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Structural Standard for Antenna Supporting Structures and Antennas

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Structural Standard for Antenna Supporting Structures and Antennas

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OBJECTIVE

The objective of this Standard is to provide recognized literature for antenna supporting structures and antennas pertaining to: (a) minimum load requirements as derived from ASCE 7-02, “Minimum Design Loads for Buildings and Other Structures”, and (b) design criteria as derived from AISC-LRFD-99, “Load and Resistance Factor Design Specification for Structural Steel Buildings” and ACI 318-05, “Building Code Requirements for Structural Concrete”. The information contained in this Standard was obtained from available sources and represents, in the judgment of the subcommittee, the accepted industry minimum structural standards for the design of antenna supporting structures and antennas. While it is believed to be accurate, this information should not be relied upon for a specific application without competent professional examination and verification of its accuracy, suitability, and applicability by a licensed professional engineer. This Standard utilizes loading criteria based on an annual probability and is not intended to cover all environmental conditions which could exist at a particular location.

When this Standard is adapted for international use, it is necessary to determine the appropriate basic wind speeds (3-second gust), wind on ice loads, and earthquake accelerations at the site location based on local data.

Equivalent International System of Units (SI) are given in square brackets [ ] throughout this Standard. SI conversion factors have been provided in Annex M.

Annex A provides procurement and user guidelines to assist in specifying the requirements for a specific structure. The user is cautioned that site-specific loading requirements, if known, take precedence over the minimum requirements of this Standard. Site-specific data and requirements differing from those contained in this Standard are to be included in the procurement specifications for the structure.

This Standard is intended to cover the requirements for most structural antennas and antenna-supporting structures, but recognizes that structures that are unusual for their height or shape, or for the shape and size of individual members, or located at sites having unusual geological or climatic conditions may require additional considerations. In these cases, a rational design based on theory, analysis, knowledge of local conditions and sound engineering practice, shall be used. The design shall be carried out by an engineer qualified in the specific design methods and materials to be used, and shall provide a level of safety and performance equal to or better than that implicit in this Standard.

SCOPE

This Standard provides the requirements for the structural design and fabrication of new and the modification of existing structural antennas, antenna-supporting structures, mounts, structural components, guy assemblies, insulators and foundations.

This Standard is based on limit states design. It is applicable mainly to steel structures but may also be applied to other materials, when required, so as to provide an equivalent level of reliability.

The appropriate standards should be referenced for structures that support antennas but that are primarily intended for other applications, such as water towers, electrical transmission line structures, sign support structures, buildings, bridges, etc. This Standard, however, does apply to the calculation of effective projected areas of appurtenances (antennas, mounts, lines, etc.) and to the serviceability limit states appropriate for structures that support antennas.

Annexes are to be considered normative elements that are necessary to comply with this Standard.

1.0 GENERAL

1.1 Strength Limit States

A structure designed to this Standard shall have sufficient strength and stability such that the design strength, ϕR_n, defined in Section 4.0 equals or exceeds the required strength, $\sum \alpha_i Q_i$, defined in Section 2.0 as expressed by the following relationship:

$$\phi R_n \geq \sum \alpha_i Q_i$$

1.2 Serviceability Limit States

A structure designed to this Standard shall have sufficient rigidity such that the limit state deformations defined in 2.8.2 are not exceeded under the service loads defined in 2.8.3.

1.3 Analysis

Load effects on individual structural members shall be determined by methods of structural analysis that take into account equilibrium, general stability, geometric compatibility and material properties in accordance with Section 3.0.

1.4 Definitions

Antenna supporting structure: a structure, including guy assemblies, guy anchorages and substructures that support antennas or antenna arrays.

Design strength, ϕR_n: the product of nominal strength and a resistance factor.

Factored load: the product of the nominal load and a load factor.

Limit state: a condition beyond which a structure or member becomes unfit for service and is judged to be no longer useful for its intended function or unsafe.-

Load effects: force and deformation responses produced in structures and their members by applied factored loads.

Load factor, α_i: a factor that accounts for deviations of the actual load from the nominal load, for uncertainties in the analysis that transforms the load into load effects, and for the probability that more than one extreme load will occur simultaneously.

Nominal loads: the magnitudes of the loads specified in this Standard for dead, wind, ice, wind on ice, earthquake, and working and climbing facilities.

Nominal strength, R_n: the capacity of a structure or member to resist the effects of loads.

Required strength, $\sum \alpha_i Q_i$: the sum of the load effects due to applied factored loads and load combinations.

Resistance factor, ϕ: a factor that accounts for the manner and consequences of failure and for unavoidable deviations from a calculated nominal strength.

Strength design: method of proportioning structural members such that the computed forces produced in the members by the factored loads do not exceed the design strengths of the members.

Structural antenna: a structure for radiating or receiving electromagnetic waves including reflectors, directors and screens.

1.5 Symbols and Notation

ϕR_n = design strength (nominal strength multiplied by a resistance factor);
$\sum \alpha_i Q_i$ = required strength (load effects due to factored loads and load combinations).

2.0 LOADS

2.1 Scope

This section provides minimum load requirements for antenna supporting structures and antennas.

2.2 Classification of Structures

Structures shall be classified according to Table 2-1 for the purposes of determining nominal wind, ice and earthquake loads.

2.3 Combination of Loads

2.3.1 Symbols and Notation

D = dead load of structure and appurtenances, excluding guy assemblies;
D_g = dead load of guy assemblies;
D_i = weight of ice due to factored ice thickness;
E = earthquake load;
T_i = load effects due to temperature;
W_o = wind load without ice;
W_i = concurrent wind load with factored ice thickness.

2.3.2 Strength Limit State Load Combinations

Structures and foundations shall be designed so that their design strength equals or exceeds the load effects of the factored loads in each of the following limit state combinations:

1. $1.2\ D + 1.0\ D_g + 1.6\ W_o$
2. $0.9\ D + 1.0\ D_g + 1.6\ W_o$
3. $1.2\ D + 1.0\ D_g + 1.0\ D_i + 1.0\ W_i + 1.0\ T_i$
4 $1.2\ D + 1.0\ D_g + 1.0\ E$
5. $0.9\ D + 1.0\ D_g + 1.0\ E$

Exceptions:

1. Temperature effects need not be considered for self-supporting structures.
2. Ice and earthquake loading need not be considered for Class I structures.
3. No load factor shall be applied to the initial tension of guys.
4. Load combinations 2 and 5 apply to self-supporting structures only.

Notes:
1. A limit state conversion factor for ice load is applied to ice thickness in 2.6.8
2. Unfactored dead loads shall be used to determine earthquake loads, E, in loading combinations 4 and 5.
3. For foundation designs, the weight of soil and substructure shall be considered as dead load in all loading combinations.

2.4 Temperature Effects

The design tension of guys shall be based on an initial temperature of 60 degrees Fahrenheit [16 degrees C]. In the absence of more accurate site data, a 50 degree Fahrenheit [28 degree C] reduction in temperature shall be considered to occur with loading combinations that include ice.

2.5 Dead Loads

2.5.1 Definitions

Dead load: D, the weight of the structure, and appurtenances, excluding guy assemblies, and for foundation design, the weight of soil and substructure.

Guy assembly dead load: D_g, the weight of all guy assemblies, including guys, end fittings, and insulators.

2.6 Wind and Ice Loads

2.6.1 Definitions

Appurtenances: items attached to the structure such as antennas, antenna mounts, transmission lines, conduits, lighting equipment, climbing devices, platforms, signs, anti-climbing devices, etc.

Basic wind speed, V: 3-second gust wind speed at 33 ft [10 m] above the ground in exposure category C as defined in 2.6.5.1 for a 50-year mean recurrence interval.

Basic wind speed with ice, V_i: 3-second gust wind speed concurrent with the design ice thickness at 33 ft [10 m] above the ground in exposure category C as defined in 2.6.5.1 for a 50-year mean recurrence interval.

Design wind load, F_w: equivalent static force to be used in the determination of wind loads.

Design ice thickness, t_i: the uniform radial thickness of glaze ice at 33 ft [10 m] above the ground in exposure category C as defined in 2.6.5.1 for a 50-year mean recurrence interval.

Discrete appurtenance: an appurtenance modeled as a concentrated load.

Effective projected area, EPA: projected area of an object multiplied by a force coefficient (also called a drag factor) used in the determination of wind loads.

Escarpment: a cliff or steep slope generally separating two levels or gently sloping areas.

Glaze ice: ice accretion assumed to have a unit weight of 56 lb/ft^3 [8.8 kN/m^3].

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Height of structure, h: the height of a structure, including latticed or tubular poles mounted on the structure, but excluding lightning rods and similar appurtenances.

Hill: a land surface characterized by a strong relief in all horizontal directions.

Hurricane prone regions: areas vulnerable to hurricanes where the basic wind speed without ice is greater than 90 mph [40.2 m/s].

Importance factor, I: a factor that accounts for the degree of hazard to human life, damage to property and reliability of service.

Linear appurtenance: an appurtenance modeled as a distributed load.

Ridge: an elongated crest characterized by strong relief in two directions.

Symmetrical appurtenance: an appurtenance for which the effective projected area (EPA) is considered constant for all wind directions.

Velocity pressure, q_z: equivalent static pressure used in the determination of wind loads.

Weight of ice, D_i: the weight of factored ice accumulated on the structure, guys, and appurtenances.

2.6.2 Symbols and Notations

α = 3-second gust wind speed power law exponent;
ε = solidity ratio of the structure without appurtenances;
θ = relative angle between the azimuth of an appurtenance and the wind direction;
θ_g = angle of wind incidence to a guy chord;
A_a = projected area of an appurtenance;
A_f = projected area of flat structural components;
A_{fs} = projected area of flat components supporting a mounting frame;
A_g = gross area of one tower face or mounting frame;
A_{iz} = cross-sectional area of ice at height z, or mounting frame;
A_p = projected area of a pole structure;
A_r = projected area of round structural components;
A_{rs} = projected area of round components supporting a mounting frame;
C = velocity coefficient for round, tubular and polygonal members;
C_a = force coefficient for a linear or discrete appurtenance;
C_{as} = force coefficient for a mounting frame;
C_d = drag factor for a guy;
C_f = force coefficient for a structure;
d = guy diameter;
D = diameter of a pole structure, a round structural component or a round appurtenance;
D_c = largest out-to-out dimension of a member;
D_f = wind direction factor for flat structural components;
D_i = weight of Ice;
D_r = wind direction factor for round structural components;
D_s = smallest projected dimension of a component;
$(EPA)_A$ = effective projected area of an appurtenance;
$(EPA)_{FN}$ = normal effective projected area of members supporting a mounting frame;
$(EPA)_{FT}$ = transverse effective projected area of members supporting a mounting frame;

$(EPA)_{MN}$ = normal effective projected area of a mounting frame;
$(EPA)_{MT}$ = transverse effective projected area of a mounting frame;
$(EPA)_N$ = effective projected area associated with the windward face normal to the azimuth of the appurtenance;
$(EPA)_S$ = effective projected area of the structure;
$(EPA)_T$ = effective projected area associated with the windward side face of an appurtenance;
e = natural logarithmic base;
f = height attenuation factor;
F_A = design wind force on appurtenances;
F_G = design wind force on guys;
F_{ST} = design wind force on the structure;
F_W = design wind load;
G_h = gust effect factor;
h = height of structure;
H = height of crest above surrounding terrain;
I = importance factor;
K_a = shielding factor for appurtenances (or wake interference factor);
K_d = wind direction probability factor;
K_e = terrain constant;
K_h = height reduction factor;
K_{iz} = height escalation factor for ice thickness;
K_t = topographic constant;
K_z = velocity pressure coefficient;
K_{zmin} = minimum value for K_z;
K_{zt} = topographic factor;
L_g = length of guy;
q_z = velocity pressure;
R_a = ratio of projected area of attachments to projected area of structural member;
R_r = reduction factor for a round element in a tower face;
R_{rf} = reduction factor for a round element in a mounting frame;
t_i = design ice thickness for site location;
t_{iz} = nominal thickness of radial glaze ice at height z;
V = basic wind speed without ice;
V_i = basic wind speed with ice;
z = height above ground;
z_g = nominal height of atmospheric boundary layer;

2.6.3 General

Antennas and antenna supporting structures have unusual shapes and response characteristics due to wind load. The provisions of this Standard take into consideration the load magnification effects caused by wind gusts in resonance with along-wind vibrations of self-supporting and guyed antenna supporting structures.

1. The basic wind speed without ice, V, the basic wind speed with ice, V_i, and the design ice thickness t_i shall be determined from 2.6.4.

2. A wind direction probability factor, K_d, shall be determined from Table 2-2.

3. An importance factor, I, shall be determined from Table 2-3 based on the structure classification listed in Table 2-1.

4. An exposure category and velocity pressure coefficient, K_z, shall be determined for the site location in accordance with 2.6.5.

5. A topographic category and topographic factor, K_{zt}, shall be determined in accordance with 2.6.6.

6. A gust effect factor, G_h, shall be determined in accordance with 2.6.7.

7. The design ice thickness shall be escalated with height in accordance with 2.6.8.

8. The design wind force shall be determined in accordance with 2.6.9.

2.6.4 Basic Wind Speed and Design Ice Thickness

The basic wind speed without ice, the basic wind speed with ice and the design ice thickness shall be as given in Annex B except as provided in 2.6.4.1. Wind shall be considered to come from any horizontal direction. Ice shall be considered to be glaze ice.

Ice may be ignored for structures located in regions where the design ice thickness is less than or equal to 0.25 inches (6 mm).

2.6.4.1 Estimation of Basic Wind Speeds and Design Ice Thickness from Regional Climatic Data

For regions not included in Annex B, for the special wind or ice regions indicated in Annex B, and for sites where records indicate that in-cloud icing produces significant loads, extreme-value statistical-analysis procedures shall be used to establish design values consistent with this Standard from available climatic data accounting for the length of record, sampling error, averaging time, anemometer height, data quality, and terrain exposure.

2.6.5 Exposure Categories

2.6.5.1 General

An exposure category that adequately reflects the characteristics of ground surface irregularities at the site shall be determined. Account shall be taken of variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features. The exposure category for a structure shall be assessed as being one of the following:

1. **Exposure B:** Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Use of this exposure shall be limited to those areas for which terrain representative of Exposure B surrounds the structure in all directions for a distance of at least 2,630 ft [800 m] or ten times the height of the structure, whichever is greater.

2. **Exposure C:** Open terrain with scattered obstructions having heights generally less than 30 ft [9.1 m]. This category includes flat, open country, grasslands and shorelines in hurricane prone regions.

3. **Exposure D:** Flat, unobstructed shorelines exposed to wind flowing over open water (excluding shorelines in hurricane prone regions) for a distance of at least 1 mile [1.61 km]. Shorelines in Exposure D include inland waterways, lakes and non-hurricane coastal areas. Exposure D extends inland a distance of 660 ft [200 m] or ten times the height of the structure, whichever is greater. Smooth mud flats, salt flats and other similar terrain shall be considered as Exposure D.

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2.6.5.2 Velocity Pressure Coefficient

Based on the exposure category determined in 2.6.5.1, a velocity pressure coefficient (K_z) shall be determined as follows:

$$K_z = 2.01(z/z_g)^{2/\alpha}$$

$$K_{zmin} \leq K_z \leq 2.01$$

where:

z = height above ground level at the base of the structure

z_g, α and K_{zmin} are tabulated in Table 2-4

2.6.6 Topographic Effects

2.6.6.1 Wind Speed-Up Over Hills, Ridges and Escarpments

Wind speed-up effects at isolated hills, ridges and escarpments constituting abrupt changes in the general topography, located in any exposure category, shall be included in the calculation of design wind loads under the following conditions:

1. The hill, ridge or escarpment is isolated and unobstructed by other similar topographic features of comparable height for a radius of 2 miles [3.22 km] measured horizontally from the point at which the height of the hill, ridge or escarpment is determined, and

2. The hill, ridge or escarpment protrudes by a factor of two or more above the average height of the surrounding terrain features within a 2 mile [3.22 km] radius, and

3. The slope (vertical to horizontal ratio) of the topographic feature exceeds 0.10, and

4. The height of the topographic feature is greater than or equal to 15 ft [4.57 m] for exposures C and D and 60 ft [18 m] for exposure B.

2.6.6.2 Topographic Categories

The topographic category for a structure shall be assessed as being one of the following:

1. **Category 1:** No abrupt changes in general topography, e.g. flat or rolling terrain, no wind speed-up consideration shall be required.

2. **Category 2:** Structures located at or near the crest of an escarpment. Wind speed-up shall be considered to occur in all directions. Structures located vertically on the lower half of an escarpment or horizontally beyond 8 times the height of the escarpment from its crest, shall be permitted to be considered as Topographic Category 1.

3. **Category 3:** Structures located in the upper half of a hill. Wind speed-up shall be considered to occur in all directions. Structures located vertically on the lower half of a hill shall be permitted to be considered as Topographic Category 1.

4. **Category 4:** Structures located in the upper half of a ridge. Wind speed-up shall be considered to occur in all directions. Structures located vertically on the lower half of a ridge shall be permitted to be considered as Topographic Category 1.

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5. **Category 5:** Wind speed-up criteria based on a site-specific investigation.

2.6.6.3 Structures Supported on Buildings or Other Structures

Wind speed-up shall not be used to account for the increased wind loads required due to height for structures supported on buildings or other structures. The height, z, above ground level shall be referenced to the ground level of the building or other supporting structure.

2.6.6.4 Topographic Factor

The wind speed-up effect shall be included in the calculation of design wind loads by using the factor K_{zt}:

$$K_{zt} = [1 + \frac{K_e K_t}{K_h}]^2$$

where:

K_h = height reduction factor given by the following equation:

$$= e^{\left(\frac{f \cdot z}{H}\right)}$$

e = natural logarithmic base = 2.718

K_e = terrain constant given in Table 2-4

K_t = topographic constant given in Table 2-5

f = height attenuation factor given in Table 2-5

z = height above ground level at the base of the structure

H = height of crest above surrounding terrain

K_{zt} = 1.0 for topographic category 1. For topographic category 5, K_{zt} shall be based on recognized published literature or research findings.

2.6.7 Gust Effect Factor

2.6.7.1 Self-Supporting Latticed Structures

For self-supporting latticed structures, the gust effect factor shall be 1.00 for structures 600 ft [183 m] or greater in height. For structures 450 ft [137 m] or less in height, the gust effect factor shall be 0.85. The gust effect factor shall be linearly interpolated for structure heights between 450 ft [137 m] and 600 ft [183 m].

These conditions are expressed by the following equations:

$$G_h = 0.85 + 0.15 \left[\frac{h}{150} - 3.0\right] \qquad \text{h, in feet}$$

$$G_h = 0.85 + 0.15 \left[\frac{h}{45.7} - 3.0\right] \qquad \text{h, in meters}$$

$0.85 \le G_h \le 1.00$

where:

h = height of structure

Note: For structures supported on buildings or other structures, the height of structure, h, shall not include the height of the supporting structure.

2.6.7.2 Guyed Masts

For guyed masts the gust effect factor shall be 0.85.

2.6.7.3 Pole Structures

For pole structures the gust effect factor shall be 1.10.

2.6.7.4 Structures Supported on Other Structures

For cantilevered tubular or latticed spines, poles or similar structures mounted on guyed masts or latticed self-supporting structures, and for all structures supported on flexible buildings (height to width ratio greater than 5), the gust effect factor shall be 1.35. Gust effect factors for supporting guyed masts and latticed self-supporting structures shall be in accordance with 2.6.7.1 or 2.6.7.2 using the loads from the cantilever based on a 1.35 gust effect factor.

2.6.8 Design Ice Thickness

The design ice thickness, t_i, shall be escalated with height when calculating ice weight and wind on ice loads in accordance with the following equations:

$$t_{iz} = 2.0\ t_i\ I\ K_{iz}(K_{zt})^{0.35}$$

$$K_{iz} = \left[\frac{z}{33}\right]^{0.10} \leq 1.4 \quad z\text{, in feet}$$

$$K_{iz} = \left[\frac{z}{10}\right]^{0.10} \leq 1.4 \quad z\text{, in meters}$$

where:

2.0 = limit state conversion factor

t_{iz} = the factored thickness of radial glaze ice at height z

t_i = design ice thickness

I = importance factor for structure from Table 2-3

K_{iz} = height escalation factor for ice thickness

z = height above ground level at base of structure

K_{zt} = topographic factor from 2.6.6.4

For purposes of calculating the additional projected area of ice, ice thickness shall be considered to accumulate with a uniform thickness around the exposed surfaces of the structure, guys and appurtenances (refer to Figure 2-1). The additional projected area of ice may be considered round when calculating wind on ice loads even though the bare projected area is flat.

For purposes of calculating the weight of ice, the cross-sectional area of ice shall be determined by:

$$A_{iz} = \pi \cdot t_{iz}(D_c + t_{iz})$$

where:

A_{iz} = cross-sectional area of ice at height z

D_c = largest out-to-out dimension of a member (refer to Figure 2-2)

The weight of ice shall be based on a unit weight of 56 lb/ft^3 [8.8 kN/m^3].

2.6.9 Design Wind Load

The design wind load shall include the sum of the horizontal design wind forces applied to the structure in the direction of the wind and the design wind forces on guys and appurtenances. All appurtenances, including antennas, mounts and lines, shall be assumed to remain intact and attached to the structure.

Strength design shall be based on the wind directions resulting in the maximum responses. For latticed structures, each of the wind directions indicated in Table 2-6 shall be considered for each face.

The horizontal design wind force for the strength design of appurtenances and their connections to supporting structures shall be determined using a gust effect factor of 1.0 and a directionality factor determined from Table 2-2. No shielding from the structure shall be considered (K_a= 1.0, refer to 2.6.9.2).

The horizontal design wind force for the strength design of a cantilevered tubular or latticed spine, pole or similar structure mounted on a guyed mast, latticed self-supporting structure, or flexible building shall be determined using a gust effect factor of 1.35 (refer to 2.6.7.4) and a directionality factor determined from Table 2-2 for the cantilevered structure.

Note: The directionality factor for determining the design wind load for the total structure, including the cantilever, shall be determined from Table 2-2 based on the type of supporting structure.

The design wind load, F_W, shall be determined in accordance with the following:

$$F_W = F_{ST} + F_A + F_G$$

where:

F_{ST} = design wind force on the structure from 2.6.9.1

F_A = design wind force on appurtenances from 2.6.9.2

F_G = design wind force on guys from 2.6.9.3

The design wind forces, $F_S + F_A$, need not exceed the wind force calculated for a structure using a solidity ratio of 1.0 (solid-faced) plus the wind load on externally mounted appurtenances that are outside the normal projected area of the structure in the direction of the wind.

