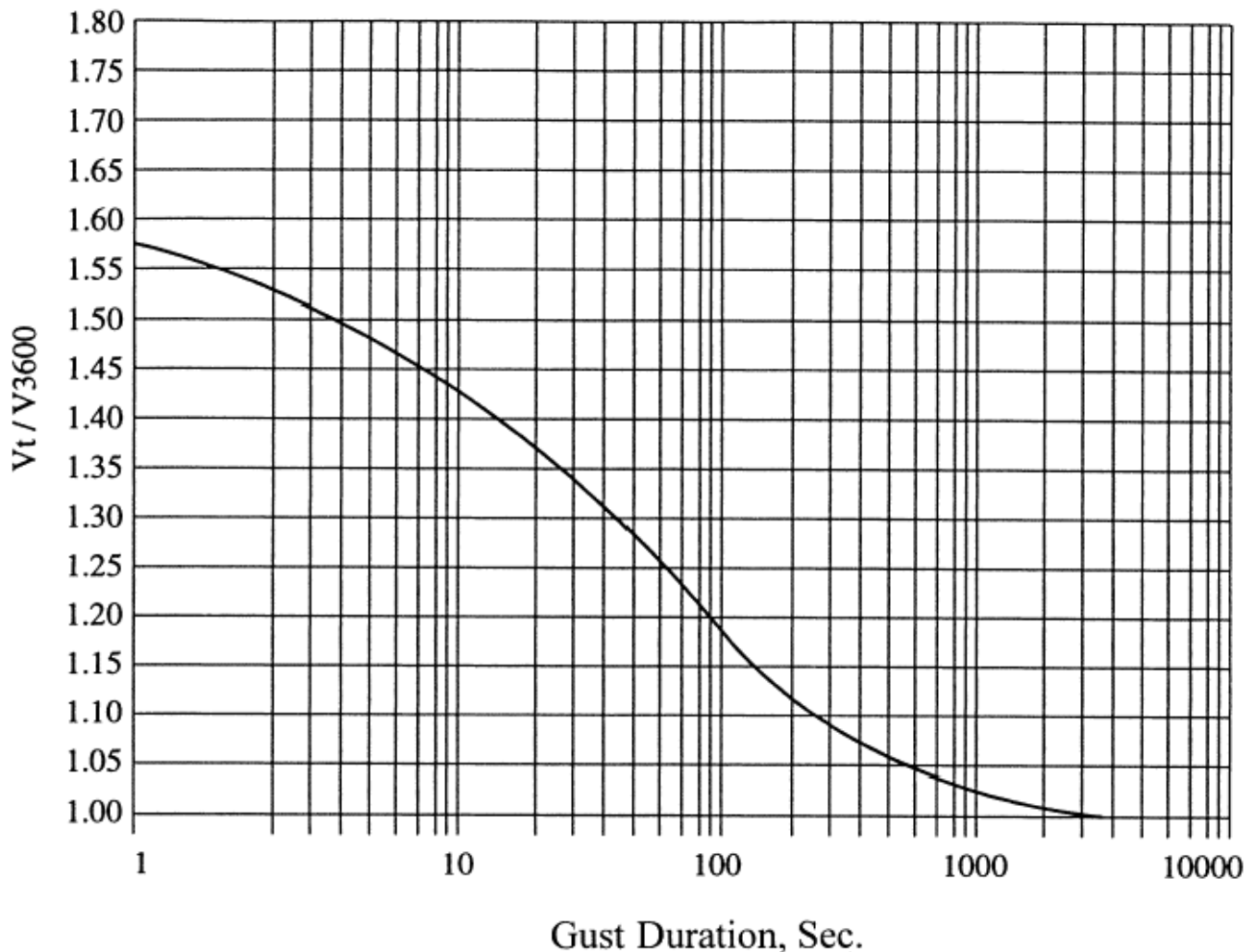


Section XXIX-A	Page 8 of 36	CIVIL WORKS CIVIL DESIGN DATA	ExxonMobil DESIGN PRACTICES
December, 2002		PROPRIETARY INFORMATION - For Authorized Company Use Only	

WIND SPEED AVERAGING PERIOD

- ▶ In reporting or using wind speed it is important to identify its averaging period. For example, meteorologists usually report “gusts” and/or “sustained” wind speeds for major storms. Whereas, for engineering design, wind speeds are usually provided for specific averaging periods ranging from 1 second to 1 hour or an averaging distance of 1 mile. As the length of averaging period decreases, the maximum mean speed corresponding to that shorter time period increases. Wind speed at a specific location varies with time. For design purposes wind speeds are averaged over certain time intervals or “durations,” and the wind is considered as coming from any direction. The relationship between wind speed averaged over period, t , to that averaged over one hour is shown in Figure 3.