2.6.9.1 Design Wind Force on Structure

The design wind force, F_S, applied to each section of a structure shall be determined in accordance with the following:

$$F_{ST} = q_z \, G_h \, (EPA)_S$$

where:

F_S = horizontal design wind force on the structure in the direction of the wind

q_z = velocity pressure from 2.6.9.6

G_h = gust effect factor from 2.6.7

$(EPA)_S$ = effective projected area of the structure from 2.6.9.1.1 or 2.6.9.1.2

2.6.9.1.1 Effective Projected Area of Latticed Structures

The effective projected area of structural components for a section, $(EPA)_S$, shall be determined from the equation:

$$(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma (A_r R_r)]$$

where:

$C_f = 4.0\varepsilon^2 – 5.9\varepsilon + 4.0$ (square cross sections)

$C_f = 3.4\varepsilon^2 – 4.7\varepsilon + 3.4$ (triangular cross sections)

ε = solidity ratio = $(A_f + A_r)/A_g$

A_f = projected area of flat structural components in one face of the section

A_r = projected area of round structural components in one face of the section including the projected area of ice on flat and round structural components in one face for loading combinations that include ice

A_g = gross area of one face as if the face were solid

D_f = wind direction factor for flat structural components determined from Table 2-6

D_r = wind direction factor for round structural components determined from Table 2-6

R_r = reduction factor for a round element

= $0.57 - 0.14\varepsilon + 0.86\varepsilon^2 - 0.24\varepsilon^3 \leq 1.0$ when $C < 32$ [4.4] and for all iced conditions (subcritical flow)

= $0.36 + 0.26\varepsilon + 0.97\varepsilon^2 - 0.63\varepsilon^3$ when $C > 64$ [8.7] for no-ice conditions (supercritical flow)

where:

$C = [I\ K_Z\ K_{ZT}]^{1/2}\ V\ D$

I = importance factor from Table 2-3

K_Z = velocity pressure coefficient from 2.6.5.2

K_{ZT} = topographic factor from 2.6.6.4

V = the basic wind speed for the loading condition under investigation, mph [m/s]

D = outside diameter of the structural component without ice, ft [m]

Notes:

1) The projected area of structural components shall include the projected area of connection plates in the face of a section.
2) In order for a structural component to be considered as a round structural component, the component must have a round profile on the windward and leeward sides of the

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component. (Formed U-shaped angle or channel members shall be considered as flat structural components.)

3) Bracing members in adjacent faces and internal plan and hip bracing need not be included in the projected area of structural components.
4) For no-ice conditions, linear interpolation may be used when 32 [4.4] $\leq$ C $\leq$ 64 [8.7] to determine R_r. For iced conditions, R_r shall be based on subcritical flow for all values of C.
5) When attachments such as step bolts or similar irregularities are attached to a round structural member, the reduction factor for the round elements, R_r shall be calculated as follows:

   (a) when $R_a \leq 0.1$, the projected areas of the attachments may be ignored
   (b) when $0.1 < R_a \leq 0.2$, the value for R_r shall be multiplied by $1.0 + 3(R_a – 0.1)$, and the projected areas of the attachments may be ignored
   (c) when $R_a > 0.20$, or alternatively for any value of R_a, the value of R_r for subcritical flow shall be used. The projected areas of attachments shall be considered separately in addition to the structural member using appropriate force coefficients for appurtenances.

   Where R_a is the ratio of the projected area of the attachments to the projected area of the structural member without the attachments for the portion being considered. For iced conditions, the ice thickness need not be included in the determination of R_a.
6) When attachments such as step bolts or similar irregularities are attached to a flat structural member, the projected areas of the attachments shall be considered separately in addition to the structural member using appropriate force coefficients except when Ra is less than or equal to 0.1, the projected areas of the attachments may be ignored.

2.6.9.1.1.1 Effective Projected Area of Latticed Leg Structures

Latticed legs shall be considered as equivalent round members for the purpose of determining the effective projected area, $(EPA)_S$, of structures with latticed legs.

The effective projected area of an individual latticed leg shall be determined in accordance with 2.6.9.1.1 with R_r based on subcritical flow and the direction factors, D_f and D_r, equal to 1.0. The diameter of the equivalent round member shall be determined by dividing the $(EPA)_S$ of the individual latticed leg by the quantity of 1.2 times the length of the latticed leg. Gross area, A_g, of the structure shall be based of the full width of the structure including the width of the latticed leg and ice when applicable.

The reduction factor, R_r, for the equivalent round member shall be based on subcritical flow.

For loading conditions that include ice, the design ice thickness shall be considered uniformly distributed around each member of the latticed leg for determining effective projected areas (ice thickness need not be added to the equivalent round member). The weight of ice shall be determined by considering each member of the latticed leg in accordance with 2.6.8.

2.6.9.1.2 Effective Projected Area of Pole Structures

The effective projected area of a pole section, $(EPA)_S$, shall be determined from the equation:

$$(EPA)_S = C_f A_P$$

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C_f = force coefficient for cantilevered pole structure from Table 2-7

A_P = actual projected area based on the pole outside diameter (for rounds), the outside point-to-point diameter (for polygons), or overall width, including ice thickness for load combinations that include ice

Note: In the absence of a detailed transmission line layout and installation bend radii of the lines, the minimum diameter of a pole structure shall not be less than the diameter which results in 45% utilization of the cross-section for the placement of internal transmission lines.

2.6.9.1.3 Uniform Wind and Ice Applied to Structure

The design wind force and ice thickness applied to a section of a structure may be based on the velocity pressure and ice thickness at the mid-height of the section. The section length considered to have uniform velocity pressure and ice thickness shall not exceed the following:

a) 60 ft [18 m] for latticed structures
b) 20 ft [6 m] for pole structures

2.6.9.2 Design Wind Force on Appurtenances

The design wind force on appurtenances (either discrete or linear but excluding microwave antennas), F_A, shall be determined from the equation:

$$F_A = q_z G_h (EPA)_A$$

where:

q_z = velocity pressure at the centerline height of the appurtenance from 2.6.9.6

G_h = gust effect factor from 2.6.7

(Note: see 2.6.9 for G_h for the strength design of appurtenances.)

$(EPA)_A$ = effective projected area of the appurtenance including ice for loading combinations that include ice.

The design wind force, F_A, shall be applied at the centroid of the effective projected area of the appurtenance in the direction of the wind. For a linear appurtenance, the length considered to have uniform velocity pressure and ice thickness shall not exceed the section length specified in 2.6.9.1.3.

In the absence of more accurate data, the design wind force on microwave antennas shall be determined using Annex C.

In the absence of more accurate data specifying effective projected area values for each critical wind direction, the effective projected area, $(EPA)_A$, of an appurtenance shall be determined from the equation:

$$(EPA)_A = K_a[(EPA)_N \cos^2(\theta) + (EPA)_T \sin^2(\theta)]$$

K_a = 1.0 for round appurtenances, regardless of location, when transitional or supercritical force coefficients are considered.
= (1- ε) for appurtenances when subcritical force coefficients are considered, entirely inside the cross section of a latticed structure or outside the cross section entirely within a face zone as defined in Figure 2-3, where ε is the minimum solidity ratio of the structure considering each face for the section containing the appurtenance. K_a need not exceed 0.6.
= 0.8 for antenna mounting configurations (when subcritical force coefficients are considered only) such as side arms, T-arms, stand-offs, etc. when 3 or more mounts are located at the same relative elevation (shielding from the mounting configuration and shielding of mounting members from antennas is excluded, refer to 2.6.9.4)
= 1.0 for other appurtenances unless otherwise specified in this section

(Notes: 1. K_a = 1.0 may be conservatively used for any appurtenance
2. The value of K_a is constant for all wind directions)

θ = relative angle between the azimuth associated with the normal face of the appurtenance and the wind direction (refer to Figure 2-4).

$(EPA)_N$ = effective projected area associated with the windward face normal to the azimuth of the appurtenance.

$(EPA)_T$ = effective projected area associated with the windward side face of the appurtenance.

The larger value of $(EPA)_N$ or $(EPA)_T$ may be conservatively used for $(EPA)_A$ for all wind directions.

In the absence of more accurate data, an appurtenance shall be considered as consisting of flat and round components in accordance with the following:

$$(EPA)_N = \Sigma(C_a A_A)_N$$

$$(EPA)_T = \Sigma(C_a A_A)_T$$

C_a = force coefficient from Table 2-8

A_A = projected area of a component of the appurtenance. The additional projected area of ice shall be considered as a round component for loading combinations that include ice.

Equivalent flat plate areas based on Revision C of this Standard shall be multiplied by a force coefficient, C_a, equal to 2.0 except when the appurtenance is made up of round members only, a force coefficient of 1.8 may be applied.

The total $(EPA)_A$ for a wireless carrier shall be determined in accordance with Annex C when specific antenna and mounting information is not available.

2.6.9.2.1 Antenna Mounting Pipes

The projected area of a mounting pipe above and below an antenna shall be included in the term $\Sigma(C_a\ A_A)_N$. The projected area of the entire mounting pipe shall be included in the term $\Sigma(C_a\ A_A)_T$.

2.6.9.2.2 Effective Projected Area for Mounting Frames (Figure 2-5)

The effective projected area associated with the windward face normal to the azimuth of a mounting frame, $(EPA)_N$, shall be determined from the equation:

$$(EPA)_N = (EPA)_{MN} + (EPA)_{FN}$$

where:

$(EPA)_{MN}$ = Effective projected area of the frame = $C_{as}\ (A_f + R_{rf}A_r)$

$C_{as} = 1.58 + 1.05\ (0.6 - \varepsilon)^{1.8}$ for $\varepsilon \leq 0.6$

$C_{as} = 1.58 + 2.63\ (\varepsilon - 0.6)^{2.0}$ for $\varepsilon > 0.6$

A_f = projected area of flat components of the mounting frame

$R_{rf} = 0.6 + 0.4\ \varepsilon^2$

ε = solidity ratio of mounting frame without antennas and mounting pipes
= $(A_f + A_r)/A_g$

A_r = projected area of round components of the mounting frame

A_g = gross area of the frame as if it were solid defined by the largest outside dimensions of the elements included in A_f and A_r

Note: For square or triangular truss mounting frames (refer to Figure 2-5), C_{as} shall be equal to C_f in accordance with 2.6.9.1.1.

$(EPA)_{FN}$ = the effective projected area in a plane parallel to the face of the mounting frame of all members supporting the mounting frame
= $0.5\ [\ 2.0(\Sigma A_{fs}) + 1.2(\Sigma A_{rs})]$

A_{fs} = projected area of flat components supporting the mounting frame without regard to shielding or overlapping members

A_{rs} = projected area of round components supporting the mounting frame without regard to shielding or overlapping members

The effective projected area associated with the windward side of a mounting frame, $(EPA)_T$, shall be determined from the equation:

$$(EPA)_T = (EPA)_{FT} + 0.5\Sigma\ (EPA)_{FTi} + 0.5\ \Sigma\ (EPA)_{MT}$$

where:

$(EPA)_{FT}$ = the effective projected area in a plane transverse to the face of the mounting frame of a frame/truss supporting the mounting frame (the larger frame/truss when more than one is present)

$(EPA)_{FTi}$ = the effective projected area in a plane transverse to the face of the mounting frame of any additional frames/trusses supporting the mounting frame

Note: The effective projected area of frame/truss supporting members shall be determined in accordance with the equation for $(EPA)_{MN}$. Alternatively, a drag factor of 2.0 may be applied to flat members and a drag factor of 1.2 applied to round members without regard to shielding or overlapping members.

$(EPA)_{MT}$ = the effective projected area, in a plane transverse to the face of the mounting frame, of all mounting frame members and all other miscellaneous support members (i.e. tiebacks) without regard to shielding or overlapping members determined using a drag factor of 2.0 applied to flat members and a drag factor of 1.2 applied to round members.

When three or more mounting frames are mounted at the same relative elevation, a 0.75 reduction factor may be applied to $(EPA)_N$ and $(EPA)_T$ to account for shielding effects when the mounting frames provide shielding to the structure and other mounting frames (refer to Figure 2-6). No shielding shall be considered for the supporting structure.

Antennas and mounting pipes supported on mounting frames shall be considered as generic appurtenances using a value of K_a equal to 0.9 except a value of K_a equal to 0.8 may be used when 3 or more mounting frames are mounted at the same relative elevation.

2.6.9.2.3 Effective Projected Area for Symmetrical Frame/Truss Platforms

The effective projected area, $(EPA)_A$, of frame/truss triangle or square symmetrical platforms (refer to Fig. 2-7) that are continuous around the perimeter of a structure (or with a horizontal gap between the corners of adjacent faces less than or equal to 10% of the width of the platform) shall be determined as if the platform were a section of a latticed structure in accordance with 2.6.9.1 using directionality factors D_F and D_r = 1.0. The projected area of all supporting members for the entire platform shall be projected onto a plane parallel to a face without regard to shielding or overlapping members of the platform or the supporting structure. A drag factor of 2.0 for flat members and a drag factor of 1.2 for round members shall be applied to the projected areas of the supporting members. Fifty percent of the total effective projected area of the supporting members shall be added to the effective projected area of the platform. The resulting total effective projected area shall be used for all wind directions. No shielding shall be considered for the supporting structure. Antennas and mounting pipes supported on the platform shall be considered as generic appurtenances with a value of K_a equal to 0.75.

2.6.9.2.4 Effective Projected Area for Low Profile Platforms

The effective projected area, $(EPA)_A$, of low profile symmetrical platforms (refer to Fig 2-8) that are continuous around the perimeter of a structure (or with a horizontal gap between the corners of adjacent faces less than or equal to 10% of the width of the platform) shall be determined by summing the projected areas of all members of the platform onto a plane parallel to a face of the platform without regard to shielding or overlapping members of the platform or the supporting structure. A drag factor of 2.0 for flat members and a drag factor of 1.2 for round members shall be applied to the projected areas of all members. The total effective projected area shall be multiplied by factor equal to 0.75 for square platform and 0.67 for triangular platforms. The resulting effective projected area shall be used for all wind directions. No shielding shall be considered for the supporting structure. Antennas and mounting pipes supported on the platform shall be considered as generic appurtenances using a value of K_a equal to 0.8.

2.6.9.2.5 Effective Projected Area for Symmetrical Circular Ring Platforms

The effective projected area, $(EPA)_A$, of symmetrical circular ring platforms (refer to Fig 2-9) that are continuous around the perimeter of a structure shall be determined by considering the supporting members of the platform and the ring members as individual members. The projected area of each ring member shall be equal to the product of the diameter of the ring and the projected vertical dimension of the ring member exposed to the wind. The projected area of all supporting members for the entire platform shall be determined by projecting all supporting members onto a vertical plane without regard to shielding or overlapping members of the platform or the supporting structure. A drag factor of 2.0 for flat members and a drag factor of 1.2 for round members shall be applied to the projected areas of the supporting members and the ring members. A 0.50 factor shall be applied to total effective projected area of the supporting members and a 1.75 factor shall be applied to the total effective projected area of the ring members. The resulting total effective projected area shall be used for all wind directions. No shielding shall be considered for the supporting structure. Antennas and mounting pipes supported on the platform shall be considered as generic appurtenances using a value of K_a equal to 0.8.

Notes for all mounting frame/platform types:

1. K_a shall equal 1.0 for antennas and antenna mounting pipes under transitional or supercritical flow conditions.
2. Grating and other horizontal working surfaces need not be included in the effective projected area.

2.6.9.3 Design Wind Force on Guys

The design wind force on guys, F_G, shall be determined in accordance with the following equation:

$$F_G = C_d \, d \, L_G \, G_h \, q_z \sin^2 \theta_g$$

where:

F_G = force applied normal to the chord of the guy in the plane containing the guy chord and the wind, refer to Figure 2-10.

C_d = 1.2, drag factor for guy

d = guy diameter including ice for loading combinations that include ice

L_G = length of guy

G_h = gust effect factor from 2.6.7.2

q_z = velocity pressure at mid-height of guy from 2.6.9.6
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θ_g = true angle of wind incidence to the guy chord

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Note: A higher drag factor, C_d, or an increased effective guy diameter may be required when attachments such as spoilers, insulators, markers, etc. are attached to a guy.

The design wind force and ice thickness may be assumed to be uniform based on the velocity pressure and ice thickness at the mid-height of each guy or guy segment. The length of each guy or guy segment may be assumed to equal the chord length. The design wind force shall be considered as a distributed force normal to the guy chord.

For ground-supported structures, mid-height shall be referenced to the ground elevation at the base of the structure. For structures supported on buildings or other supporting structures, the mid-height of a guy shall be measured from the mid-height elevation of the guy to the ground level of the building or other supporting structure. The height z for a guy segment shall not be less than zero.

2.6.9.4 Shielding

Shielding, except as noted herein, may be considered for intersecting or parallel elements. The unshielded element shall be considered as flat unless both elements are round. Full shielding may be considered when the clear distance between the elements in the direction under consideration for determining effective projected areas (EPA) is less than or equal to 2.0 times the smallest projected dimension of the element in the direction under consideration. No shielding shall be considered for clear distance ratios greater than 4.0. Linear interpolation shall be allowed for ratios between 2.0 and 4.0. Refer to Figure 2-11.

Shielding from an appurtenance shall not be considered when a value of K_a less than 1.0 per 2.6.9.2 is used to determine the design wind force on the appurtenance.

Note: Shielding considerations will vary with wind direction.

2.6.9.5 Transmission Lines Mounted in Clusters or Blocks

The projected area of each line in a cluster or block, independent of their spacing or location within the group, (i.e. no shielding of lines and no reduction of ice thickness) shall be included in the calculation of wind loads using a force coefficient, C_a, equal to 1.2 (based on round/elliptical lines), except that the group of lines need not be considered larger than an equivalent appurtenance with a width equal to the maximum out-to-out dimension of the group for both the normal and transverse sides with a force coefficient, C_a, equal to 1.5 for square or rectangular clusters and 1.2 for round clusters. Refer to Figure 2-12. For loading conditions that include ice, a force coefficient, C_a, equal to 1.5 shall apply for both round, square and rectangular clusters.

Note: The width of the equivalent appurtenance may be used for determining shielding in accordance with 2.6.9.4.

For purpose of calculating the weight of ice, the radial thickness of ice shall be considered on each individual line except that the total cross section of ice need not exceed the area of a cluster as indicated in Figure 2-12.

2.6.9.6 Velocity Pressure

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

$$q_z = 0.00256\, K_z\, K_{zt}\, K_d\, V^2\, I \text{ (lb/ft}^2\text{)}$$

$$= 0.613\, K_z\, K_{zt}\, K_d\, V^2\, I \text{ [N/m}^2\text{]}$$

where:

K_z = velocity pressure coefficient from 2.6.5.2

K_{zt} = topographic factor from 2.6.6.4

K_d = wind direction probability factor from Table 2-2

V = the basic wind speed for the loading condition under investigation, mph [m/s]

I = importance factor from Table 2-3

2.7 Earthquake Loads

2.7.1 Definitions

Design Earthquake: the earthquake effects that are two-thirds of the corresponding maximum considered earthquake.

Site Class: A classification assigned to a site based on the types of soil present.

Structure Irregularity: A structure containing a torsional, stiffness or mass irregularity as defined in Table 2-9.

2.7.2 Symbols and Notations

ϕ_{im} = displacement amplitude at level i when vibrating in the m^{th} mode;

ϕ_{zm} = displacement amplitude at level z when vibrating in the m^{th} mode;
a, b & c = acceleration coefficients;

A_{gi} = area of an individual guy at elevation;
A_s = earthquake amplification factor;
C_g = natural frequency conversion factor for guyed masts;

C_{zm} = seismic force distribution factor for the m^{th} mode;
E = modulus of elasticity of structure material;
F_a = acceleration-based site coefficient at short periods;
F_{SZ} = Lateral seismic force at level z;
F_v = velocity-based site coefficient at 1 second;

F_{zm} = seismic forces at level z for the m^{th} mode;
f_1 = fundamental frequency of structure, Hertz;

f_m = frequency of structure for the mode under consideration;

G_{ri} = average guy radius for guys at elevation;
g = acceleration due to gravity;

H_{gi} = height above base to guy elevation;
h = height of structure;
h_i = height from the base of structure to level;
h_z = height from the base of structure to level z;
I = importance factor;

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I_S = moment of inertia of a section of a structure;
i = number designating the level of the structure;

I_{avg} = average moment of inertia of structure;
I_{bot} = moment of inertia at base of structure;
I_{top} = moment of inertia at top of structure;
K_g = equivalent stiffness of guys;
K_m = simplified natural frequency conversion factor for guyed masts;
K_S = coefficient used to determine fundamental frequencies of a structure;

k_e = seismic force distribution exponent;
L = height of pole structure;

L_{gi} = average chord length of guys at elevation i;
L_S = length of a section of a structure;
M_S = total mass of a section of a structure;
m = subscript denoting quantities in the m^{th} mode;
N = standard penetration resistance of a soil;

N_i = number of guys at guy elevation i;
n = number designating the uppermost level of the structure or number of guy levels;
PI = plastic index of a soil;
R = response modification coefficient;
S_1 = maximum considered earthquake spectral response acceleration at 1 second;
S_A = design spectral response acceleration;

S_{am}= design spectral response acceleration at period T_m;

S_{az}= acceleration coefficient at height z;
S_{D1} = design spectral response acceleration at a period of 1.0 second;
S_{DS} = design spectral response acceleration at short periods;
S_s = spectral response acceleration at short period;
S_U = undrained shear strength of a soil;
T_m = period for mode m;
T_O = period used to define the design spectral response;
T_S = period used to define the design spectral response;
V_s = total seismic shear;

V_{sm} = portion of the base shear contributed by the m^{th} mode;
W = weight of structure including appurtenances and upper half of guys;
W_I = weight used to determine fundamental frequencies of a structure;
W_L = weight of structure excluding appurtenances;

W_m= effective modal gravity load;
W_t = total weight of structure including appurtenances and guys;
W_u = weight of discrete appurtenances in the top third of structure;
W_2 = weight of structure and appurtenances within top 5% of structure height;

w_a = average face width of structure;
w_i = portion of total gravity load assigned to level i;

w_O = face width at base of structure;
w_z = portion of total gravity load assigned to level under consideration;
z = number designating the level under consideration.

2.7.3 General

Antennas and antenna supporting structures require special considerations of their response characteristics in regions of high seismicity. The provisions of this Standard provide design

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criteria to insure sufficient strength and stability to resist the effects of seismic ground motions for self-supporting and guyed antenna supporting structures.

Earthquake effects may be ignored for structures assigned to structure Class I in accordance with Table 2-1 or for any structure located in a region where the earthquake spectral response acceleration at short periods (S_s) from 2.7.5 is less than or equal to 1.00. Further, for structures without irregularities as described in Table 2-9, earthquake effects may be ignored when the total seismic shear is less than 50% of the total horizontal wind load without ice. The equivalent lateral force procedure specified in 2.7.7 may be used for all structures to calculate the total seismic shear to be compared to wind loading for purposes of this section and for the purpose of Section 9.6. Wind loading for this comparison shall be based on the 50-year recurrence interval basic wind speed for the site.

When required, earthquake loads shall be evaluated in accordance with the seismic analysis procedures specified in 2.7.4.

1. An importance factor I shall be determined from Table 2-3 based on the structure classification listed in Table 2-1.

2. Determine an appropriate seismic analysis procedure method for the structure from Table 2-10.

3. Determine the maximum considered earthquake spectral response acceleration (expressed as a ratio to the acceleration due to gravity) at short periods (S_s) and at 1 second (S_1) from 2.7.5.

4. Determine the Site Class based on the soil properties at the site in accordance with Table 2-11.

5. Modification factors F_a and F_v, based on the Site Class, shall be determined from Tables 2-12 and 2-13 respectively.

6. The design spectral response acceleration at short periods (S_{DS}) and at 1 second (S_{D1}) shall be determined in accordance with 2.7.6.

2.7.4 Seismic Analysis Procedures

A structural analysis, when required for earthquake loads, shall be made in accordance with one of the seismic analysis procedure methods prescribed in Table 2-10.

Ground motions shall be considered to occur in the same directions considered for wind loading for seismic analysis procedure methods 1,2, and 3. Torsional moments shall be included in the analysis for structures with torsional irregularities as described in Table 2-9. The mathematical model used for seismic analysis shall be in accordance with 3.4 and 3.5.

(Note: Load effects produced by the seismic forces from methods 1 & 2 from Table 2-10 shall be determined by a geometrical non-linear analysis when such an analysis is required in accordance with 3.5.)

Earthquake loads for structures supported on buildings or other supporting structures shall be determined in accordance with 2.7.12.

2.7.5 Maximum Considered Earthquake Spectral Response Accelerations

The maximum considered earthquake spectral response accelerations at short periods (S_s) and at 1 second (S_1) shall be as given in Annex B and Appendix 1 except as provided by 2.7.5.1.

2.7.5.1 Site-Specific Procedures for Determining Ground Motion Accelerations

For structures located in regions not included in Annex B, the maximum accelerations S_s and S_1 shall be based on regional seismicity and geology and shall be expressed as a ratio to the acceleration due to gravity. The maximum considered earthquake ground motion shall be taken as the motion represented by assuming 5% of critical damping having a 2% probability of exceedance within a 50 year period.

A site-specific geotechnical investigation and a dynamic site response analysis shall be used to determine S_s and S_1 for structures in all Site Class F locations (see Tables 2-12 and 2-13).

2.7.6 Design Spectral Response Accelerations

The design earthquake spectral response acceleration at short periods, S_{DS}, and at 1 second, S_{D1}, shall be determined from the following equations:

$$S_{DS} = 2/3\ F_a\ S_s$$

$$S_{D1} = 2/3\ F_v\ S_1$$

where:

F_a = acceleration-based site coefficient based on site class and spectral response acceleration at short periods from Table 2-12.

F_v = velocity-based site coefficient based on site class and spectral response acceleration at 1 second from Table 2-13

Note: when S_s and S_1 are based on site-specific dynamic response analysis procedures, F_a and F_v shall be equal to 1.0.

2.7.7 Equivalent Lateral Force Procedure (Method 1)

1. Determine the total weight (W) of the structure including appurtenances. For guyed masts, W shall also include the weight of the upper half of the guy assemblies attached to the structure.

2. Calculate the total seismic shear (V_s) in accordance with 2.7.7.1.

3. Distribute the total seismic shear in accordance with 2.7.7.2.

4. Analyze the structure statically using the seismic forces as external loads.

2.7.7.1 Total Seismic Shear

The total seismic shear, V_s, in a given direction shall be determined in accordance with the following equation:

$$V_s = \frac{S_{DS} \; W \cdot I}{R}$$

Alternatively, for ground-supported structures, the total seismic shear, V_s, need not be greater than:

$$V_s = \frac{f_1 S_{D1} W \cdot I}{R}$$

When the alternate equation for V_s is used, V_s shall not be less than 0.044 S_{DS} W I and for sites where S_1 equals or exceeds 0.75, V_s using the alternate equation shall also not be less than:

$$V_s = \frac{0.5 S_1 W \cdot I}{R}$$

where:

S_{DS} = design spectral response acceleration at short periods from 2.7.6

S_{D1} = design spectral response acceleration at a period of 1.0 second from 2.7.6

S_1 = maximum considered earthquake spectral response acceleration at 1 second from 2.7.5

f_1 = fundamental frequency of the structure in accordance with 2.7.11

W = total weight of the structure including appurtenances, for guyed masts, W also includes one-half the weight of guys supporting the structure

I = importance factor from Table 2-3

R = response modification coefficient equal to 3.0 for latticed self-supporting structures, 2.5 for latticed guyed masts and 1.5 for tubular pole structures

2.7.7.2 Vertical Distribution of Seismic Forces

The lateral seismic force, F_{sz}, induced at any level, z, shall be determined from the following equation:

$$F_{sz} = \frac{w_z h_z^{k_e}}{\sum_{i=1}^{n} w_i h_i^{k_e}} V_s$$

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where:

V_s = total seismic shear from 2.7.7.1

n = number designating the uppermost level of the structure with regard to the distribution of gravity loads

i = number designating the level of the structure starting from the base to the uppermost level

z = number designating the level under consideration

w_z = portion of total gravity load (W) assigned to level under consideration

h_z = height from the base of structure to level z

w_i = portion of total gravity load (W) assigned to level i

h_i = height from the base of structure to level i

k_e = seismic force distribution exponent, equal to 1.0 for structures having a fundamental frequency of 2.0 or higher, and equal to 2.0 for structures having a fundamental frequency of 0.4 or less. For structures having a fundamental frequency between 2.0 and 0.4, k_e shall be equal to 2.0 or shall be determined by linear interpolation between 1.0 and 2.0. Alternatively, k_e may be set equal to 2.0 for any structure.

(Note: For guyed masts, one-half of the weight of guys shall be assigned to the corresponding guy attachment points on the mast.)

2.7.8 Equivalent Modal Analysis Procedure (Method 2)

1. Calculate the fundamental frequency of the structure in accordance with Section 2.7.11.

2. Determine the seismic forces for each level of the structure in accordance with 2.7.8.1.

3. Analyze the structure statically using the seismic forces as external loads.

2.7.8.1 Determination of Seismic Forces

The lateral seismic force (F_{sz}) induced at each level of the structure (z) shall be determined from the following equation:

$$F_{sz} = \frac{S_{az} w_z I}{R}$$

where:

z = number designating the level under consideration

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S_{az} = acceleration coefficient at height z

$$= \frac{a\,(S_A)^2 + b\,(S_{DS})^2}{[\,(S_A)^2 + c\,(S_{DS})^2]^{1/2}}$$

w_z = portion of total gravity load (W) assigned to level under consideration

I = importance factor from Table 2-3

R = response modification coefficient equal to 3.0 for latticed self-supporting structures, 2.5 for latticed guyed masts and 1.5 for tubular pole structures

a, b & c = acceleration coefficients determined from Figure 2-13

$S_A = S_{D1}(f_1)$ when $f_1 \leq S_{DS}/S_{D1}$, otherwise $S_A = S_{DS}$

f_1 = fundamental frequency of structure from 2.7.11

S_{DS} = design spectral response acceleration at short periods from 2.7.6

S_{D1} = design spectral response acceleration at 1 second from 2.7.6

2.7.9 Modal Analysis Procedure (Method 3)

1. Construct a mathematical model of the structure that represents the spatial distribution of mass and stiffness throughout the structure.

2. Conduct an analysis to determine the natural modes of vibration for the structure including the period of each mode, the modal shape vector, and the modal mass participation factor. The analysis shall include a sufficient number of modes to obtain a combined modal mass participation of at least 85%. The analysis for each direction under consideration shall be based upon established methods of structural analysis.

3. Establish the design response spectrum from 2.7.9.1.

4. Calculate the base shear (V_{sm}) contributed by each mode from 2.7.9.2.

5. Determine the seismic forces for each level of the structure for each mode in accordance with 2.7.9.3.

6. Analyze the structure statically using the seismic forces as external loads for each mode.

7. Combine the load effects of each mode by calculating the square root of the sum of the squares of the modal values.

2.7.9.1 Design Response Spectrum

The design response spectrum shall be determined in accordance with the following equations as represented in Figure 2-14

S_{am} = design spectral response acceleration at period T_m for the mode under investigation

$T_m = 1/f_m$

f_m = frequency of structure for the mode under consideration

For $T_m < 4.0$ sec

$S_{am} = S_{DS}\,(0.4 + 0.6\,T_m/To)$ when $T_m \le To$

$S_{am} = S_{DS}$ when $To < T_m < Ts$

$S_{am} = S_{D1} / T_m$ when $T_m \ge Ts$

For $T_m \ge 4.0$ sec

$S_{am} = 4S_{D1} / T_m^2$

where:

S_{DS} = design spectral response acceleration at short periods from 2.7.6

S_{D1} = design spectral response acceleration at 1 second from 2.7.6

$To = 0.2\,S_{D1}/S_{DS}$

$Ts = S_{D1}/S_{DS}$

2.7.9.2 Base Shear Contributed by Each Mode

The base shear (V_{sm}) contributed by each mode shall be determined from the following equations:

$$V_{sm} = \frac{S_{am} W_m I}{R}$$

$$W_m = \frac{\left(\sum_{i=1}^{n} w_i \phi_{im}\right)^2}{\sum_{i=1}^{n} w_i \phi_{im}^2}$$

where:

S_{am} = design spectral response acceleration at period T_m

W_m = effective modal gravity load

I = importance factor from Table 2-3

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R = response modification coefficient equal to 3.0 for latticed self-supporting structures, 2.5 for latticed guyed masts and 1.5 for tubular pole structures

n = number designating the uppermost level of the structure with regard to the distribution of gravity loads

i = number designating the level of the structure starting from the base to the uppermost level

m = subscript denoting quantities in the m^{th} mode

w_i = portion of total gravity load (W) assigned to level i

ϕ_{im} = displacement amplitude at the *i*th level of the structure when vibrating in its m^{th} mode

2.7.9.3 Seismic Forces Contributed by Each Mode

The seismic forces (F_{zm}) at each level of the structure (z) for each mode (m) shall be determined in accordance with the following equation:

$$F_{zm} = C_{zm} V_{sm}$$

where:

$$C_{zm} = \frac{w_z \phi_{zm}}{\sum_{i=1}^{n} w_i \phi_{im}}$$

z = number designating the level under consideration

C_{zm} = seismic force distribution factor for the m^{th} mode

V_{sm} = portion of the base shear contributed by the m^{th} mode

w_z = portion of total gravity load (W) assigned to level z

w_i = portion of total gravity load (W) assigned to level i

ϕ_{zm} = displacement amplitude at level z when vibrating in the m^{th} mode

ϕ_{im} = displacement amplitude at level i when vibrating in the m^{th} mode

2.7.10 Time-History Analysis (Method 4)

1. Construct a mathematical model of the structure that represents the spatial distribution of mass and stiffness throughout the structure considering structural damping to be equivalent to 5% of critical damping.

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2. Select two orthogonal horizontal ground-motion time-histories from not less than three recorded events compatible with the seismicity of the site or alternatively generate a simulated ground-motion time-history in accordance with acceptable earthquake engineering methods.

3. For each horizontal component, construct a 5% response spectrum. Combine the response spectra for each pair of horizontal components using the square root of sum of squares (SRSS). Average the resulting combined spectra. Scale the horizontal
ground-motion components such that the averaged combined spectrum is not less than 1.3 times the design response spectrum calculated in accordance with 2.7.9.1 multiplied by the importance factor for the structure. The scaling factor shall be applied to all ground-motion components.

4. Perform a time-history analysis for each event in accordance with acceptable methods of structural analysis using the two scaled simultaneous ground-motion components. When the horizontal distance between the base of a guyed mast to a guy anchor point exceeds 1000 ft [300 m], out-of-phase excitation of the anchor point shall be included in the analysis. The time delay shall be calculated using the design shear wave velocity in the soil at the site and the distance between the base and the guy anchor point.

5. Determine the load effects for design by selecting the maximum values from the time -history analyses.

2.7.11 Fundamental Frequency of Structure (f_1)

The fundamental natural frequency of the structure (f_1) in the direction under consideration shall be determined using the structural properties and deformational characteristics of the resisting elements. In lieu of a formal analysis, the fundamental natural frequency of a structure may be determined in accordance with 2.7.11.1 through 2.7.11.3.

2.7.11.1 Self-Supporting Latticed Structures

$$f_1 = \frac{K_s(w_a)}{h^2}\sqrt{\frac{W_1}{W_1 + W_2}}$$

where:

$$W_1 = W'\left(\frac{w_a}{w_o}\right)^2 + 0.15 \infty f$$

Ks = 4540 for h and w_a in feet and 1500 for h and w_a in meters

W = total weight of the structure including appurtenances

W_2 = weight of structure and appurtenances within top 5% of the structure height

w_a = average face width of structure, ft [m]

w_o = face width at base of structure, ft [m]

h = height of structure, ft [m]

2.7.11.2 Self-Supporting Pole Structures

$$f_1 = \frac{1}{2\pi}\sqrt{\frac{3EI_{avg}\,g}{L^3(W_u + 0.236W_L)}}$$

where:

E = modulus of elasticity of structure material, ksi [MPa]

$I_{avg} = (I_{top} + I_{bot}) / 2$, in^4 [mm^4]

I_{top} = moment of inertia at top of structure, in^4 [mm^4]

I_{bot} = moment of inertia at base of structure, in^4 [mm^4]

W_u = weight of discrete appurtenances in the top third of structure, kips [N]

$W_L = W_t - W_u$, kips [N]

W_t = total weight of the structure including appurtenances, kips [N]

L = height of pole structure, in [mm]

g = acceleration due to gravity, in/s^2 [mm/s^2]

2.7.11.3 Guyed Masts

$$f_1 = C_g\sqrt{\frac{K_g}{W_t}}$$

$$K_g = \sum_{i=1}^{n}\left(\frac{N(A_{gi})(G_{ri})(H_{gi})}{h(L_g)^2}\right)$$

where:

C_g = 176.5 [14.66]

K_g = equivalent stiffness of guys

W_t = weight of structure including appurtenances and the total weight of all guys, kips [kN]

n = number of guy levels

i = number designating guy level starting from the base to the uppermost guy level

N_i = number of guys at guy level i

A_{gi} = area of an individual guy at level i, in^2 [mm^2]

G_{ri} = average guy radius for guys at level i, ft [m]

H_{gi} = height above base to guy level i, ft [m]

h = height of structure, ft [m]

L_{gi} = average chord length of guys at level i, ft [m]

Alternatively, the following simplified equation may be used:

$$f_1 = K_m \sqrt{\frac{1}{h^{1.5}}}$$

where:

K_m = 122 [50]

h = height of structure, ft [m]

2.7.12 Structures Supported on Buildings or Other Supporting Structures

Earthquake loads for structures less than or equal to 100 ft in height, with no mass or stiffness irregularities in accordance with Table 2-9, may be evaluated in accordance with the procedure specified in 2.7.7 (Method 1) multiplied by an amplification factor as specified in 2.7.12.1.

Interaction effects between the structure and the supporting structure shall be considered for structures with mass or stiffness irregularities and for structures over 100 ft in height. Rational methods that account for the dynamic characteristics of the structures shall be used for these structures and may be used for any supported structure to determine earthquake loads, however, earthquake loads shall not be less than 80% of the earthquake loads determined in accordance with 2.7.7.

2.7.12.1 Amplification Factor

The earthquake loads determined in accordance with the procedures specified in 2.7.7 (Method 1) shall be multiplied by an amplification factor (A_s) as follows:

For self-supporting or guyed structures, the amplification factor shall be equal to 3.0.

For structures bracketed to the supporting structure at the mid-height of the structure or above, the amplification factor shall be equal to 1.0.

For structures bracketed to the supporting structure below the mid-height of the structure, the amplification factor shall be equal to 3.0 or may be linearly interpolated between 3.0 and 1.0 based on the elevation of the bracket with respect to the mid-height of the structure.

2.8 Serviceability Requirements

2.8.1 Definitions

Displacement: the horizontal displacement under service loads of a point from the unfactored no-wind load position.

Service loads: the loading combination used to calculate serviceability limit state deformations.

Sway: the angular rotation under service loads of an antenna beam path in the local vertical plane of the antenna from the unfactored no-wind load position.

Twist: the angular rotation under service loads of an antenna beam path in the local horizontal plane of the antenna from the unfactored no-wind load position.

2.8.2 Limit State Deformations

The deformations under service loads at any point on a structure, unless otherwise required, shall not exceed the following:

1. A rotation of 4 degrees about the vertical axis (twist) or any horizontal axis (sway) of the structure.

2. A horizontal displacement of 5% of the height of the structure.

3. For cantilevered tubular or latticed spines, poles or similar structures mounted on latticed structures, a relative horizontal displacement of 1% of the cantilever height measured between the tip of the cantilever and its base.

2.8.3 Service Loads

Service loads shall be defined by the following loading combination for a 60 mph [27 m/s] basic wind speed:

$$1.0\ D + 1.0\ D_g + 1.0\ W_o$$ (Refer to 2.3.1)

The horizontal wind forces for determining service loads shall be based on an importance factor, I, of 1.00, and a directionality factor, K_d, of 0.85 for all structures. The velocity pressure coefficient, K_z, the gust effect factor, G_h, and the topographic factor, K_{zt}, shall be equal to the values for the strength limit state condition.

Table 2-1
Classification of Structures

Description of Structure	Class
Structures that due to height, use or location represent a low hazard to human life and damage to property in the event of failure and/or used for services that are optional and/or where a delay in returning the services would be acceptable.	I
Structures that due to height, use or location represent a substantial hazard to human life and/or damage to property in the event of failure and/or used for services that may be provided by other means.	II
Structures that due to height, use or location represent a high hazard to human life and/or damage to property in the event of failure and/or used primarily for essential communications.	III

Table 2-2
Wind Direction Probability Factor

Structure Type	Wind Direction Probability Factor, Kd
Latticed structures with triangular, square or rectangular cross sections	0.85
Tubular pole structures, latticed structures with other cross sections, appurtenances	0.95

Table 2-3
Importance Factors

Structure Class	Wind Load Without Ice	Wind Load With Ice	Ice Thickness	Earthquake
I	0.87	N/A	N/A	N/A
II	1.00	1.00	1.00	1.00
III	1.15	1.00	1.25	1.50
Note: Ice and earthquake loads do not apply to Class I structures				

Table 2-4
Exposure Category Coefficients

Exposure Category	Z_g	α	K_{zmin}	K_e
B	1200 ft [366 m]	7.0	0.70	0.90
C	900 ft [274 m]	9.5	0.85	1.00
D	700 ft [213 m]	11.5	1.03	1.10

Table 2-5
Topographic Category Coefficients

Topographic Category	K_t	f
2	0.43	1.25
3	0.53	2.00
4	0.72	1.50

Table 2-6
Wind Direction Factors

Tower Cross Section	**Square**		**Triangular**		
Wind Direction	Normal	45°	Normal	60°	±90°
D_f	1.0	1 + .75ε (1.2 max)	1.0	0.80	0.85
D_r	1.0	1 + .75ε (1.2 max)	1.0	1.0	1.0
Wind directions measured from a line normal to the face of the structure					

Table 2-7
Force Coefficients (C_F) for Pole Structures

C mph.ft [m/s.m]	Round	18 Sided	16 Sided	12 Sided	8 Sided
< 32 [4.4] (Subcritical)	1.2	1.2	1.2	1.2	1.2
32 to 64 [4.4 to 8.7] (Transitional)	$38.4/(C)^{1.0}$ [$5.23/(C)^{1.0}$]	$25.8/(C)^{0.885}$ [$4.42/(C)^{0.885}$]	$12.6/(C)^{0.678}$ [$3.26/(C)^{0.678}$]	$2.99/(C)^{0.263}$ [$1.77/(C)^{0.263}$]	1.2 [1.2]
> 64 [8.7] (Supercritical)	0.60	0.65	0.75	1.0	1.2

$C = (I\ K_{zt}\ K_z)^{0.5}\ (V)(D)$ for D in ft [m], V in mph [m/s]

V is the basic wind speed for the loading condition under investigation. D is the pole outside diameter for rounds or the outside point-to-point diameter for polygons.

Notes:

1. When linear appurtenances such as ladders, waveguides, coax, brackets, or other similar projections are attached on the outside of the pole shaft, effective projected areas shall be calculated as follows:
   a. When $R_a \leq 0.1$, the projected areas of the attachments may be ignored.
   b. When $0.1 < R_a \leq 0.2$, the value for C_f shall be multiplied by $1.0 + 3(R_a – 0.1)$, and the projected areas of the attachments may be ignored.
   c. When $R_a > 0.2$, or alternatively for any value of R_a, the value of C_F for subcritical flow shall be used. The projected areas of the attachments shall be considered separately in addition to the structure using appropriate force coefficients for appurtenances.

   Where R_a is the ratio of the projected area of the attachments (perpendicular to the wind direction) to the projected area of the structure without the attachments for the portion being considered. For iced conditions, the ice thickness need not be included in the determination of R_a.

2. For iced conditions, C_f shall be based on subcritical flow for all values of C.

3. Linear interpolation, based on the inscribed angle of each side, between the values shown, may be used for other cross-sections. The inscribed angle for a round cross-section is 0 degrees.

Table 2-8
Force Coefficients (C_a) For Appurtenances

Member Type		Aspect Ratio ≤ 2.5	Aspect Ratio = 7	Aspect Ratio ≥ 25
		C_a	C_a	C_a
Flat		1.2	1.4	2.0
Round	C < 32 [4.4] (Subcritical)	0.70	0.80	1.2
	32 ≤ C ≤ 64 [4.4 ≤ C ≤ 8.7] (Transitional)	$3.76/(C)^{0.485}$ [$1.43/(C)^{0.485}$]	$3.37/(C)^{0.415}$ [$1.47/(C)^{0.415}$]	$38.4/(C)^{1.0}$ [$5.23/(C)^{1.0}$]
	C > 64 [8.7] (Supercritical)	0.50	0.60	0.60

Where:

C = (I Kzt Kz)0.5 (V)(D) for D in ft [m], V in mph [m/s]

V is the basic wind speed for the loading condition under investigation.

D is the outside diameter of the appurtenance.

Aspect ratio is the overall length/width ratio in the plane normal to the wind direction. (Aspect ratio is independent of the spacing between support points of a linear appurtenance, and the section length considered to have uniform wind load).

Notes:

1. For cylindrical appurtenances, when irregularities such as flanges, hangers, etc., are present, effective projected areas shall be calculated as follows:

   a. When Ra ≤ 0.1, the projected areas of the irregularities may be ignored.
   b. When 0.1 < Ra ≤ 0.2, the value for Ca shall be multiplied by 1.0 + 3(Ra – 0.1), and the projected areas of the irregularities may be ignored.
   c. When Ra > 0.2, or alternatively for any value of Ra, the value of Ca for subcritical flow shall be used. The projected areas of irregularities shall be considered separately in addition to the appurtenance using the appropriate force coefficients.

   Where Ra is the ratio of the projected area of the irregularities (perpendicular to the wind direction) to the projected area of the appurtenance without the irregularities for the portion being considered. For iced conditions, the ice thickness need not be considered in the determination of Ra

2. For flat appurtenances, when irregularities such as flanges, hangers, etc., are present, the projected areas of the irregularities shall be considered separately in addition to the appurtenance using appropriate force coefficients except when Ra is less than or equal to 0.1, the projected areas of the irregularities may be ignored.

3. For iced conditions, Ca shall be based on subcritical flow for all values of C.

4. Linear interpolation may be used for aspect ratios other than those shown.

5. Subcritical force coefficients may conservatively be used for any value of C.

Table 2-9 Structure Irregularities

Type	Description
Torsional Irregularity	Center of mass of a section including appurtenances is offset from the vertical alignment of the structure by more than 30% of the smallest plan dimension of the section.
Stiffness Irregularity	Average bending stiffness of a section (I_S/L_S) varies by more than 50% from an adjacent section.
Mass Irregularity	Mass per unit length (M_S/L_S) of a section including appurtenances varies by more than 200% from an adjacent section.

Where: I_S = average moment of inertia of a section
M_S= total mass of a section
L_S = length of a section

Notes:

1. A section of a structure shall be considered as the portion between leg connections for latticed structures and the distance between splices in tubular pole structures, not to exceed 50 ft [15 m] for any structure.

2. The mass and stiffness of guys for guyed masts shall be excluded when determining irregularities.

3. Torque arms, star mounts, etc. shall not be considered as a stiffness irregularity.

4. Mounting frames, antenna mounts, platforms, etc, shall not be considered as a stiffness irregularity.

Table 2-10 Seismic Analysis Procedure Methods

Analysis Procedure Method Description [1]	Height Limitations on Analysis Procedure Methods					
	No mass or stiffness irregularities per Table 2-9			With mass or stiffness irregularities per Table 2-9		
	Self-Supporting		Guyed Masts [2]	Self-Supporting		Guyed Masts [2]
	Poles	Latticed		Poles	Latticed	
Equivalent Lateral Force, Method 1 in accordance with 2.7.7	50 ft [15 m]	100 ft [30 m]	No Limit	N/A	N/A	1500 ft [457 m]
Equivalent Modal Analysis, Method 2 in accordance with 2.7.8	No Limit	No Limit	N/A	200 ft [61 m]	600 ft [183 m]	N/A
Modal Analysis, Method 3 in accordance with 2.7.9	No Limit	No Limit	N/A	No Limit	No Limit	N/A
Time-History Analysis, Method 4 in accordance with 2.7.10	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit

Notes:

1. Vertical seismic forces may be ignored for Methods 1, 2 & 3.
2. Method 4 shall be used when the horizontal distance from the base of the structure to any guy anchor point exceeds 1000 ft [305 m].