FIGURE 3
RATIO OF PROBABLE MAXIMUM SPEED AVERAGED OVER T SEC TO HOURLY MEAN SPEED



	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	Section	Page
		XXIX-A	9 of 36
		December, 2002	

Example Problem 2

- ♦ **Example 2** shows how to use [Figure 3](#) to convert from a fastest mile wind speed to the equivalent wind speed based on a 3 second gust. It follows the following procedure:

Given: Fastest mile wind speed

Find: Equivalent wind speed based on a specific averaging period (t_2)

Step 1: Calculate time for a volume of air with a length of mile to pass over a point.

$$t_1 = \frac{3600}{V(\text{mph})} \quad \text{Eq. (3)}$$

- ♦ **Step 2:** Enter **Figure 3** using t_1 from above and read V_t/V_{3600} .

$$N_1 = \frac{V_{t_1}}{V_{3600}} \quad \text{Eq. (4)}$$

Step 3: Enter **Figure 3** using the t_2 (duration of interest) and read V_t/V_{3600}

$$N_2 = \frac{V_{t_2}}{V_{3600}} \quad \text{Eq. (5)}$$

Step 4: To determine V_t at duration of interest

$$V_{t_2} = \frac{N_2}{N_1} V_{t_1} \quad \text{Eq. (6)}$$

where:

- t_1 = Time to travel 1 mile, in seconds
- V_{t_1} = V = Fastest-mile wind speed, in mph
- t_2 = Gust duration of interest, in seconds
- V_{t_2} = Wind speed at duration of interest, in mph
- V_{3600} = Hourly mean wind speed, in mph

MEAN RECURRENCE INTERVAL

Historically, ExxonMobil downstream plants have been designed for wind speeds based on a mean recurrence interval (return period) of 50 years. This is consistent with the requirements of some national standards for most buildings and industrial facilities, including the US (ANSI 58.1, ASCE 7) British and Australian Building Codes. The wind design criteria in the Canadian Code are based on wind speeds corresponding to 30 and 100 year return periods. IOL specifies the 100-yr value for new facilities.

Other recurrence intervals may be used where warranted. That is, a shorter period may be appropriate for short-lived pilot plants and temporary facilities, and a longer period may be justified for permanent facilities that are highly wind sensitive or for those posing a high degree of hazard to life and property in the case of failure. Most locations and affiliates have used the standard 50-year value per their national code requirements. The basis for selecting the design wind speed, per this DP, is 50-year mean recurrence interval together with a project specific, or owner specified value of the importance factor (default 1.0) consistent with local codes and practices. For certain essential and hazardous facilities, ASCE 7 increases the wind load by applying an importance factor, $I = 1.15$, which is equivalent to using a 100-year recurrence interval wind velocity.

Mean recurrence intervals are derived from statistical analyses of wind data. Key steps in analyses involve selecting appropriate historical data and fitting the wind data to a statistical frequency distribution. The probability that the design wind speed will be exceeded in a given time interval can be calculated from this distribution. The reciprocal of the probability value is the mean recurrence interval.

WIND RISK

Statistically, wind speeds are random, extreme events. Therefore, there is always some risk associated with any value selected as design wind speed. The wind speed for the design of a structure is specified based on a standard return period or mean

Section XXIX-A	Page 10 of 36	CIVIL WORKS CIVIL DESIGN DATA PROPRIETARY INFORMATION - For Authorized Company Use Only	ExxonMobil DESIGN PRACTICES
December, 2002			

recurrence interval, R, in years. That is, the event (wind speed being exceeded) is expected to occur on the average of once in R years. The corresponding annual probability of exceedance is $p_1 = 1/R$ and the probability of exceedance in n year, p_n is:

$$p_n = 1 - \left(1 - \frac{1}{R}\right)^n = 1 - (P)^n \quad \text{Eq. (7)}$$

where the annual non-exceedance probability, $P = (1 - 1/R)$.

Conversely, the mean recurrence interval on return period that corresponds to a given probability of exceedance (p_n) during the design life (n) of a facility is:

$$R = \left(1 - (1 - p_n)^{1/n}\right)^{-1} \quad \text{Eq. (8)}$$

For example, the probabilities that the 50-year wind speed will be exceeded in 25 and 50 years are $p_{25} = 0.40$, and $p_{50} = 0.64$, respectively. The corresponding values for the 100-year wind speed are $p_{25} = 0.22$ and $p_{50} = 0.40$, and $p_{25} = 0.05$ and $p_{50} = 0.095$ for the 500-year wind speed.

As expected, the probability that a wind speed of a given magnitude at a certain recurrence interval will be exceeded increases with the longer the period of time the structure is exposed to the wind environment. Similarly, the higher the mean recurrence interval, the lower the probability of exceeding the design wind speed. Values of probability of exceeding the design wind speed at various mean recurrence intervals and exposure periods are as follows:

MEAN RECURRENCE INTERVAL (YEARS)	ANNUAL PROBABILITY	PROBABILITY OF EXCEEDANCE				
		EXPOSURE PERIOD / LIFE OF STRUCTURE (YEARS)				
		5	10	25	50	100
25	0.04	0.18	0.34	0.64	0.87	0.98
50*	0.02	0.10	0.18	0.40	0.64	0.87
100	0.01	0.05	0.10	0.22	0.40	0.64
200	0.005	0.02	0.05	0.10	0.22	0.39

* ExxonMobil's normal design wind basis

As indicated by the above probability values, increasing the mean recurrence interval reduces the probability of a wind speed exceeding the design value. However, longer recurrence intervals result in higher design wind speeds and increased wind load. A stronger and more expensive structure may be needed to carry the additional loading. Thus, the choice of a mean recurrence interval and associated design wind speed must be balanced between the cost of reducing the risk and the consequences of failure.