Table 2-11 Site Class Definitions

Site Class	Description of Upper 100 ft [30.5 m] of Soil for the Site Location	Standard Penetration Resistance, N Cohesionless Soils PI ≤ 20	Undrained Shear Strength, S_u Cohesive Soils PI > 20
A	Hard rock with 10 ft [3 m] or less of soil overburden.	N/A	N/A
B	Competent rock with moderate fracturing and weathering with 10 ft [3 m] or less of soil overburden.	N/A	N/A
C	Very dense soil, soft rock or highly fractured and weathered rock.	> 50	> 2 ksf [100 kPa]
D	Stiff soil.	15 to 50	1.0 to 2.0 ksf [50 to 100 kPa]
E	Weak soil (excluding site class F).	< 15	< 1.0 ksf [50 kPa]
		Soil profiles over 10 ft [3 m] thick with PI ≥ 20, moisture content ≥ 40%, S_u < 0.5 ksf [25 kPa]	
F	Soils vulnerable to potential failure or collapse under seismic loading.	Soil profiles containing any of the following: peat and/or highly organic clays over 10 ft [3 m] thick, very high plasticity clays (PI > 75) over 25 ft [7.6 m] thick, soft/medium clays over 120 ft [36.6 m] thick, liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils.	

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Table 2-12 Acceleration-Based Site Coefficient, F_a

Site Class	Maximum Considered Earthquake Spectral Response Acceleration at Short Periods, (S_s)				
	$S_s \leq 0.25$	$S_s = 0.5$	$S_s = 0.75$	$S_s = 1.0$	$S_s \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	Note 1	Note 1	Note 1	Note 1	Note 1

Linear interpolation is allowed between values shown.
Note 1: Site-specific procedures required in accordance with 2.7.5.1.

Table 2-13 Velocity-based Site Coefficient, F_v

Site Class	Maximum Considered Earthquake Spectral Response Acceleration at One Second, (S_1)				
	$S_1 \leq 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \geq 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	Note 1	Note 1	Note 1	Note 1	Note 1

Linear interpolation is allowed between values shown.
Note 1: Site-specific procedures required in accordance with 2.7.5.1.

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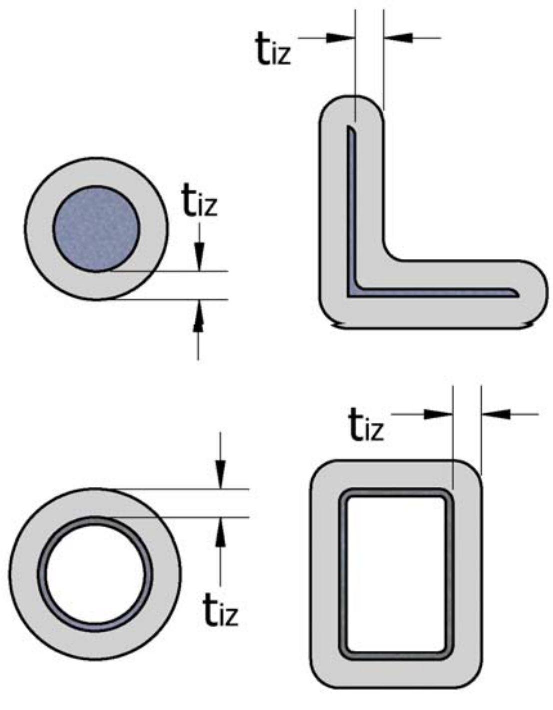
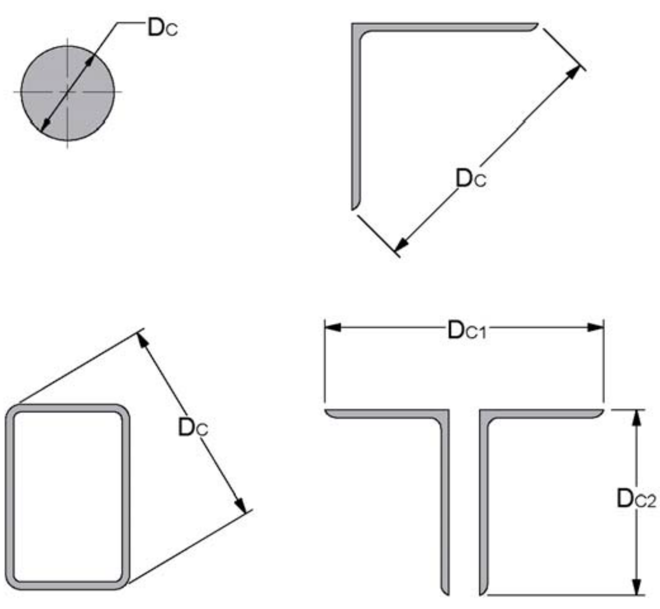
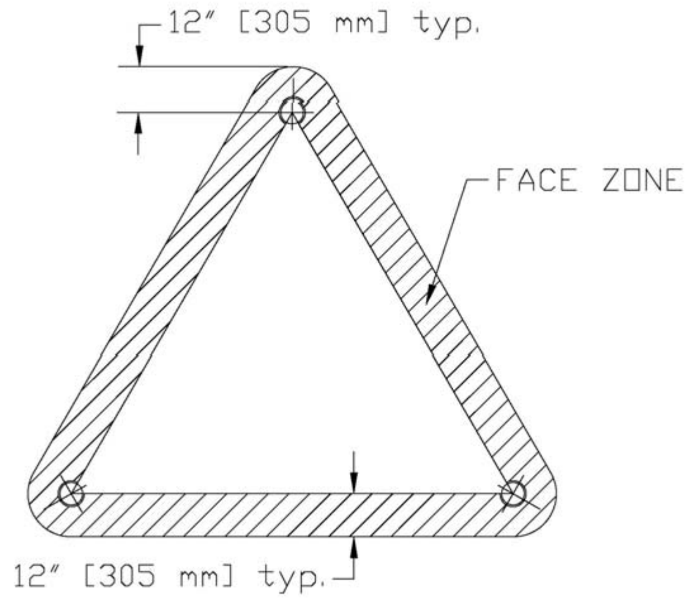


Figure 2-1: Projected Area of Ice

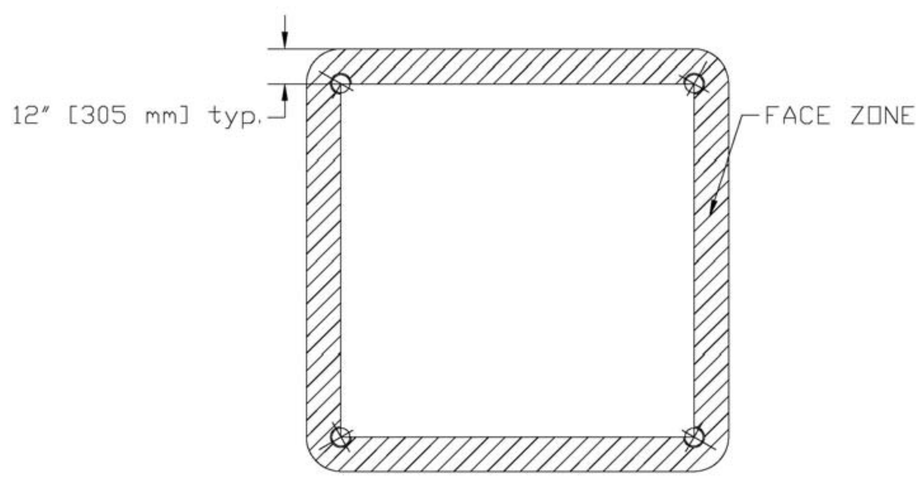


Note: D_c is the larger of D_{c1} and D_{c2}

Figure 2-2: Out-to-Out dimensions for Calculating Ice Weight

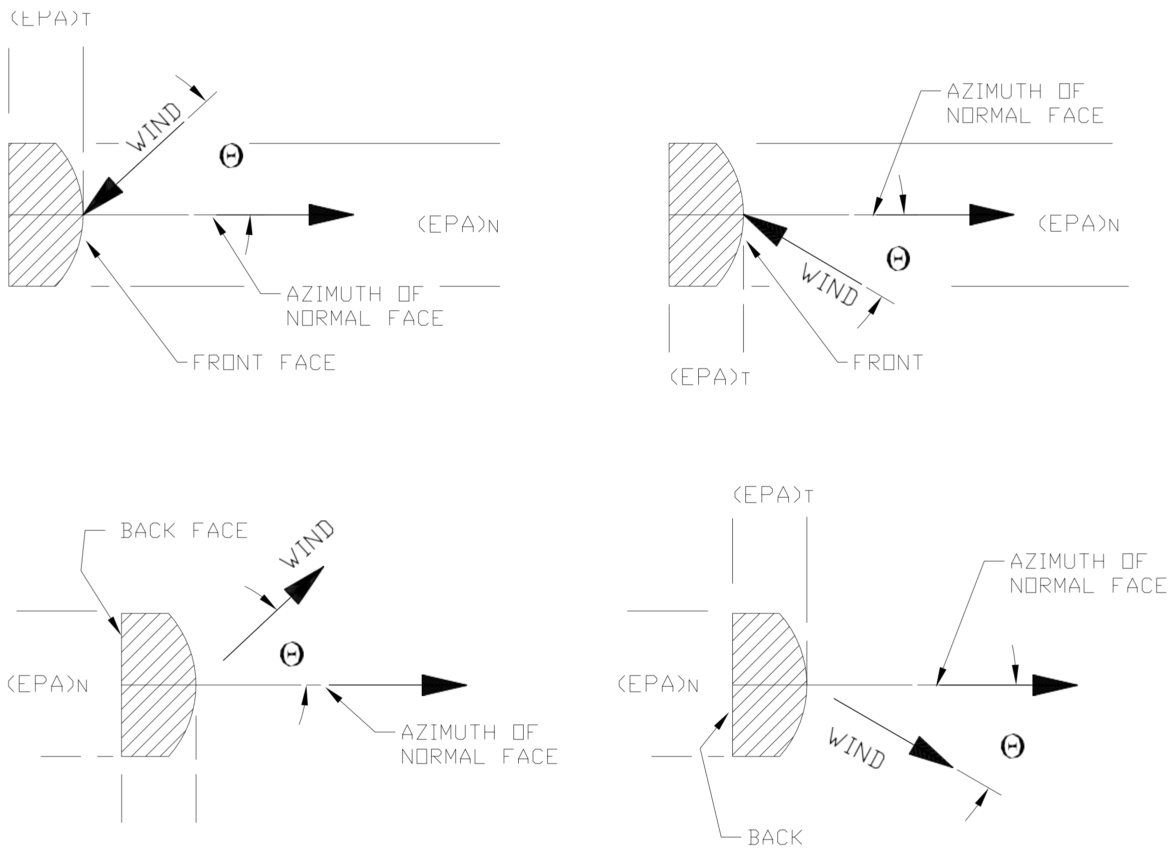


Triangular Cross-Section



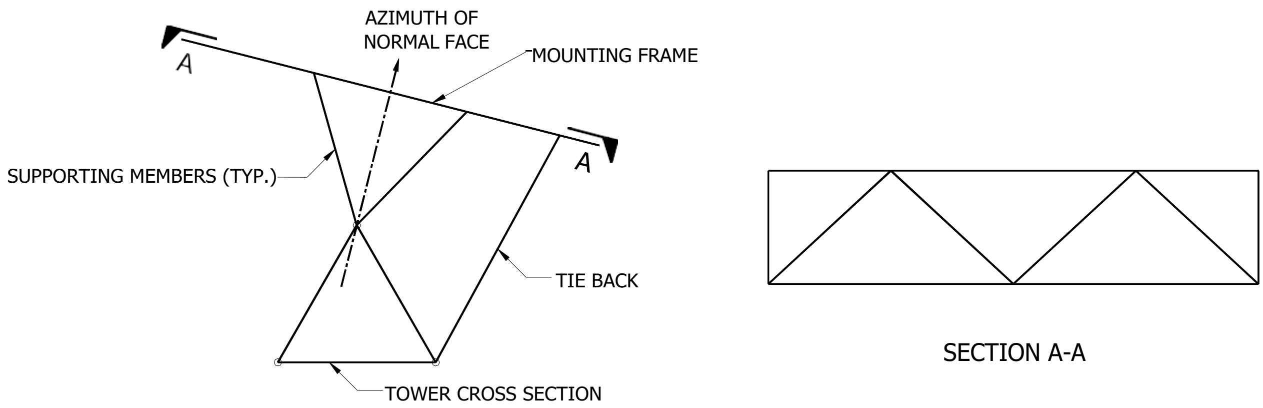
Square Cross-Section

Figure 2-3: Face Zone for Appurtenances

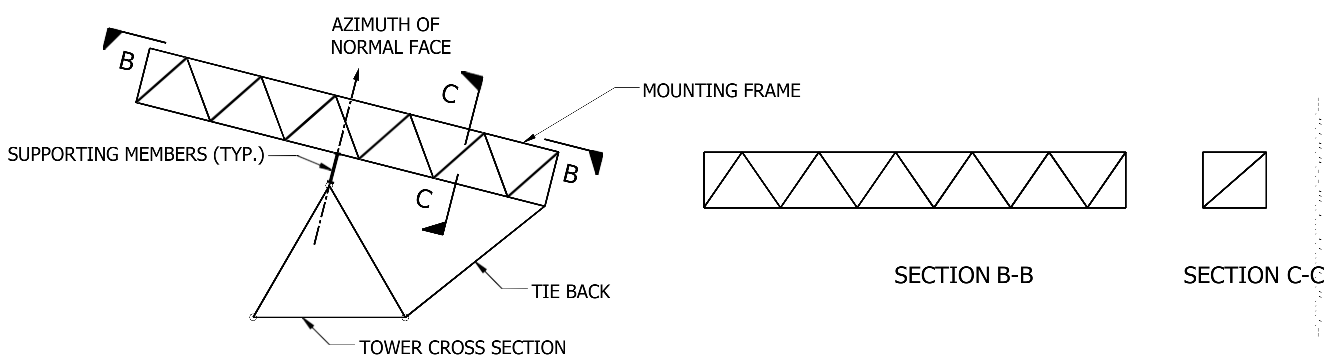


NOTE: $(EPA)_N$ AND $(EPA)_T$ REPRESENT THE EFFECTIVE PROJECTED AREAS OF THE APPURTENANCE FOR THE WINDWARD NORMAL AND TRANSVERSE FACES OF THE APPURTENANCE.

Figure 2-4: Wind Force on Appurtenances

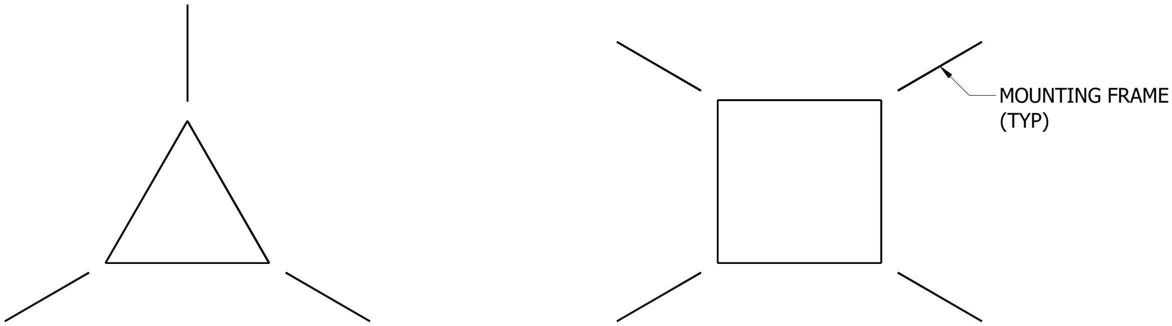


PLANE FRAME TYPE MOUNTING FRAMES

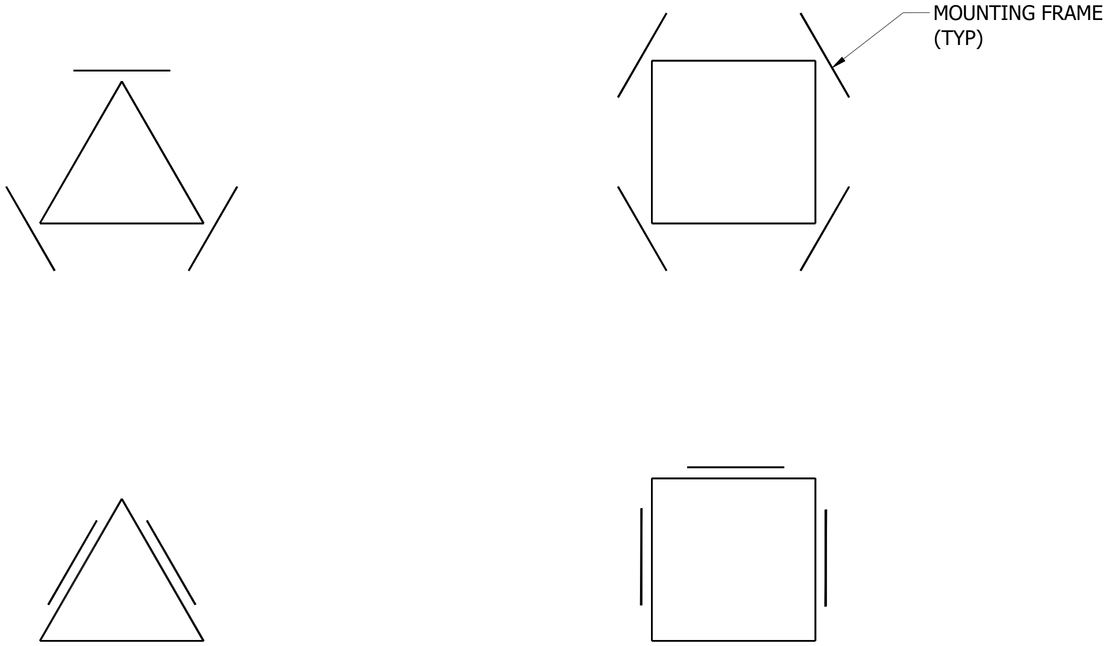


TRUSS TYPE MOUNTING FRAMES

Figure 2-5: Mounting Frames



0.75 REDUCTION FACTOR NOT ALLOWED



0.75 REDUCTION FACTOR APPLIES
(MINIMUM OF 3 MOUNTING FRAMES REQUIRED)

Figure 2-6: Multiple Mounting Frames

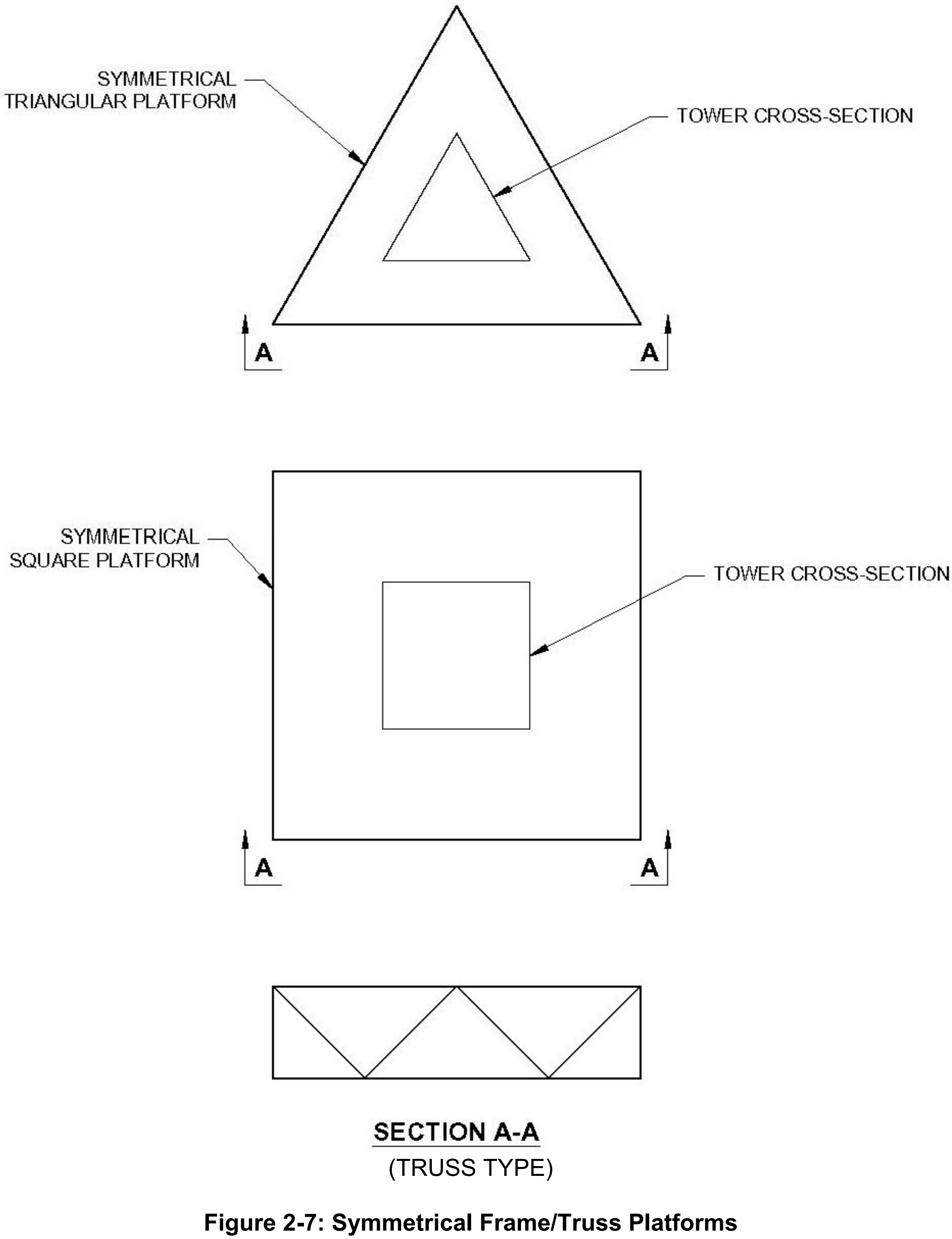


Figure 2-7: Symmetrical Frame/Truss Platforms

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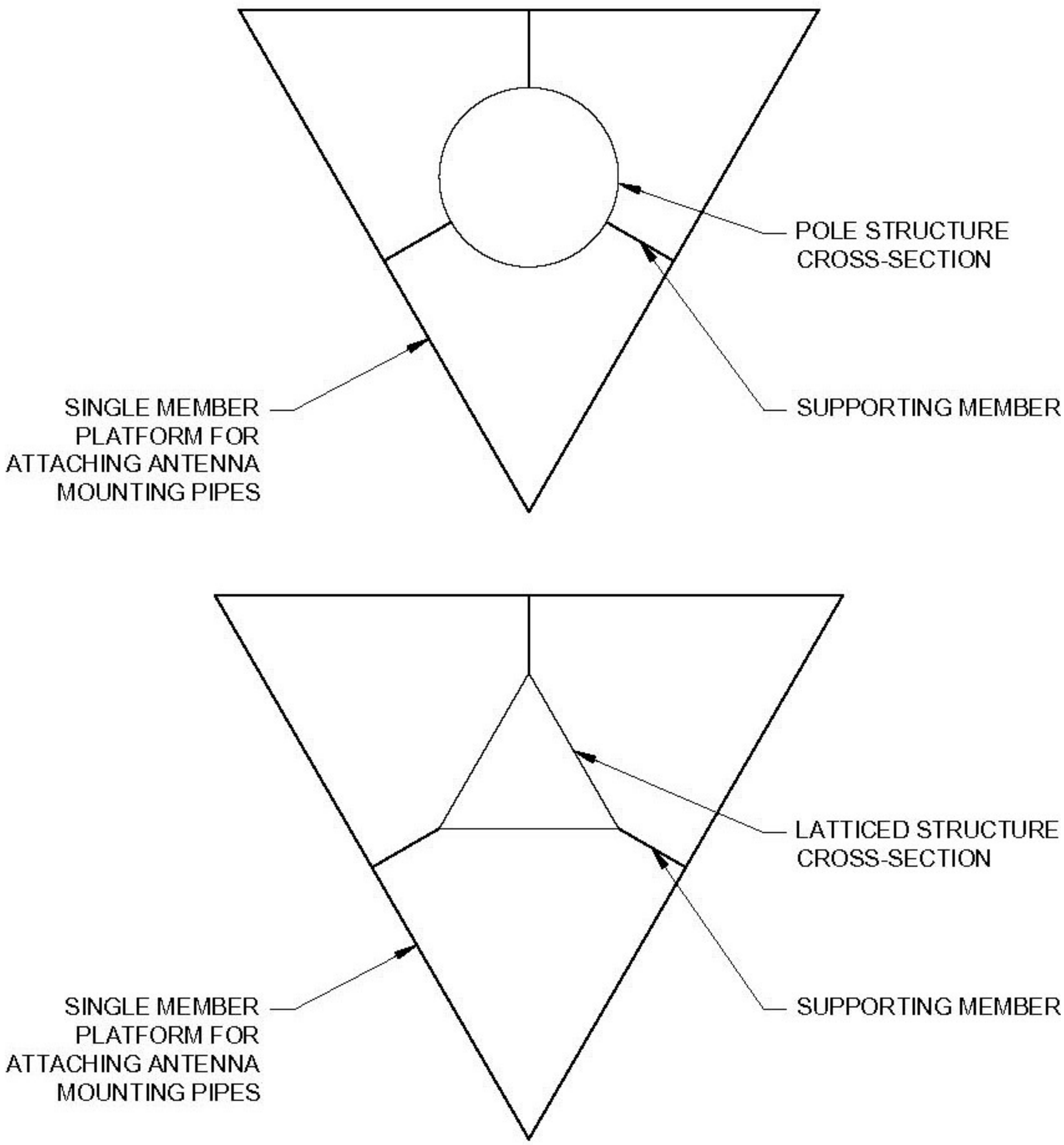

Figure 2-8: Low Profile Platforms

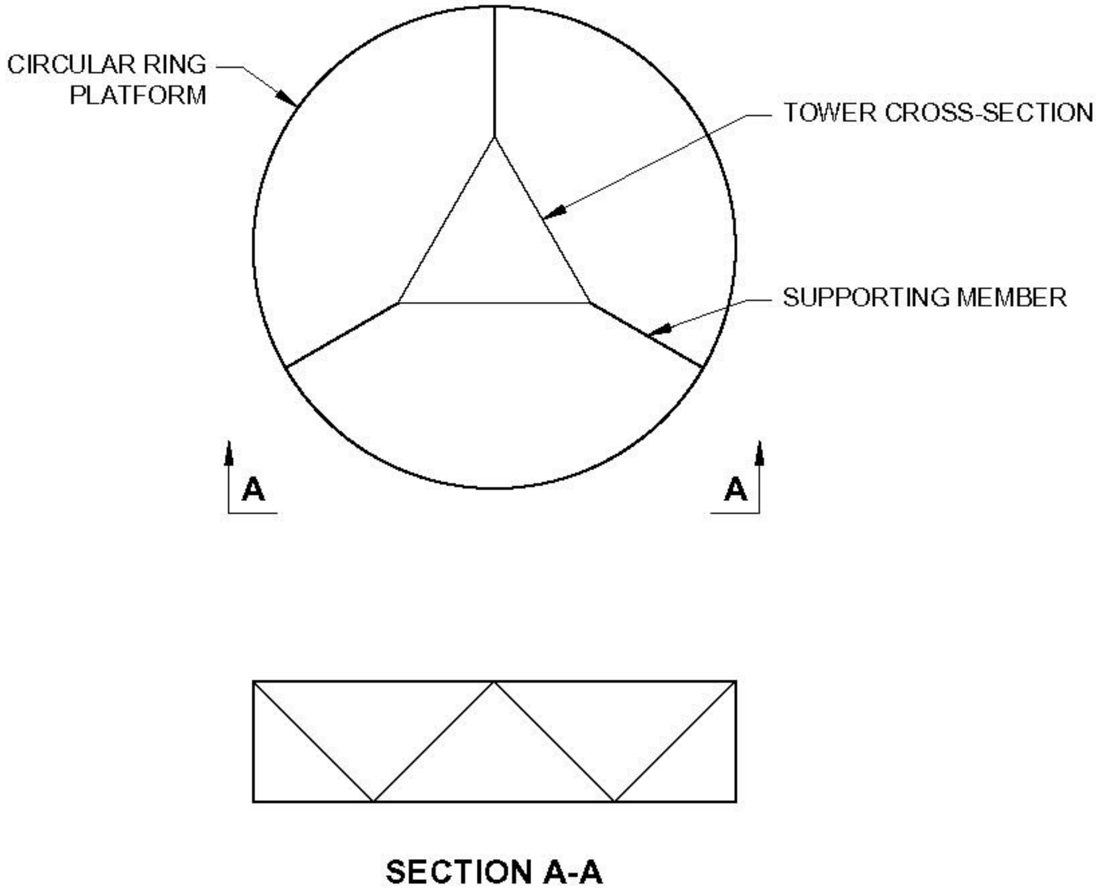

Figure 2-9: Circular Ring Platforms

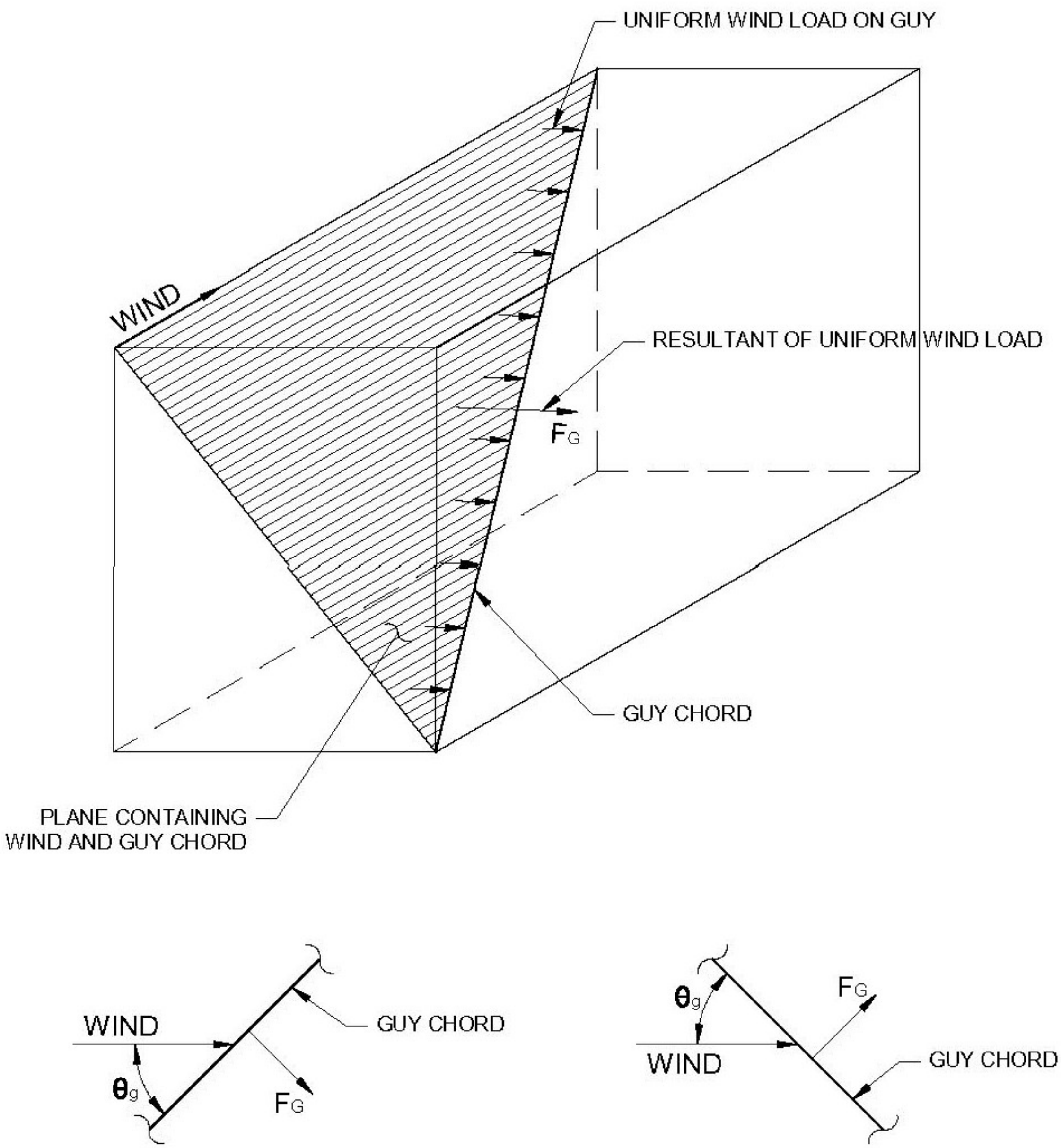

Figure 2-10: Wind Force on Guys

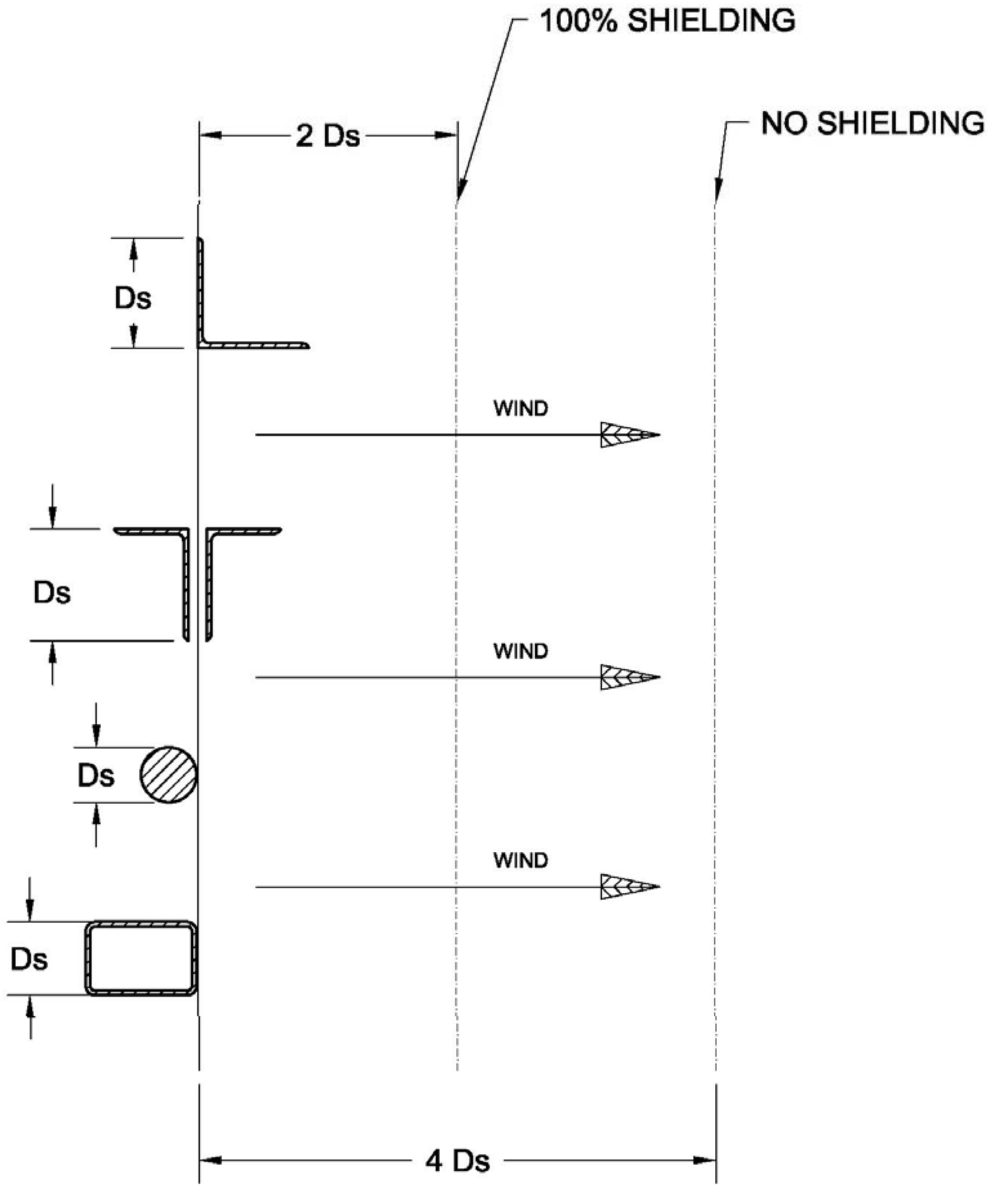

Figure 2-11: Shielding Limitations

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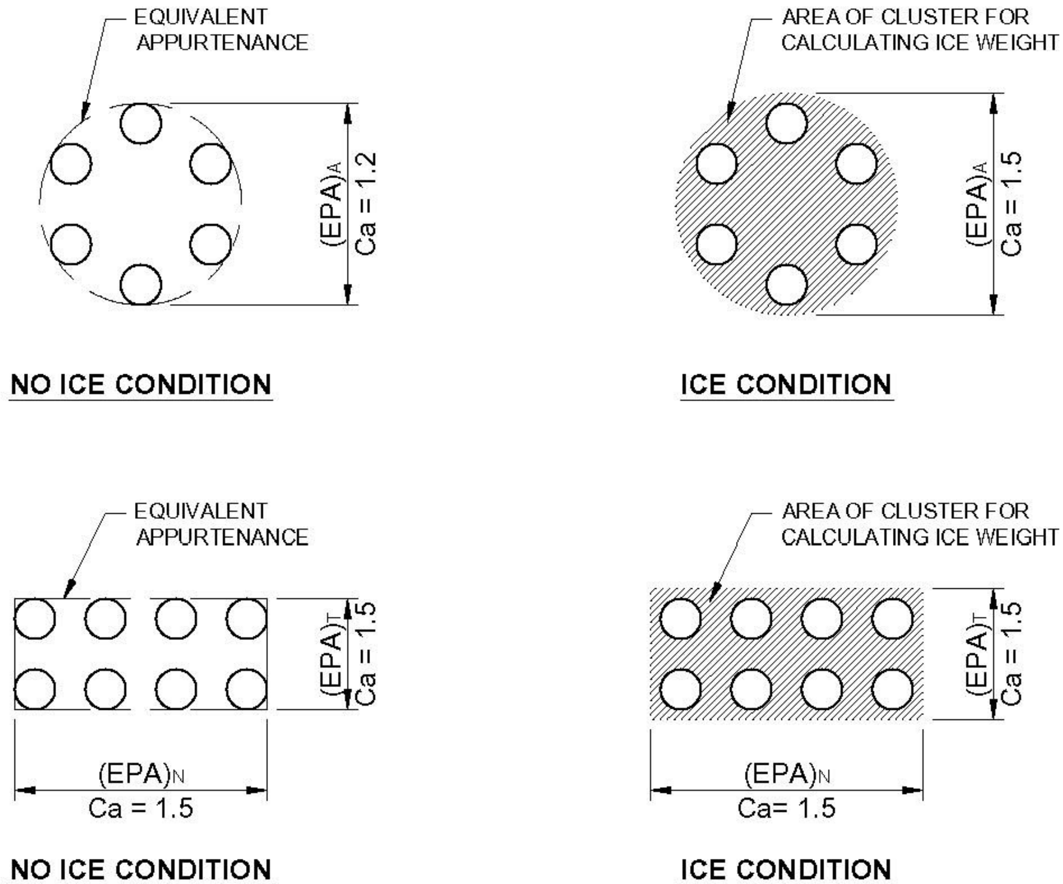


NOTE: $(EPA)_A$, $(EPA)_N$, AND $(EPA)_T$ REPRESENT THE EFFECTIVE PROJECTED AREAS OF THE EQUIVALENT APPURTENANCE BASED ON THE APPROPRIATE OUT-TO-OUT DIMENSION OF THE CLUSTER (INCLUDING ICE FOR LOADING COMBINATIONS THAT INCLUDE ICE).

Figure 2-12: Equivalent EPA of Transmission Line Clusters

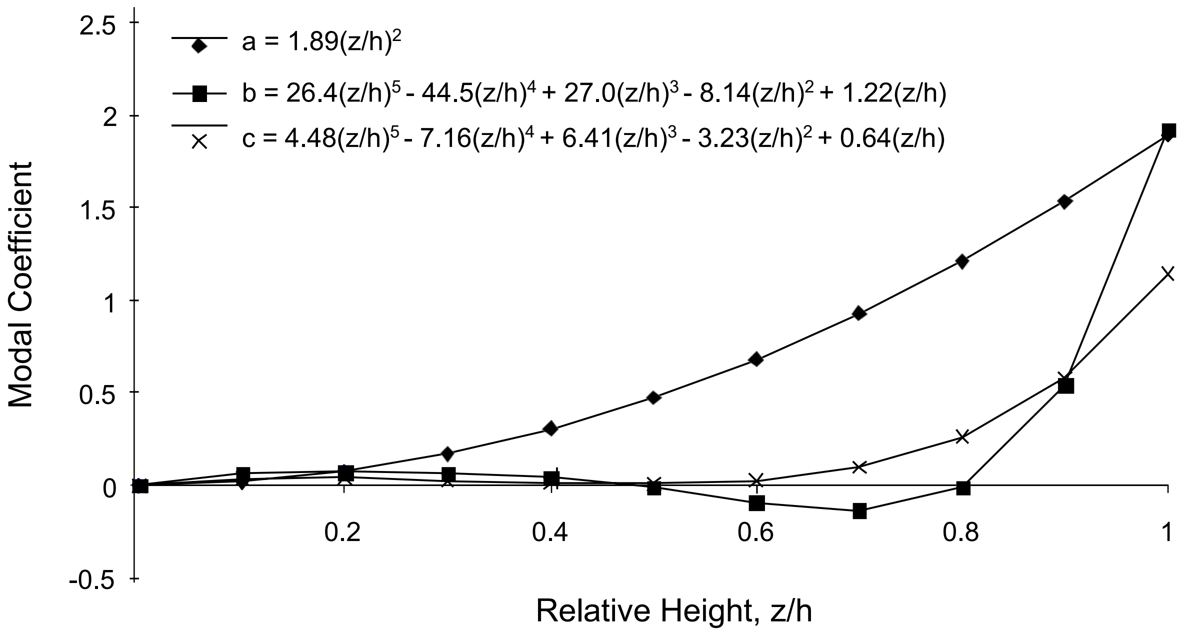


Figure 2-13: Equivalent Modal Coefficients, a,b & c

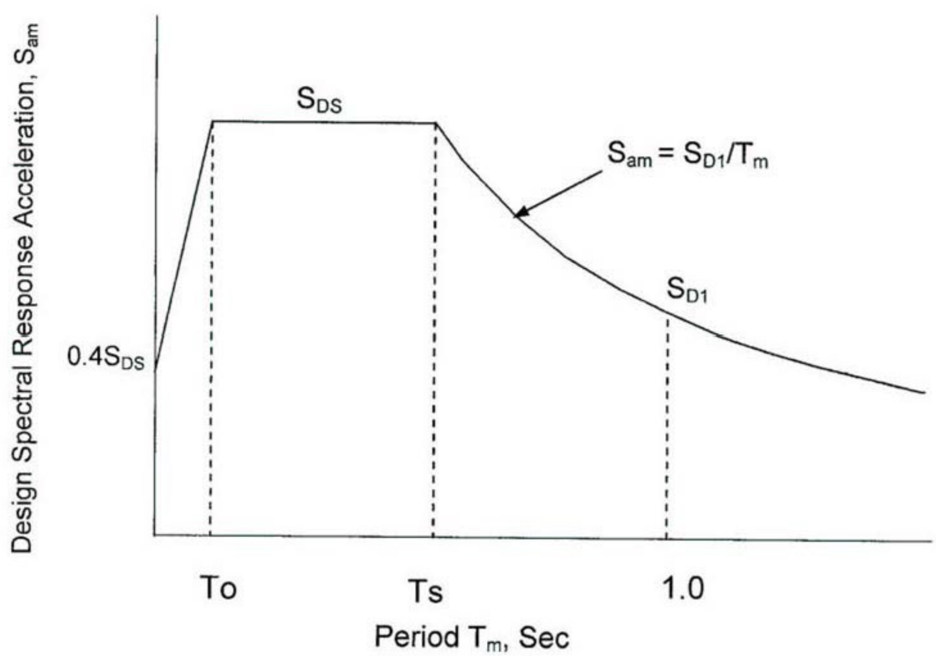


Figure 2-14: Design Response Spectrum

3.0 ANALYSIS

3.1 Scope

This section defines: (i) the minimum acceptable analysis models and techniques, and (ii) the requirements to account for the dynamic effects of wind gusts.

3.2 Definitions

For the purposes of this Standard, the following definitions apply.

Guyed mast: a latticed or pole structure with supporting guys.

Mast span: the distance between the base and the first guy level, the distance between two successive guy levels, or the distance above the top guy level to the top of the structure (cantilever span).

Mean wind conversion factor, m: a factor used to determine the mean hourly wind pressure.

3.3 Symbols and Notation

F_A = horizontal design wind force for appurtenances;
F_{ST} = horizontal design wind force on the structure;
f_{wi} = width of segment of structure;
h = height of a guyed mast ;
h_i = height of segment of structure;
m = mean wind conversion factor;
P-⊗ = effects of displacement on member forces;
q_z = velocity pressure.

3.4 Analysis Models

The minimum acceptable models of analysis are as follows:

(a) Self-Supporting Latticed Towers

1. An elastic three-dimensional truss model made up of straight members pin connected at joints producing only axial forces in the members.

2. An elastic three-dimensional frame-truss model where continuous members (legs, K-type bracing horizontals without plan bracing) are modeled as 3-D beam elements producing both moments and axial forces in the members while the remaining members which are subjected primarily to axial loads may be modeled as 3-D truss elements producing only axial forces in the members.

(b) Self-Supporting Pole Structures

An elastic three-dimensional beam-column model producing moments, shears and axial forces in the pole structure. Unless the analysis model considers second order effects within each element, the minimum number of beam elements shall be equal to five per pole section and the maximum beam element length shall not exceed 6 ft [1.8 m]
Note: Due to modeling complexity (e.g. meshing, element interconnection, …) of plate or shell models, the stresses obtained from such models shall not be less than the stresses obtained from the beam-column model noted above.

(c) Guyed Masts

1. An elastic three-dimensional beam-column where the mast is modeled as equivalent three-dimensional beam-column members supported by cables represented either as non-linear elastic supports or cable elements. This analysis produces moments, shear and axial forces in the mast, which results in individual member forces.

2. An elastic three-dimensional truss model where individual members of the mast are modeled as straight members connected at joints producing only axial forces in the members. The cables are represented as cable elements.

3. An elastic three-dimensional frame-truss model where continuous members (legs) of the mast are modeled as 3-D beam elements producing both moments and axial forces in the members while other members may be modeled as 3-D truss members. The cables are represented as cable elements.

3.4.1 Application of wind forces to Latticed Structures

The horizontal design wind force on the structure, F_{ST}, shall be equally distributed to each leg joint of the cross-section at the panel points for three-dimensional truss or frame-truss models.

The horizontal design wind force, F_A, for appurtenances shall be distributed to each leg joint according to the location of the appurtenance (i.e. lateral load and torsion considered).

Local bending shall be considered for structural components supporting appurtenances that are supported in the middle half of the component. For main bracing members, under this condition, local bending shall be considered for the condition of wind normal to the plane of the bracing members with no axial member load considered.

Note: Weight and earthquake forces shall be distributed and considered in a similar manner.

3.5 Displacement Effects

The analysis of all structures, except as provided herein, shall take into account the effects of displacements on member forces (P-⊗ effects). For guyed structures the effects of displacements of the guy points as well as the effects of displacements between guy points shall be considered. For finite element beam-column models, unless the analysis model considers second order effects within each element, the minimum number of beam elements between guy levels shall be equal to five. P-⊗ effects need not be considered for self- supporting latticed towers with heights less than 450 ft [137 m] provided that the height to face width ratios, h_i/f_{wi}, are less than 10 as shown in Figure 3-1.

3.6 Wind Loading Patterns

To account for the dynamic effects of wind gusts, the following wind loading patterns shall be considered for the strength limit state condition: (refer to Figures 3-2 and 3-3)

3.6.1 Latticed Self-Supporting Towers

When the apex defined by the projection of the inclined legs of a latticed self-supporting tower lies within the height of the tower (refer to Figure 3-2), the following wind loading patterns shall be investigated for load combination 1 as specified in 2.3.2 by varying the velocity pressure as follows:

1. Full velocity pressure over the entire height of the structure.

2. Full velocity pressure below the apex point and mean velocity pressure above the apex point.

3. Full velocity pressure above the apex point and mean velocity pressure below the apex point.

The mean velocity pressure shall be determined by multiplying the velocity pressure, (q_z per 2.6.9.6) by the mean wind conversion factor, m, from Table 3-1.

The above loading patterns shall apply for each apex point in towers with multiple legs slopes that differ by more than 1 degree in adjacent sections. All combinations of wind loading patterns shall be considered when determining maximum load effects.

3.6.2 Guyed Masts

For guyed masts with three or more spans and with at least one mast span greater than 80 feet [24 m] within the top one-third of the height of the structure, the following wind loading patterns (refer to Figure 3-3) shall be investigated for load combination 1 as specified in 2.3.2 by varying the velocity pressure as follows:

1. Full velocity pressure over the entire height of the structure. For masts greater than 450 feet [137 m] in height, full wind pressure over the entire structure need not be considered when pattern loading is investigated.

2. Mean velocity pressure on the top mast span and full velocity pressure on the remaining spans.

3. Mean velocity pressure on the second mast span from the top and full velocity pressure on the remaining spans.

4. Mean velocity pressure on the third mast span from the top and full velocity pressure on the remaining spans

The mean velocity pressure shall be determined by multiplying the velocity pressure, (q_z per 2.6.9.6) by the mean wind conversion factor, m, from Table 3-1. Full wind pressure shall be applied to guys for all pattern loadings.

Notes:

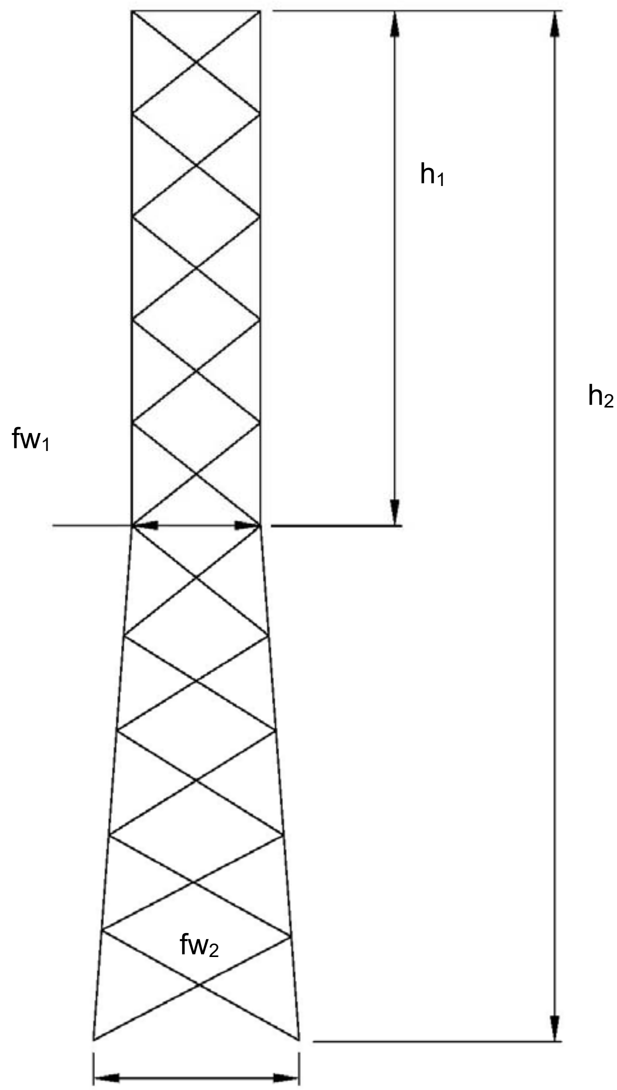
1. For masts with cantilevers (e.g. broadcast antenna structures, spines, or the mast itself), the cantilevers shall be considered as the top span.
2. For masts where the total length of the top three mast spans is less than one-third the height of the structure, the above wind loadings patterns shall be continued for each subsequent span until the total length of the considered spans is greater than one-third the height of the structure (refer to figure 3-3).
3. When the distance between two guy elevations is less than 3 times the larger face width between the guy elevations, the wind pressure patterns shall extend to the mid-point of the two guy elevations. The short span shall not be considered as an independent span for purposes of this section.

3.7 Mast Shear and Torsion Responses for Guyed Masts

For all latticed masts, the mast face shear in a non-cantilever span due to mast shear and torsion shall not be less than 40% of the maximum absolute value of the face shear in the span. For all tubular masts, the mast shear in a non-cantilever span shall not be less than 40% of the maximum absolute value of the shear in the span.

Table 3-1: Mean Wind Conversion Factor

Exposure Category	Mean Wind Conversion Factor (m)
B	0.55
C	0.60
D	0.65



Note: Max $\frac{\text{height}}{\text{face width}}$ ratio = max of $\frac{h_1}{fw_1}$ or $\frac{h_2}{fw_2}$

Figure 3-1: Height to Width Ratios

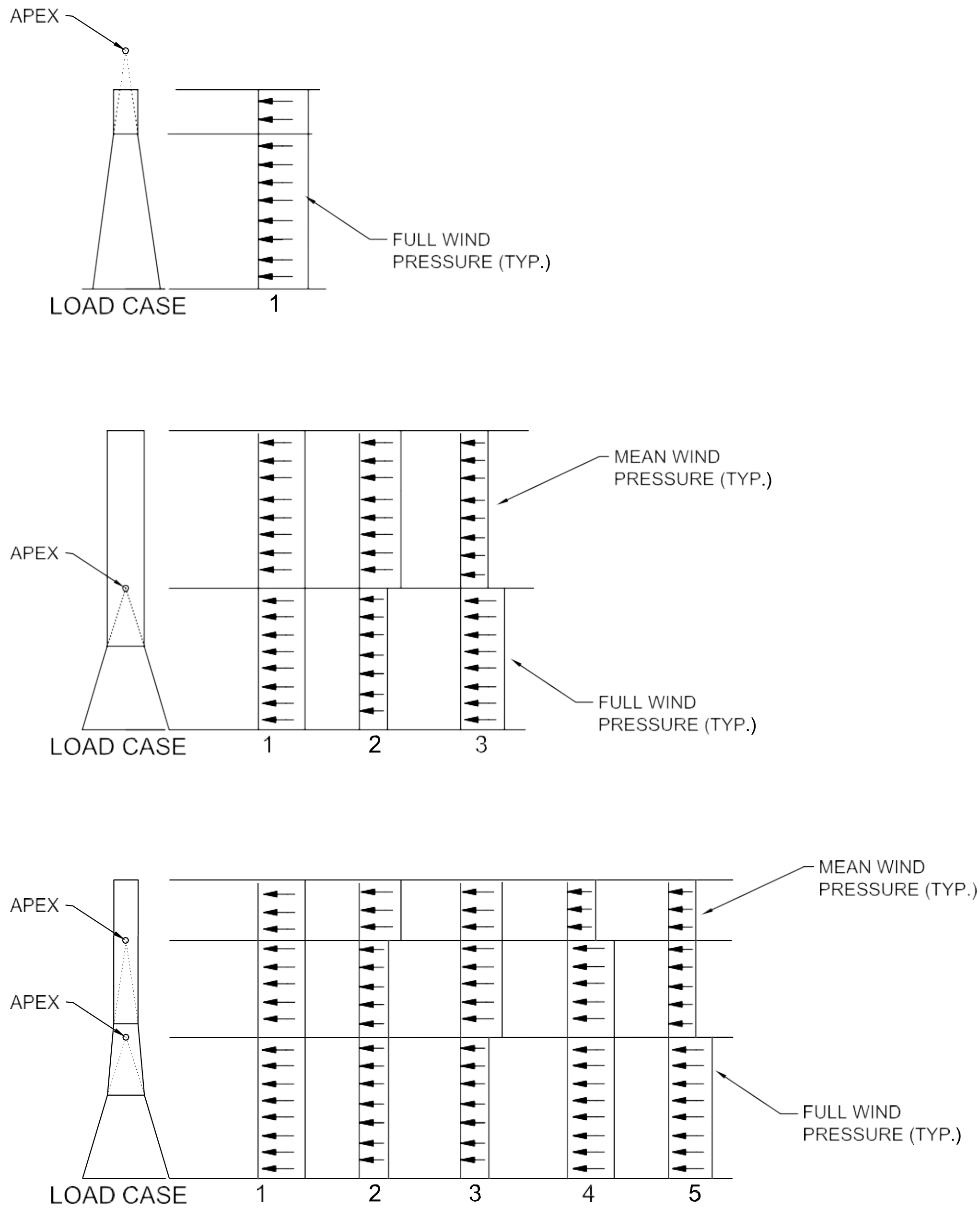


Figure 3-2: Pattern Loading for Self-Supporting Towers

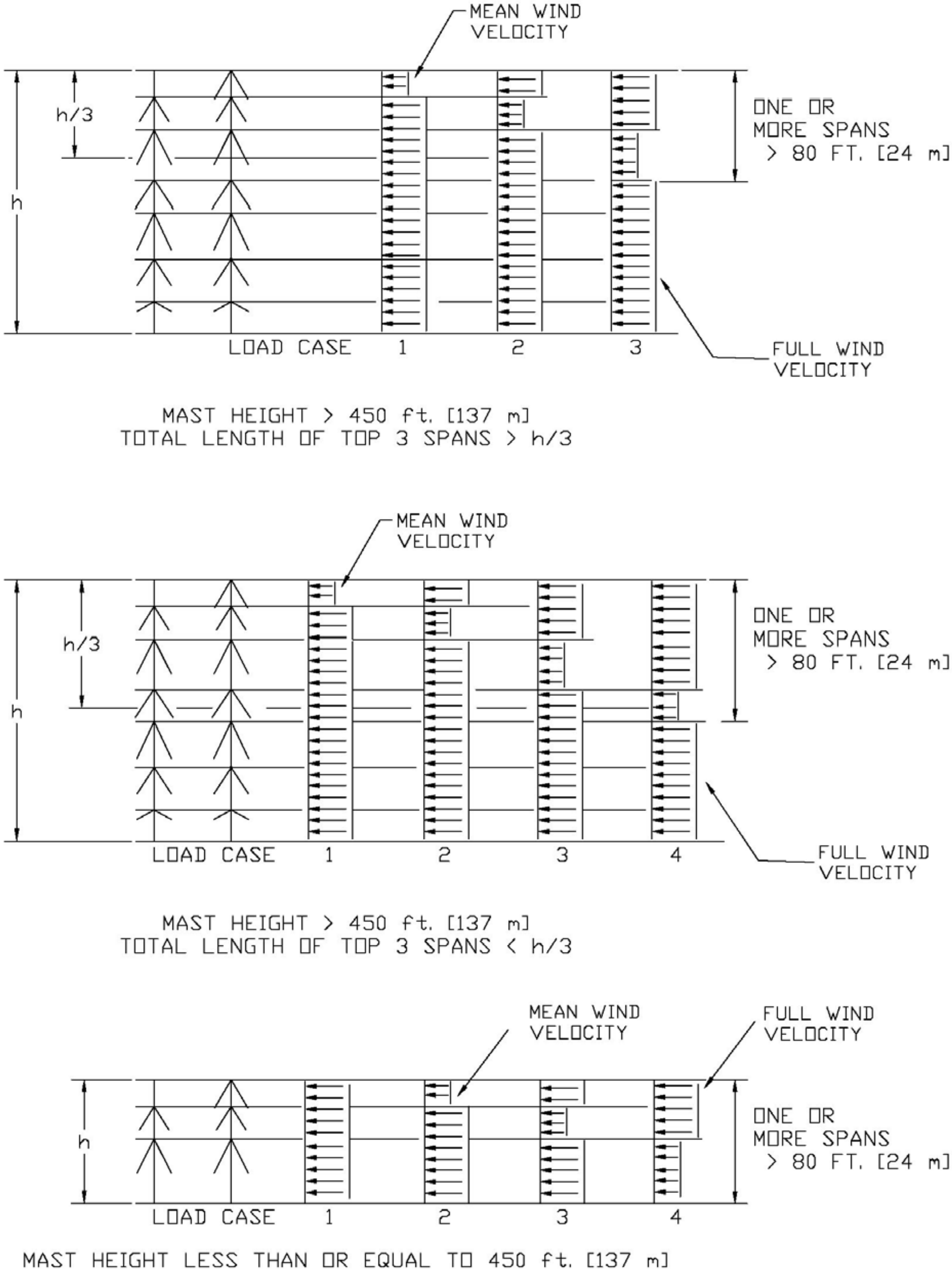


Figure 3-3: Pattern Loading for Guyed Masts

4.0 DESIGN STRENGTH OF STRUCTURAL STEEL

4.1 Scope

This section relates to the strength design of structural steel angles, solid rounds and tubular members used in latticed towers, poles and guyed masts. The following clauses are based on the AISC-LRFD-99. When the requirements in AISC-LRFD-99 differ from this Standard, this Standard shall govern. If other shapes or types of structures are utilized, the requirements of AISC-LRFD-99 shall be used.

Cold formed light gauge steel structural members not covered by this Standard shall conform to the requirements of AISI-2001 “North American Specification for the Design of Cold-formed Steel Structural Members”, hereafter referred to as the AISI Specification.

4.2 Definitions

Effective length factor: a factor, K, to modify the unbraced length, L, to take into account the structural configuration and end conditions.

Effective slenderness ratio: the slenderness ratio modified to take into account the structural configuration and end conditions for the purpose of calculating the design compression strength.

Line of action: a line that is parallel to the longitudinal axis of a member that passes through the centroid of the bolt group connecting the member to another member.

In-plane buckling: direction of buckling considered in plane defined by the face of a latticed structure.

Out-of-plane bucking: direction of buckling considered normal to the face of a latticed structure.

Panel points: the centerline location of bracing member connections to a leg.

Radius of gyration: the square root of the moment of inertia about the axis of buckling under consideration divided by the area of a member.

Slenderness ratio: the ratio of the unbraced length, L, to the corresponding radius of gyration, r.

Slip-critical connection: a bolted joint governed by shear using oversized or slotted holes parallel to the line of force.

Secondary members: members used primarily to reduce the unbraced length of a supported member.

Unbraced length: the length between panel points or nodes providing restraint, which may vary for different planes of buckling depending on the bracing pattern. For leg members, L shall not be less than the centerline distance between panel points. For bracing members, L shall not be less than the length between the centers of connecting bolt or weld patterns.

Weak axis buckling: direction of buckling considered about the weak principal axis of a member.

4.3 Symbols and Notations

α_i = separation ratio;
λ_c = column slenderness parameter;
η = coefficient of friction;
ϕ = resistance factor for connections;
ϕ_a = resistance factor for axial compression or tension;
ϕ_c = resistance factor for compression;
ϕ_f = resistance factor for flexure;
ϕ_n = resistance factor for yielding under normal stress;
ϕ_p = resistance factor for connecting elements;
ϕ_t = resistance factor for tension;
ϕ_T = resistance factor for torsion;
ϕ_v = resistance factor for shear;
A = A_n for bolted members, and A_g for welded members;
A_b = nominal unthreaded body area of bolt;
A_{en} = effective net area;
A_g = gross area of member;
A_{gt} = gross area subject to tension;
A_{gv} = gross area subject to shear;
A_n = net area of a member;
A_{nt} = net area subject to tension;
A_{nv} = net area subject to shear;
A_{pb} = projected bearing area of a link plate;
A_{sf} = effective shear area of a link plate;
a = shortest distance from the edge of the pin hole to the edge of the member measured parallel to the direction of the force;
a_i = distance between connectors;
$\frac{a_i}{r_{ib}}$ = slenderness ratio of individual components;
$\frac{a_i}{r_i}$ = largest slenderness ratio of individual components;
B_1 = moment amplification factor;
b = width of angle leg;
b_{eff} = effective edge distance of a link plate;
c = distance from neutral axis to extreme fiber;
D = outer diameter of tubular member;
d = nominal bolt or pin diameter;
E = modulus of elasticity of member;
F_{cr} = critical stress;
F_s = axial design compressive force in the supported member;
F_u = specified minimum tensile strength of the critical connected part;
F_{ub} = specified minimum tensile strength of bolt;
F_y = specified minimum yield strength;
F'_y = effective yield stress;
F'_{yf} = effective yield stress for flexural loading;
F''_y = effective yield stress based on lateral torsional buckling;
g = transverse center to center spacing (gage) between fastener gage lines;
h = distance between centroid of individual components of the built-up member;
I_w = moment of inertia about the major principal axis;
J = polar moment of inertia;

K = effective length factor;
KL/r = effective slenderness ratio;
$\left(\frac{KL}{r}\right)_o$ = effective slenderness ratio of built-up member acting as a unit;
$\left(\frac{KL}{r}\right)_m$ = modified effective slenderness ratio of built up member;
L = laterally unbraced length of member;
L_B = lateral unbraced Length;
L_T = torsional unbraced length
L/r = slenderness ratio of member;
L_c = clear distance, in direction of force, between edge of hole and edge of adjacent hole or edge of the material;
M_n = nominal flexural strength;
M_{nx} = nominal flexural strength about the x-axis;
M_{ny} = nominal flexural strength about the y-axis;
M_{nw} = nominal flexural strength about the major principal axis;
M_{nz} = nominal flexural strength about the minor principal axis;
M_u = flexural moment due to factored loads;
M_{uw} = flexural moment about the major principal axis due to factored loads;
M_{uz} = flexural moment about the minor principal axis due to factored loads;
N_t = flexural to torsional unbraced length ratio;
n = number of threads per unit of length;
P_e = elastic Euler buckling load;
P_l = nominal strength of a link plate;
P_n = nominal axial strength;
P_r = resistance required at a panel point within a face of a latticed structure;
P_s = minimum bracing resistance normal to the supported member;
P_u = axial compressive force due to factored loads;
r = governing radius of gyration about the axis of buckling;
r_i = minimum radius of gyration of an individual component of a built-up member;
r_{ib} = radius of gyration of individual component about its centroidal axis parallel to the axis of buckling under consideration for the built-up member;
r_x = governing radius of gyration about the x axis of buckling;
r_y = governing radius of gyration about the y axis of buckling;
r_z = governing radius of gyration about the z axis of buckling;
R_n = nominal bearing strength at bolt or attachment holes;
R_{np} = nominal strength of connecting element;
R_{nt} = nominal tensile strength of bolt or anchor rod;
R_{nv} = nominal shear strength of bolt or anchor rod;
S = minimum elastic section modulus;
S_w = elastic section modulus to the leg tip about the major principal axis;
S_z = elastic section modulus to the leg tip about the minor principal axis;
s = longitudinal center to center spacing (pitch) of any two consecutive holes;
T_n = nominal torsional strength;
T_u = torsional moments due to factored loads;
T_{ub} = bolt tensile force due to factored loads;
t = thickness of the member or of the critical connected part;
U = reduction factor for effective net area calculation;
V_n = nominal shear strength;
V_{ub} = bolt shear force due to factored loads;
V_u = transverse shear force due to factored loads;
W_n = net width of the part;

w = width of flat element of a member;
x = connection eccentricity;
Z = plastic section modulus.

4.4 General

4.4.1 Minimum Bracing Resistance

In order to consider a reduction in the unbraced length of a supported member at a node or panel point, bracing and secondary members shall provide a minimum resistance, P_s, normal to the supported member (in both directions) in the plane of buckling under consideration. P_s shall be determined in accordance with the following:

$$P_s = [1.5 + \frac{(\frac{KL}{r} - 60)}{60}] \frac{F_s}{100}$$

$$1.5\frac{F_S}{100} \leq P_s \leq 2.5\frac{F_S}{100}$$

where:

F_s = axial design compressive force in the supported member

KL/r = effective slenderness ratio of the supported member in the plane of buckling under consideration

The resistance required for leg members at a panel point within a face of a tower, P_r, shall be determined from Table 4-1.

The minimum required design strengths of multiple members connecting at a panel point within a face shall be determined from Table 4-2.

A secondary diagonal member that is connected to either end of a horizontal secondary member shall have a minimum design strength equal to one-half of the required design strength of the horizontal divided by the cosine of the angle between the members (refer to Table 4-2) unless a more rigorous analysis is performed.

Note: the minimum resistance, P_s need not be considered in conjunction with any loading combination.

4.4.2 Slenderness Ratios

The slenderness ratio, L/r, shall preferably not exceed:

(a) 150 for leg members,
(b) 200 for main compression members other than leg members,
(c) 250 for secondary members, and
(d) 300 for tension members, except for tension rod bracing and cables.

4.4.3 Design Values for Yield and Tensile Strength

For design purposes, the minimum nominal values for the yield strength and ultimate tensile strength for the type and grade of steel specified shall be used.

4.4.4 Normal Framing Eccentricities

4.4.4.1 Leg Members

Eccentricities shall be considered unless the following conditions are met:

(a) For solid round and tubular leg members, the lines of action of the bracing members meet at a point within the diameter of the leg.
(b) For angle leg members, the lines of action of the bracing members meet at a point within a distance equal to 75% of the angle width b, on either side of the centroid of the angle.
(c) For built-up leg members, the lines of action of the bracing members meet at a point within the cross-section of the built-up leg.

4.4.4.2 Bracing Members

The effective slenderness ratio formulas specified in 4.5.2 account for the effects of eccentric axial loading for angles connected by one leg with normal framing eccentricities. Normal framing eccentricity shall be defined as the condition where the centroid of the bolt or weld group is located between the heel of the angle and the centerline of the connected leg of the member. When a joint eccentricity exceeds this condition, the bracing member resistance shall be multiplied by the factor b/2g, where “b” is the width of the connected leg and “g”, is the distance from the heel of the angle to the centroid of the connection. If the width of the connected leg is 3 in. [76 mm] or less or the slenderness ratio, L/r, is greater than 120, the reduction factor need not be applied.

For tubular and other shapes, which have similar eccentric connections to angles, the same effective slenderness ratio formulas given in 4.5.2 shall be used.

4.5 Compression Members

4.5.1 Leg Members

The effective slenderness ratios, KL/r, for leg members shall be as provided in Table 4-3. The minimum effective length factor, K, shall be equal to 1.0 for latticed structures.

4.5.2 Bracing Members

The effective slenderness ratios, KL/r, for bracing members shall be determined taking into account the loading condition, bracing pattern, member end restraints and framing eccentricities. Effective slenderness ratios, (KL/r), shall be determined from Table 4-4, except for round members welded directly to leg members where the effective length factors, K, shall be taken from Table 4-5. Effective lengths and slenderness ratios for commonly used bracing patterns are shown in Tables 4-6 and 4-7. Effective length, L, shall be the distance between the centroids of the end connections.

A single bolt shall not be considered as providing partial restraint against rotation. It is permissible to consider a multiple bolt or welded connection to provide partial restraint if the connection is to a member capable of resisting rotation of the joint.

A multiple bolt or welded connection made only to a gusset plate without also being connected directly to the member providing restraint (i.e. leg member) shall not be considered to provide partial restraint in the out-of-plane direction.

4.5.2.1 Cross Bracing

The crossover point when connected shall be considered to provide support resisting out-of-plane buckling under any one of the following conditions:

(a) One of the diagonal members is continuous and the force in the tension member is at least 20 % of the force in the compression member.
(b) Triangulated horizontal plan bracing (Fig. 4-2) is provided at the intersection point with sufficient resistance as defined in 4.4.1.
(c) A continuous horizontal member meeting the following criteria is connected at the crossover point:
   i. The continuous horizontal has sufficient strength to provide resistance to the leg as defined in 4.4.1.
   ii. The strength of the continuous horizontal is determined ignoring the out-of- plane buckling resistance of the diagonals.

Otherwise, the crossover point shall not be considered as providing support resisting out-of-plane buckling. (Refer to Table 4-6).

When there are no diagonal members continuous through the crossover point, either of the following conditions shall be satisfied:

(d) Triangulated horizontal plan bracing with sufficient resistance as defined in 4.4.1 is provided at the crossover point.
(e) A continuous horizontal with sufficient strength as defined in (c) above is provided through the crossover point.

4.5.2.2 K-Type or Portal Bracing

Triangulated plan bracing shall be provided at the bracing apex point with sufficient resistance as defined in 4.4.1 when the horizontal member is not a continuous member.

When triangulated plan bracing is not provided with a continuous horizontal, the out-of-plane unbraced length of the horizontal shall be considered to be 0.75 times the total length of the horizontal. The horizontal member shall have sufficient strength to provide strength to the legs as defined in 4.4.1 determined using the full length of the horizontal. (Refer to Table 4-7).

4.5.2.3 Cranked K Type or Portal Bracing

Triangulated internal hip bracing, with sufficient resistance as defined in 4.4.1, shall be provided at the main diagonal bend. (Refer to Figure 4-1).

4.5.3 Built-Up Members

Individual components of built-up members composed of two or more shapes shall be connected to one another at intervals, a_i, such that the maximum slenderness ratio (a_i/r_i) of each of the component shapes between the connectors does not exceed 100% of the governing effective slenderness ratio of the built-up member.

A minimum of two bolts shall be used at each intermediate connector point when the connected width (i.e. connected leg width of a double angle) of a compression member exceeds 4 in. [102 mm].

For buckling modes that involve relative deformations that produce shear forces in the connectors (e.g. buckling about the axis parallel to the back-to-back legs for double angles), the effective slenderness ratio shall be modified by the following equations:

(a) For end conditions that are welded or fully-tensioned bolted (70% of the ultimate tensile bolt strength), or with two or more snug-tight bolted connectors:

i. For intermediate bolted connectors that are snug-tight:

$$\left(\frac{KL}{r}\right)_m = \sqrt{\left(\frac{KL}{r}\right)_o^2 + \left(\frac{a}{r_i}\right)^2}$$

ii. For intermediate connectors that are welded or fully-tensioned bolted according to AISC-LRFD-99:

$$\left(\frac{KL}{r}\right)_m = \sqrt{\left(\frac{KL}{r}\right)_o^2 + 0.82\frac{\alpha_i^2}{\left(1+\alpha_i^2\right)}\left(\frac{a}{r_{ib}}\right)^2}$$

where:

$\left(\frac{KL}{r}\right)_o$ = effective slenderness ratio of built-up member acting as a unit

$\left(\frac{KL}{r}\right)_m$ = modified effective slenderness ratio of built up member

$\frac{a_i}{r_i}$ = largest slenderness ratio of individual components

$\frac{a_i}{r_{ib}}$ = slenderness ratio of individual components relative to its centroidal axis parallel to the axis of buckling under consideration for the built-up member

a_i = distance between connectors

r_i = minimum radius of gyration of individual component

r_{ib} = radius of gyration of individual component about its centroidal axis parallel to the axis of buckling under consideration for the built-up member

α_i = separation ratio = $h/2r_{ib}$

h = distance between centroid of individual components perpendicular to the axis of buckling under consideration for the built-up member

(b) For end conditions that use a single snug-tight connector:

$$\left(\frac{KL}{r}\right) = L/r_{ib}$$

When lacing is used to connect built-up compression members consisting of two or more components, the lacing shall be triangulated and extend the full length of the member. Built-up compression members without triangulated lacing shall be modeled as a Vierendeel truss considering combined bending and axial forces in accordance with 4.8. The design strength of the bracing system shall be capable of providing the resistance, P_s, as required in 4.4.1.

4.5.4 Design Compression Strength

4.5.4.1 Effective Yield Stress

For 60° and 90° angle members, the effective yield stress for axial compression, F'_y, shall be determined as follows:

$w/t < 0.47\sqrt{\frac{E}{F_y}}$ $\qquad F'_y = F_y$

$0.47\sqrt{\frac{E}{F_y}} < w/t < 0.85\sqrt{\frac{E}{F_y}}$ $\qquad F'_y = \left[1.677 - 0.677\left(\frac{w/t}{0.47\sqrt{E/F_y}}\right)\right]F_y$

$0.85\sqrt{\frac{E}{F_y}} < w/t < 25$ $\qquad F'_y = [0.0332\,\pi^2\,E/(w/t)^2]$

The width to thickness ratio (w/t) shall not exceed 25 for angle members (refer to Figure 4-3).

For solid round members, the effective yield stress, F'_y, shall be equal to F_y.

For tubular round members, the diameter to thickness ratio (D/t) shall not exceed 400. The effective yield stress, F'_y, shall be determined as follows:

$D/t \le 0.114\,E/F_y$ $\qquad F'_y = F_y$

$0.114\,E/F_y < D/t \le 0.448\,E/F_y$ $\qquad F'_y = \left(\frac{0.0379E}{(D/t)F_y} + \frac{2}{3}\right)F_y$

$0.448\,E/F_y < D/t \le 400$ $\qquad F'_y = \frac{0.337E}{(D/t)}$

where:

D = outer diameter of tubular member
t = wall thickness of tubular member

E = Elastic modulus of the tubular member

For polygonal tubular steel members, the maximum width to thickness ratio (w/t) and effective yield stress, F'_y, shall be determined from Table 4-8.

For other shapes, the effective yield stress, F'_y, shall be determined in accordance with AISC-LRFD-99 Chapter B.

4.5.4.2 Design Axial Strength

The design axial strength of compression members shall be taken as $\phi_c P_n$:

$$\phi_c = 0.85$$

$$P_n = A_g F_{cr}$$

(a) For $\lambda_c \leq 1.5$

$$F_{cr} = (0.658^{\lambda_c^2})F'_y$$

(b) For $\lambda_c > 1.5$

$$F_{cr} = \left(\frac{0.877}{\lambda_c^2}\right)F'_y$$

where:

$$\lambda_c = \frac{KL}{r\pi}\sqrt{\frac{F'_y}{E}}$$

A_g = gross area of member, in^2 [mm^2]

F'_y = effective yield stress, ksi [MPa]

E = modulus of elasticity, ksi [MPa]

K = effective length factor

L = laterally unbraced length of member, in. [mm]

r = governing radius of gyration about the axis of buckling, in. [mm]

Section E3 of AISC-LRFD-99 for flexural torsional buckling need not apply to single or double angle members of either 90 degree or 60 degree cross sections.

4.6 Tension Members

4.6.1 Built-up Members

The longitudinal spacing of connectors between components of built-up members composed of two or more shapes, shall preferably limit the slenderness ratio in any component between the connectors to 300.

4.6.2 Tension-Only Bracing Members

Welded end tabs for tension-only bracing members shall be detailed to develop the design strength of the member based on yielding of the gross section of the member. The member shall be detailed with draw such that the member is in tension when installed.

4.6.3 Design Tensile Strength

The design axial tensile strength, $\phi_t P_n$, of a member shall be taken as the lesser of yielding in the gross section, rupture in the net effective section, or block shear rupture.

For tension yielding in the gross section:

$\phi_t = 0.80$ for guy anchor shafts

$\phi_t = 0.90$ for other members

$P_n = F_y A_g$

For tension rupture in the effective net section:

$\phi_t = 0.65$ for guy anchor shafts

$\phi_t = 0.75$

$P_n = F_u A_{en}$

For block shear rupture:

$\phi_t = 0.65$ for guy anchor shafts

$\phi_t = 0.75$ for other members

when: $F_u A_{nt} \geq 0.6 F_u A_{nv}$

$P_n = 0.6 F_y A_{gv} + F_u A_{nt} \leq 0.6F_uA_{nv}+F_uA_{nt}$

when: $0.6 F_u A_{nv} > F_u A_{nt}$

$P_n = 0.6 F_u A_{nv} + F_y A_{gt} \leq 0.6F_uA_{nv}+F_uA_{nt}$

where:

A_g = gross area

A_{en} = effective net area

A_{gv} = gross area subject to shear

A_{gt} = gross area subject to tension

A_{nv} = net area subject to shear

A_{nt} = net area subject to tension

4.6.3.1 Net Area

The net area of a member, A_n, shall be taken as the sum of the products of the thickness and the net width of each element computed as follows:

In computing the net area of the section, the width of the bolt hole shall be taken as 1/16 in. [2 mm] greater than the nominal dimension of the hole.

For a chain of holes extending across a part in any diagonal or zigzag line, the net width of the part, W_n, shall be obtained by deducting from the gross width the sum of the diameters or slot dimensions of all holes in the chain, and adding, for each gage space in the chain, the quantity s^2 / 4g in accordance with the following:

$$A_n = W_n\, t + (s^2\, t) / (4g)$$

where:

s = the longitudinal center to center spacing (pitch) of any two consecutive holes.

g = the transverse center to center spacing (gage) between fastener gage lines.

4.6.3.2 Effective Net Area

When a tension force is transmitted directly to each of the member's cross-sectional elements by fasteners or welds, the effective net area, A_{en}, is equal to the net area A_n.

When a tension force is transmitted by fasteners or welds through some, but not all of the cross-section elements of the member, the effective net area, including shear lag effects shall be taken as:

$$A_{en} = A\, U$$

where:

A = A_n for bolted members, and A_g for welded members

U = a reduction factor = $1 - x/L_c$ where $0.75 \leq U \leq 0.9$

x = connection eccentricity (distance from the outer face of the connected element to the centroid of the member)

L_c = length of the connection in the direction of loading (center to center of outside holes or the length of weld in the direction of loading).

Notes:
1) For single bolted members U shall be equal to 0.75.
2) Alternatively, when the outstanding leg of a member is ignored in calculating A_n, U need not be less than 1.0.

4.7 Flexural Members

The design flexural strength shall be taken as, $\phi_f M_n$:

$\phi_f = 0.9$
M_n = nominal flexural strength

Note: Bracing members connected with normal framing eccentricities as defined in 4.4.4.2 need not be considered as flexural members.

4.7.1 Solid Round Members

For solid round members, M_n shall be determined as follows:

$M_n = F_y'Z$

where:

F_y' = effective yield stress as determined from 4.5.4.1

Z = plastic section modulus

4.7.2 Tubular Round Members

For tubular round members, the diameter to thickness ratio (D/t) shall not exceed 400. M_n shall be determined as follows:

$$\frac{D}{t} \le 0.0714\frac{E}{F_Y} \qquad M_n = F_y Z$$

$$0.0714\frac{E}{F_Y} < \frac{D}{t} \le 0.309\frac{E}{F_Y} \qquad M_n = \left[\frac{0.0207\,E}{(D/t)\,F_y} + 1\right] F_y S$$

$$0.309\frac{E}{F_Y} < \frac{D}{t} \le 400 \qquad M_n = \left[\frac{0.330\,E}{(D/t)}\right] S$$

where:

D = outer diameter of tubular member

t = wall thickness of tubular member

E = modulus of elasticity, 29,000 ksi [200,000 MPa]

S = elastic section modulus

Z = Plastic section modulus

4.7.3 Polygonal Tubular Members

For polygonal tubular members, M_n shall be determined as follows:

$M_n = F'_y S$

where:

F'_y = effective yield stress as determined from 4.5.4.1
S = minimum elastic section modulus

4.7.4 Single Equal Leg Angle Members

For 60° and 90° single angle members, bending shall be considered about the major and minor principal axes of the member.

4.7.4.1 Effective Yield Stress

Effective yield stress for flexural loading, F'_{yf}, based on local buckling shall be determined in accordance with the following:

$\frac{b}{t} \leq 0.54\sqrt{\frac{E}{Fy}}$ $\qquad F'_{yf} = 1.5\ Fy$

$0.54\sqrt{\frac{E}{Fy}} < \frac{b}{t} \leq .91\sqrt{\frac{E}{Fy}}$ $\qquad F'_{yf} = \left[1.5 - 0.93\left(\frac{b/t}{0.54\sqrt{\frac{E}{Fy}}} - 1.0\right)\right] Fy$

$\frac{b}{t} > 0.91\sqrt{\frac{E}{Fy}}$ $\qquad F'_{yf} = \frac{0.72E}{\left(b/t\right)^2}$

where:

b = width of angle leg

t = thickness of angle

E = modulus of elasticity, 29,000 ksi [200,000 MPa]

F_y = steel yield strength, ksi [MPa]

Effective yield stress, F''y, based on lateral torsional buckling shall be determined in accordance with the following:

$L_B < L_T$ $\qquad F''_y = \left[1.92 - 1.17\sqrt{N_t}\right] F_y$

$L_B \geq L_T$ $\qquad F''_y = \left(\frac{0.92}{N_t} - \frac{0.17}{N_t^2}\right) F_y$

where: $N_t = L_B / L_T$

L_B = lateral unbraced Length

$$L_T = \frac{Eb^3 t}{3F_y I_w}$$

I_w = moment of inertia about the major principal axis

Nominal Flexural Strength

$M_{nw} = F'_{yf} S_w$ or $F''_y S_w$ whichever is smaller

$M_{nz} = F'_{yf} S_z$ when leg tips are subjected to compression due to applied moment about the weak principal axis

$M_{nz} = 1.5 F_y S_z$ when leg tips are subjected to tension due to applied moment about the weak principal axis

where:

M_{nw} = nominal flexural strength about the major principal axis

M_{nz} = nominal flexural strength about the minor principal axis

S_z = elastic section modulus to the leg tip about the minor principal axis

S_w = elastic section modulus to the leg tip about the major principal axis

Bending about the major and minor axes shall be combined in accordance with 4.8.1.2.

4.7.5 Other Members

For other shapes, the design flexural design strength shall be determined in accordance with AISC-LRFD-99 Chapter F.

4.8 Combined Bending and Axial Forces

4.8.1 Latticed Structures

Factored moments, M_u, shall be multiplied by an amplification factor, B_1, in accordance with the following, to account for secondary moments in individual members:

B_1 = 1.0 when member displacement effects (P-delta) are considered or for tension members.

$B_1 = 0.85/ (1-P_u/P_e)$ for members whose ends are restrained or continuous (e.g. leg members).

$B_1 = 1.00/ (1-P_u/P_e)$ for members whose ends are unrestrained (e.g. bracing members).

where:

P_u = Axial compressive force due to factored load.

$P_e = \pi^2 EI / (KL)^2$

KL = laterally unbraced effective length of member in the direction of buckling under consideration

EI = flexural stiffness in the direction of buckling under consideration.

4.8.1.1 Solid and Tubular Round Members

Solid and tubular round members which are subjected to combined bending and axial force shall satisfy the following interaction equations:

(a) when $\frac{P_u}{\phi_a P_n} \geq 0.2$

$$\left|\frac{8}{9}\left(\left|\frac{P_u}{\phi_a P_n}\right| + \left|\frac{B_1 M_u}{\phi_f M_n}\right|\right)\right| \leq 1.0$$

but $\frac{P_u}{\phi_a P_n}$ shall not be greater than 1.0

(b) when $\frac{P_u}{\phi_a P_n} < 0.2$

$$\left|\frac{P_u}{2\phi_a P_n}\right| + \left|\frac{B_1 M_u}{\phi_f M_n}\right| \leq 1.0$$

$$\left|\frac{P_u}{\phi_n F_y A}\right| + \left|\frac{M_u}{\phi_f M_n}\right| \leq 1.0$$

where:

P_u = axial force due to factored loads

P_n = nominal axial strength

M_u = resultant flexural moment due to factored loads

M_n = nominal flexural strength

ϕ_a = 0.85 = resistance factor for axial compression
= 0.90 = resistance factor for axial tension

ϕ_n = 0.90 = resistance factor for yielding under normal stress

ϕ_f = 0.90 = resistance factor for flexure

4.8.1.2 Single Equal Leg Angle Members

Single Angle members subjected to combined bending and axial force shall satisfy the following interaction equations:

(a) when $\frac{P_u}{\phi_a P_n} \geq 0.2$

$$\frac{8}{9}\left(\left|\frac{P_u}{\phi_a P_n}\right| + \left|\frac{B_1 M_{uw}}{\phi_f M_{nw}}\right| + \left|\frac{B_1 M_{uz}}{\phi_f M_{nz}}\right|\right) \leq 1.0$$

but $\frac{P_u}{\phi_a P_n}$ shall not be greater than 1.0

(b) when $\frac{P_u}{\phi_a P_n} < 0.2$

$$\left|\frac{P_u}{2\phi_a P_n}\right| + \left|\frac{B_1 M_{uw}}{\phi_f M_{nw}}\right| + \left|\frac{B_1 M_{uz}}{\phi_f M_{nz}}\right| \leq 1.0$$

$$\left|\frac{P_u}{\phi_n F_y A}\right| + \left|\frac{M_{uw}}{\phi_f M_{nw}}\right| + \left|\frac{M_{uz}}{\phi_f M_{nz}}\right| \le 1.0$$

where:

P_u = axial force due to factored loads

P_n = nominal axial strength

M_{uw} = flexural moment about the major principal axis due to factored loads

M_{uz} = flexural moment about the minor principal axis due to factored loads

M_{nw} = nominal flexural strength about the major principal axis

M_{nz} = nominal flexural strength about the minor principal axis

ϕ_a = 0.85 = resistance factor for axial compression
= 0.90 = resistance factor for axial tension

ϕ_f = 0.90 = resistance factor for flexure

ϕ_n = 0.90 = resistance factor for yielding under normal stress

4.8.1.3 Other Members

For other shapes, combined bending and axial forces shall be investigated in accordance with AISC-LRFD-99 Chapter H.

4.8.2 Tubular Pole Structures

For tubular poles, the following interaction equation shall be satisfied:

$$\left(\frac{P_u}{\phi_C P_n}\right) + \left(\frac{M_u}{\phi_f M_n}\right) + \left(\frac{V_u}{\phi_v V_n} + \frac{T_u}{\phi_T T_n}\right)^2 \le 1.0$$

When $\left(\frac{T_u}{\phi_T T_n}\right)$ is greater than 0.2, M_n shall not exceed $F'_y S$.

where:

P_u = axial compressive force due to factored loads

P_n = nominal axial compressive strength = $(F'_y)(A)$

F'_y = effective yield stress determined from 4.5.4.1 for round poles or Table 4-8 for polygonal poles.

M_u = flexural moment due to factored loads

M_n = nominal flexural strength as per 4.7

V_u = transverse shear force due to factored loads

V_n = nominal shear strength= $0.5(F'_y)(A)$

S = minimum elastic section modulus

T_u = torsional moments due to factored loads

T_n = nominal torsional strength = $(F'_y)(J/c)$

J = polar moment of inertia

c = distance from neutral axis to extreme fiber

ϕ_c = 0.85 = resistance factor for axial compression

ϕ_f = 0.90 = resistance factor for flexure

ϕ_v = 0.90 = resistance factor for shear

ϕ_T = 0.90 = resistance factor for torsion

4.9 Connections

4.9.1 Bolts

ASTM A490 bolts and ASTM A325 bolts shall not be reused once they are placed in service and tensioned beyond 40 percent of their ultimate capacity.

Hot-dip (or mechanically) galvanized A490 bolts and hot-dip (or mechanically) galvanized A354 Gr. BD anchor rods shall not be used.
For all A325 bolt diameters, F_{ub}, equal to 120 ksi [818 MPa] shall be used to calculate design tensile and shear strengths.

4.9.2 Nut-Locking Devices

Bolts used to connect load-carrying members shall be provided with a nut-locking device or mechanism such as, but not limited to, lock nuts, lock washers, or palnuts, to prevent loosening, except as provided in 4.9.3.

4.9.3 Pre-tensioned Bolts

Slip-critical connections and connections subjected to tension where the applications of externally applied load results in prying action produced by deformation of the connected parts shall be made with high-strength bolts tightened to 70% of the ultimate tensile strength of the bolt. Nut-locking devices are not required for pre-tensioned bolts.

Exception: For tension connections, where it can be shown that the stiffness of the connected parts is sufficient to reduce prying forces to insignificance, tension connections may be made with high-strength bolts tightened to a snug-tight condition. Snug tight is defined as the tightness that exists as a result of a few impacts of an impact wrench or the full effort of a person using an ordinary spud wrench.

(Note: Contact surfaces for slip-critical connections shall not be oiled or painted and for galvanized material, the contact surfaces shall be prepared in accordance with AISC-LRFD-99).

4.9.4 Edge Distances

Table J3.4 of the AISC specification shall apply except at sheared edges, where the minimum edge distance shall be 1.5 times the bolt diameter.

The minimum spacing of bolts in a line is preferably 3 bolt diameters but shall not be less than 2 2/3 diameters.

4.9.5 Bearing Type Connections

High-strength bolts tightened to a snug-tight condition as defined in 4.9.3 are permissible for use in bearing-type connections. Bearing-type connections shall not be used with oversize or slotted holes parallel to the line of force for bolts loaded primarily in shear.

4.9.6 Connection Resistance

4.9.6.1 Design Tensile Strength

The design tensile strength of a single bolt or threaded part shall be taken as ϕR_{nt}

where:

$R_{nt} = F_{ub} A_n$

The net area, A_n, through the threaded portion of the bolt is given by:

$$A_n = \frac{\pi}{4}\left(d - \frac{0.9743}{n}\right)^2$$

where:

$\phi = 0.75$

F_{ub} = specified minimum tensile strength of bolt

d = nominal diameter of bolt

n = number of threads per unit of length

Alternatively, A_n may be considered as 0.75 A_b

where:

A_b = nominal unthreaded body area of bolt

4.9.6.2 Design Bearing Strength

The design bearing strength at bolt or attachment holes, ϕR_n, shall be taken as:

$$R_n = 1.2L_c tF_u \leq 2.4dtF_u$$

When slotted holes are used perpendicular to the line of force, ϕR_n shall be taken as:

$$R_n = 1.0L_c t\,F_u \leq 2.0dtF_u$$

where:

$\phi = 0.75$

L_c = clear distance, in the direction of the force, between the edge of the hole and the edge of an adjacent hole or edge of the material, in [mm].

F_u = specified minimum tensile strength of the critical connected part

d = nominal bolt diameter

t = thickness of the critical connected part

For multiple bolt connections, the bearing resistance shall be taken as the sum of the bearing resistances of the individual bolts.

4.9.6.3 Design Shear Strength

The design shear strength of a bolt, ϕR_{nv}, shall be taken as:

$\phi = 0.75$

(a) When threads are excluded from the shear plane:

$$R_{nv} = 0.5\,F_{ub}\,A_b$$

(b) When threads are included in the shear plane:

$$R_{nv} = 0.4\,F_{ub}\,A_b$$

where:

F_{ub} = Specified minimum tensile strength of bolt

A_b = nominal unthreaded area of bolt

Slotted holes must be perpendicular to the line of force.

4.9.6.4 Combined Shear and Tension

For bolts subjected to combined shear and tension, the following relationship shall be satisfied:

$$\left(\frac{V_{ub}}{\phi R_{nv}}\right)^2 + \left(\frac{T_{ub}}{\phi R_{nt}}\right)^2 \leq 1$$

where:

$\phi = 0.75$

V_{ub} = Bolt shear force due to factored loads

R_{nv} = Nominal shear strength of bolt

T_{ub} = Bolt tensile force due to factored loads

R_{nt} = Nominal tensile strength of bolt

4.9.6.5 Connecting Elements

The design strength of welded and bolted connecting elements, $\phi_p R_{np}$, shall be the lower value obtained according to limit state of yielding, rupture and block shear.

ϕ_p = 0.90 for yielding

ϕ_p = 0.75 for rupture

ϕ_p = 0.75 for block shear

(a) For tension yielding:

$R_{np} = F_y A_{gt}$

(b) For tension rupture:

$R_{np} = F_u A_{nt}$

(c) For shear yielding:

$R_{np} = 0.60F_y A_{gv}$

(d) For shear rupture:

$R_{np} = 0.60F_u A_{nv}$

(e) For block shear:

Refer to 4.6.3.

where:

A_{gv} = gross area subject to shear

A_{gt} = gross area subject to tension

A_{nv} = net area subject to shear

A_{nt} = net area subject to tension

Notes:

1. Refer to 4.6.3.1 for the determination of net area.
2. The width used to determine gross and net areas of connection plates shall not exceed the width at the end of the plate defined by spreading the applied force out from the start of the joint 30° to each side in the plate along the line of force.
3. The net area of a connection plate shall not be considered larger than 85% of the gross area.

4.9.7 Splices

Splices shall be designed to resist the maximum tensile, compressive and shear forces occurring at the splice.

For leg members of guyed towers, unless the additional guy rupture loading requirements of Annex E are satisfied for each guy, the leg splices shall develop a minimum design tensile strength equal to the lower of 33% of the design compression force at the splice or 500 kips [2200 kN].

When eccentricity of a joint exists, the additional forces introduced into the connection shall be considered.

4.9.7.1 Tubular Pole Structures

The design length of a slip type splice shall not be less than 1.5 times the inside width of the base of the upper section. The inside width shall be measured between flats for polygonal cross sections.

4.9.8 Guy Assembly Link Plates

The design strength of a link plate, ϕP_l, shall be taken as the lowest value of:

(a) Tension on the effective area:

$\phi = 0.75$ $\quad$ $P_l = 2\, t\, b_{eff}\, F_u$

(b) Shear on the effective area:

$\phi = 0.75$ $\quad$ $P_l = 0.6\, A_{sf}\, F_u$

(c) Bearing on the projected area at the pin:

$\phi = 0.75$ $\quad$ $P_l = 1.8\, A_{pb}\, F_y$

(d) Yielding on the gross area:

$\phi = 0.90$ $\quad$ $P_l = A_g\, F_y$

where:

a = the shortest distance from the edge of the pin hole to the edge of the member measured parallel to the direction of the force

A_{pb} = projected bearing area

$A_{sf} = 2\, t\, (a + d/2)$

b_{eff} = 2 t + 0.625 in. [2 t + 16 mm], but not more than the actual distance from the edge of the pin hole to the edge of the part measured in a direction normal to the applied force.

d = the pin diameter

t = the thickness of the plate

The pin hole shall be located midway between the edges of the member in the direction normal to the applied force. The width of the plate beyond the pin hole shall not be less than 2 b_{eff} + d and the minimum extension, a, beyond the bearing end of the pin hole, parallel to the axis of the member, shall not be less than 1.33 b_{eff}.

The corners beyond the pin hole, are permitted to be cut at 45 degrees to the axis of the member, provided the net area beyond the pin hole, on an plane perpendicular to the cut, is not less than that required beyond the pin hole parallel to the axis of the member.

Note: The 1/32 in. [1 mm] oversize pinhole diameter specified in AISC does not apply.

4.9.9 Anchor Rods

For anchor rods, the following interaction equation shall be satisfied:

$$\left(\frac{P_u + \frac{V_u}{\eta}}{\phi R_{nt}} \right) \leq 1$$

where:

ϕ= 0.75

P_u = tension force for detail types (a), (b) & (c) and larger of compression or tension force for type (d) as depicted in Figure 4-4.

V_u = shear force (direct shear and torsion components) corresponding to P_u

R_{nt} = nominal tensile strength of anchor rod as per 4.9.6.1

η = 0.90 for detail type (a)
= 0.70 for detail type (b)
= 0.55 for detail type (c)
= 0.40 for detail type (d)

For detail type (d), when the clear distance from the top of concrete to the bottom leveling nut exceeds 1.5 times the diameter of the anchor rod, the following interaction equation shall also be satisfied:

$$\left(\frac{V_u}{\phi R_{nv}} \right) + \left(\frac{P_u}{\phi R_{nt}} \right) + \left(\frac{M_u}{\phi R_{nm}} \right)^2 \leq 1$$

where:

M_u = bending moment corresponding to V_u
= 0.65 $l_{ar} V_u$

l_{ar} = length from top of concrete to bottom of anchor rod leveling nut

R_{nv} = nominal shear strength of anchor rod as per 4.9.6.3

R_{nm} = nominal flexural strength of anchor rod in accordance with 4.7.1 using the tensile root diameter for the determination of z

d_{rt} = tensile root diameter of rod
= d – 0.9743/n

d = nominal rod diameter

n = number of threads per unit of length.

4.9.10 Welded Connections

Welded connections shall conform to AISC-LRFD Chapter J.

4.9.10.1 Tubular Pole Structures

Longitudinal seam welds for tubular pole sections shall have 60 percent minimum penetration, except in the following areas where the longitudinal seam welds shall be complete penetration or full fusion through the full cross-section:

(a) Longitudinal seam welds within 6 in. [150 mm] of circumferential welds or flange or base plates.

(b) Outside (female) section longitudinal seam welds in the slip splice area for a minimum distance equal to the maximum lap dimension plus 6 in. [150 mm].

Transverse seam welds shall be complete penetration or full fusion through the full cross-section.

Base plate to pole shaft welds shall be complete penetration welds. Alternatively pole shafts may be inserted into flanges or base plates and connected with inner and outer fillet welds.

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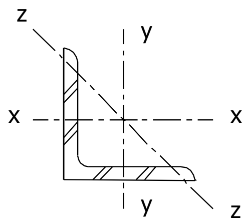
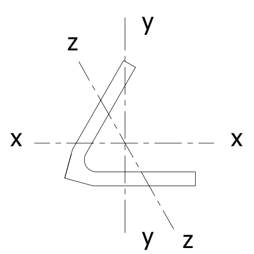
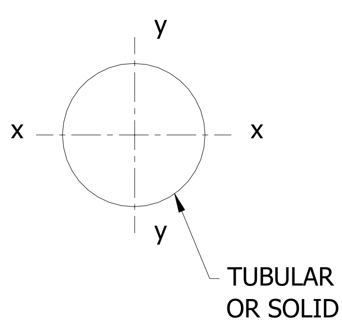
Table 4-1: Bracing Resistance Required for Leg Members

Leg Shape	Tower Cross Section	Bracing Resistance, P_r, Required in a Face at a Panel Point
	Square	When weak-axis buckling (KL/r_z) governs: $P_r = P_s / (2 \times 0.707) = 0.707\ P_s$ When in-plane buckling (KL/r_x or KL/r_y) governs: $P_r = P_s$
 Note: $r_x > r_y > r_z$	Triangular	When weak-axis buckling (KL/r_z) governs: $P_r = P_s / (2 \times 0.866) = 0.577\ P_s$ When in-plane buckling (KL/r_y) governs: $P_r = P_s$ When out-of-plane buckling (KL/r_x) governs: $P_r = P_s / (0.866) = 1.15\ P_s$
	Square	In-plane buckling (KL/r_x or KL/r_y) governs $P_r = P_s$
	Triangular	Out-of-plane buckling (KL/r_x) governs $P_r = P_s / (0.866) = 1.15\ P_s$

Notes:

1. Alternatively, P_r may be determined using the worse case effective slenderness ratio (highest ratio) to determine P_s and multiplying the result by 1.15 for triangular cross sections or by 1.00 for square cross sections.

2. One value of P_r applies for both faces when investigating a segment of a leg. The larger value shall be used considering the leg segment above and below a panel point.

3. Weak-axis buckling governs angle legs for symmetrical bracing patterns. In-plane, out-of-plane or weak-axis buckling may govern staggered bracing patterns.

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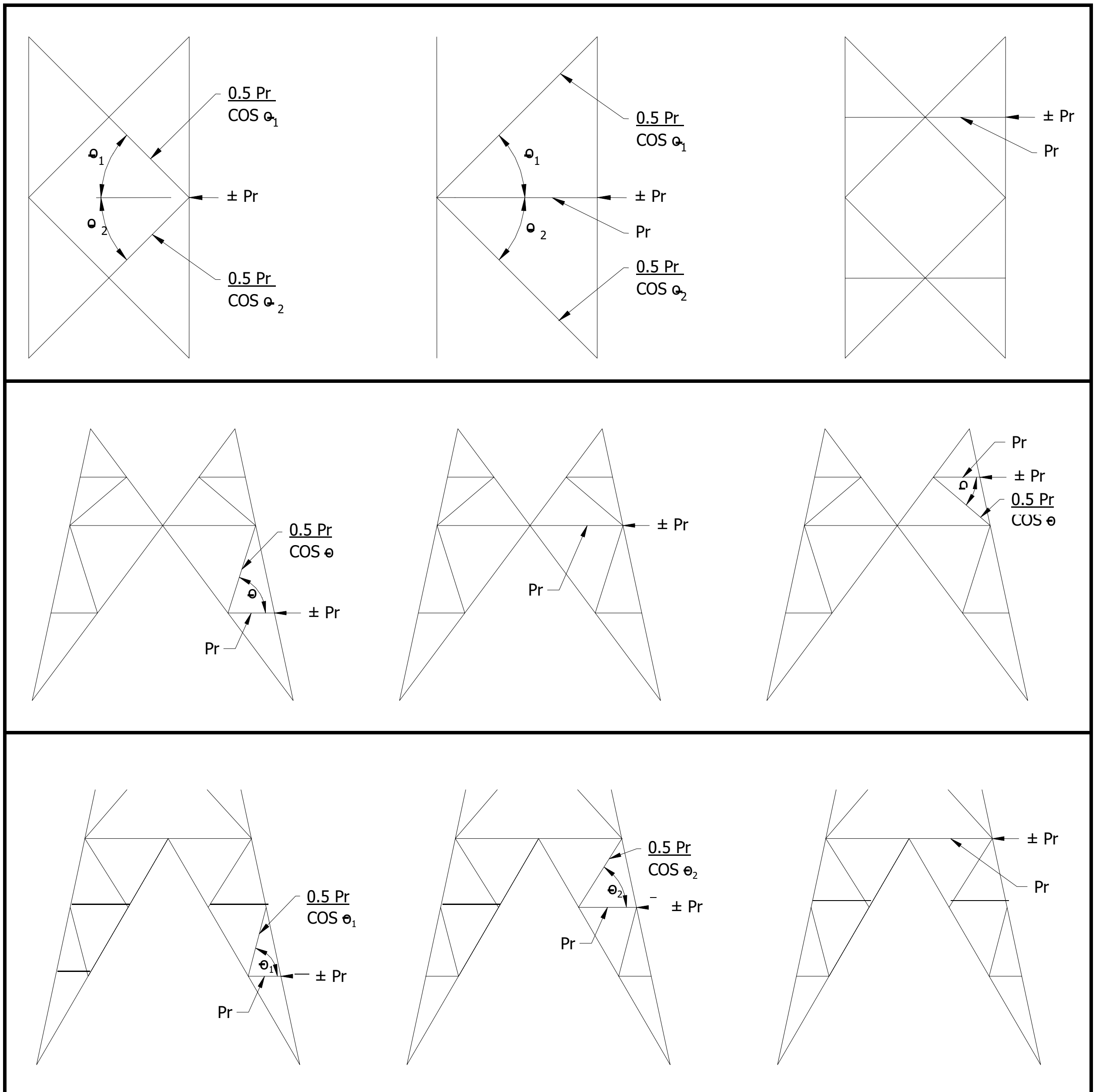
Table 4-2: Minimum Required Resistance at Panel Points



Notes:

1. For leg slopes greater than 15 degrees from vertical, P_r shall be divided by the cosine of the leg slope.

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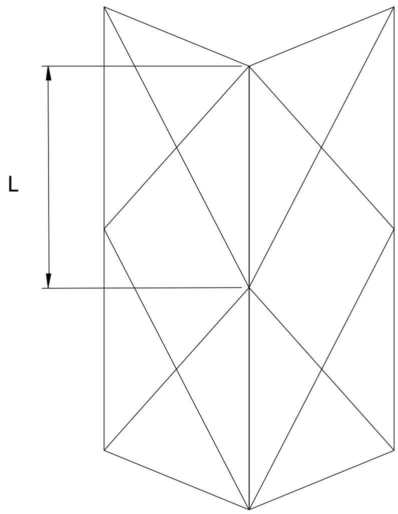
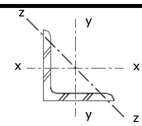
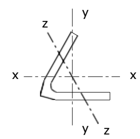
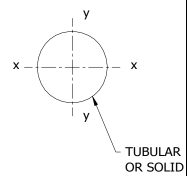
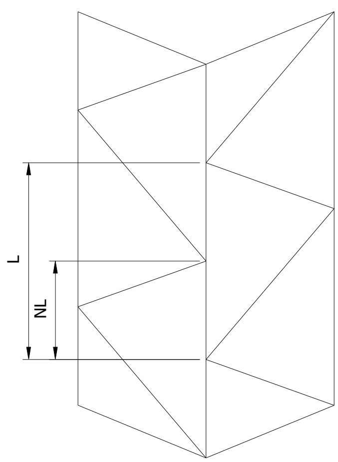
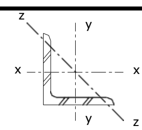
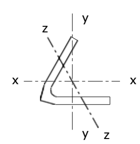
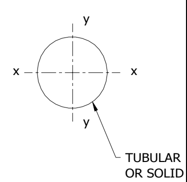
Table 4-3: Effective Slenderness Ratios for Leg Members

Symmetrical Bracing Patterns		
	Leg Shapes	Effective Slenderness Ratios K = 1.0
		$\frac{KL}{rz}$
		$\frac{KL}{rz}$
		$\frac{KL}{rx}$
Staggered Bracing Patterns		
 N ≥ 0.5	Leg Shapes	Effective Slenderness Ratios K = 1.0
		$\frac{KL}{rx}, \frac{KL}{ry}, \left(\frac{(1+2N)}{3}\right)\frac{KL}{rz}$
		$\frac{KL}{rx}, \frac{KL}{ry}, \left(\frac{(1+2N)}{3}\right)\frac{KL}{rz}$
		$\frac{KL}{rx}$

Notes:
1. L shall equal the panel spacing measured along the axis of the leg.
2. The maximum effective slenderness ratio shall be used to determine the design compression strength and the bracing resistance required to provide lateral support.

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Table 4-4: Effective Slenderness Ratios for Bracing Members

Slenderness Ratios < 120, Eccentricity Governs		
Formula Number	Equation	Conditions at Ends of the Buckling Length Under Consideration
1	KL / r = L / r	Concentric at both ends
2	KL / r = 30 + 0.75 L / r	Concentric at one end and normal framing eccentricity at the other end
3	KL / r = 60 + 0.50 L / r	Normal framing eccentricity at both ends
Concentric Conditions	Double angles or channels Round members with concentric end plate	
Normal Framing Eccentricity Conditions	Single angles or channels Round members with eccentric end plate Round members with flattened ends	

Slenderness Ratios ≥ 120, Restraint Governs		
Formula Number	Equation	Conditions at Ends of the Buckling Length Under Consideration
4	KL / r = L / r	Unrestrained against rotation at both ends
5	KL / r = 28.6 + 0.762 L / r	Partially restrained at one end and unrestrained at other end
6	KL / r = 46.2 + 0.615 L / r	Partially restrained against rotation at both ends
Unrestrained Conditions	Single bolt connections	
Partially Restrained Conditions	Multiple bolt or welded connections to a stiffer member / component or group of members / components	

Notes:
1. Formula 2 applies to single angles in cross bracing patterns when L / r < 120 and the angles are connected back-to-back at the crossover point.
2. Different equations may apply for each direction of buckling under consideration. The maximum effective slenderness ratio shall be used to determine the compressive strength.

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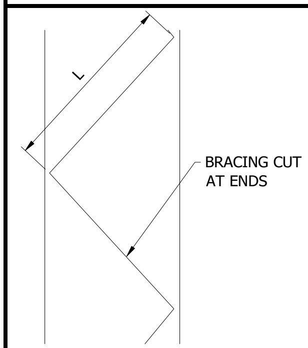
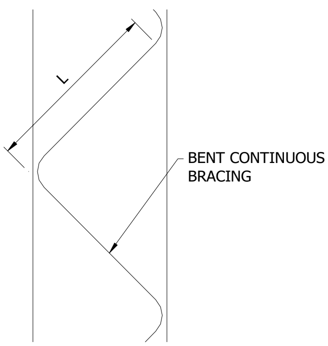
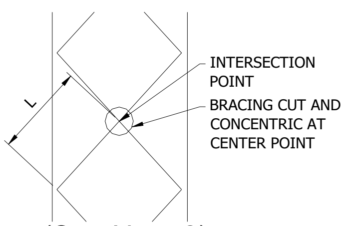
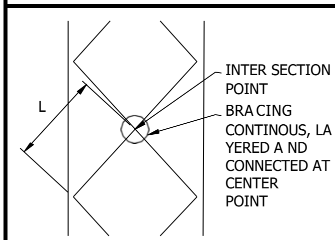
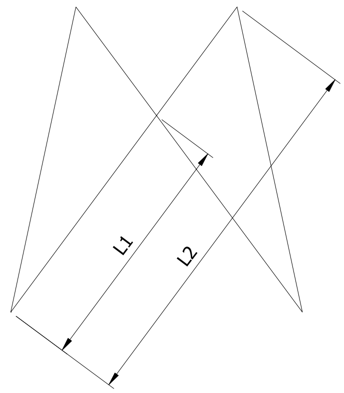
Table 4-5: Effective Slenderness Ratios for Round Bracing Members Directly Welded to Legs

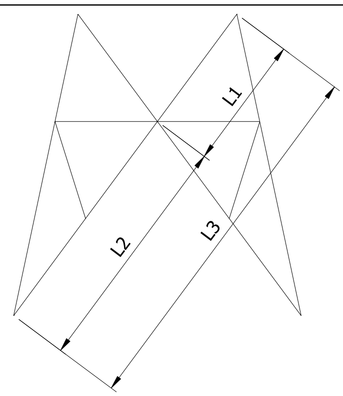
Bracing Pattern	Slenderness Ratio of Brace Member		
	L / r < 80	80 ≤ L / r ≤ 120	L / r > 120
	K = 1.0	K = 0.70 + 0.30 (120 – L / r) / 40	K = 0.70
	K = 1.1	K = 0.70 + 0.40 (120 – L / r) / 40	K = 0.70
 (See Note 2)	K = 1.0	K = 0.75 + 0.25 (120 – L / r) / 40	K = 0.75
 (See Note 2)	K = 1.1	K = 0.90 + 0.20 (120 – L / r) / 40	K = 0.90

Notes:
1. L shall be determined using the panel spacing and the clear distance between the legs.
2. When the tension force in the tension member of a double braced pattern is less than 20% of the compression force in the compression member, the values of KL shall be determined based on a single braced condition.

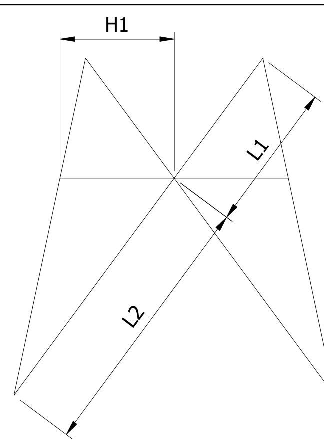
Table 4-6: Buckling Length Considerations for Cross Bracing



Crossover Point Providing Support	Crossover Point Connected but No Support Provided
$L1/r_{min}$	$L1/r_{min}$ $L2/r_{out}$



Crossover Point Providing Support	Crossover Point Connected but No Support Provided
$L1/r_{min}$ $L2/r_{out}$	$L1/r_{min}$ $L3/r_{out}$

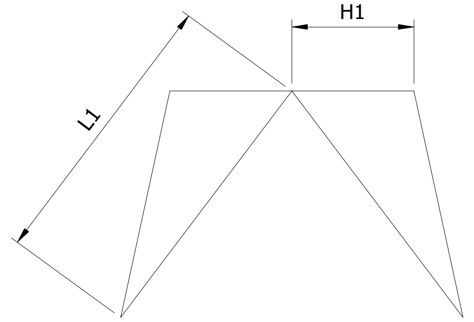


Internal Bracing at Crossover Point	No Internal Bracing at Crossover Point
$L1/r_{min}$ $L2/r_{min}$ $H1/r_{min}$	$L1/r_{min}$ $L2/r_{min}$ $H1/r_{min}$ $2H1/r_{out}$

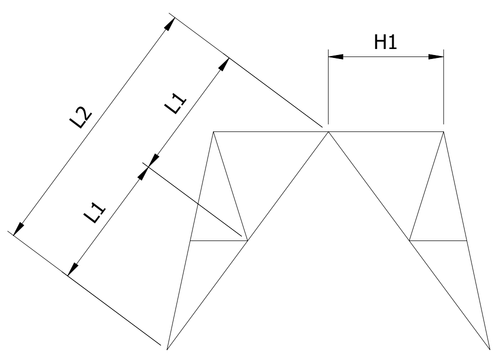
Notes:

1. L shall be determined using the length between the centers of connecting bolt or weld patterns.
2. "r_{min}" refers to the minimum radius of gyration for a member (i.e. the z-z axis for a single angle member, r_x or r_y for a round member.)
3. "r_{out}" refers to the radius of gyration associated with out-of-plane buckling.
4. Refer to 4.5.2.1 for criteria to determine support at the crossover point.
5. Horizontals must meet the requirement of 4.5.2.1 when diagonals are not continuous through the crossover point