In the design of structures, safety factors or load factors are applied to wind loads and other design loads, to cover uncertainties and to provide for structural safety in the design. For wind, these factors imply that such structures should be designed to survive a 500-year wind speed, according to ASCE 7. That is, for a design life of 50 years there is 0.095 probability that wind will cause the ultimate capacity of the structure or its components to be exceeded if wind load condition governed the design.

To provide a consistent wind risk for new and existing facilities in a plant, the following may be used as a guide in selecting design wind speed:

1. The wind loads for new or modified existing facilities should not be any less than that used for the plant historically, unless such loads are judged to be too conservative in view of available data.
2. The design wind speed should not be less than the 50-year site specific value (R = 50), per ASCE 7.
3. An increase in the design wind loading of 50% (23% increase in design wind speed), without any increase in the other unfactored design loads, should not cause the ultimate capacities of the main structural components to be exceeded. For components that are loaded only by wind, such as cladding, the design wind load increase should be taken as 30% (14% on wind speed). The "ultimate" wind speeds corresponding to the increased wind loads should not be less than the 500-year values as implied by the ASCE 7 standard. That is, the design wind speed should not be less than about 80% of the 500-year value.
4. Unless project specifics dictate otherwise the design life of plant structures should be taken as n = 50 years for new construction and for major structural modification or upgrading of existing facilities. However, shorter design life (not less than 25 years) may be considered for pilot plants and temporary facilities.



ExxonMobil DESIGN PRACTICES	CIVIL WORKS CIVIL DESIGN DATA	Section	Page
	PROPRIETARY INFORMATION - For Authorized Company Use Only	XXIX-A	11 of 36
		December, 2002	

5. For applications of serviceability design or other applications, the wind speeds associated with mean recurrence intervals other than 50 years may be determined using the factors below.

WIND SPEED CONVERSION FACTORS FOR OTHER MEAN RECURRENCE INTERVALS (MRI)			
MRI (Years)	Continental U.S.		Alaska
	V = 85-100 mph (38-45 m/s)	V > 100 (hurricane) (44.7 m/s)	
500	1.23	1.23	1.18
200	1.14	1.14	1.12
100	1.07	1.07	1.06
50	1.00	1.00	1.00
25	0.93	0.88	0.94
10	0.84	0.74 (74 mph min) (33.9 m/s)	0.87
5	0.78	0.66 (70 mph min.) (31.3 m/s)	0.81

- Note: Conversion factors for the column "V > 100 (hurricane) " are approximate. For the MRI = 50 as shown, the actual return period, as represented by the design wind speed map in fig 6-1 of ASCE 7-98 varies from 50 to approximately 90 years. For an MRI = 500, the conversion factor is theoretically "exact" as shown.

The various numerical factors discussed above are provided as a guide to illustrate the principle of consistent risk in the selection of design wind speeds. They can be modified, as required, to meet specific conditions.

WIND SPEED CALCULATION PROCEDURES

DERIVING DESIGN WIND SPEED

Design wind speeds for locations not listed in [Appendix A](#) and that do not have a local wind code, or for those in unique areas such as on ocean promontories, on mountains, in gorges, or in other unusual locations where the local wind code may be inadequate, may have to be determined from the available wind records. Wind speed data may be requested from the National Climatic Center, which maintains climatic records for some overseas locations as well as for the United States. Requests should be directed to:

Director
 National Climatic Data Center
 151 Patton Avenue
 Asheville, North Carolina 28801-5001
 Ph: 828-271-4800
 Web site: <http://nnndc.noaa.gov>

Data are also readily available from several national, regional, and local meteorological agencies throughout the world. A method is described below for calculating the design wind speed from wind data.

STATISTICAL ANALYSIS OF WIND SPEEDS

Maximum wind speeds at a particular location or over an area are extreme and somewhat random occurrences, and thus they are subjected to probability distributions similar to other extreme, random events. For a given record of N events the maximum value may not necessarily correspond to a return period, $R = N$, since several records of N events would be required to make that determination. However, based on a single record of sufficient length ($N > 10$), statistical procedures can be used to estimate the values for specific return periods based on an exponential type extreme value probability distribution function. The procedure recommended herein to determine the non-hurricane wind speeds corresponding to various return periods (mean recurrence intervals) are based on methods provided in "Wind Effects on Structures" by Simui and Scanlon.

Given a minimum of 10 yearly maximum wind speeds, the wind speed, V, corresponding to a return period, R, can be determined from the following: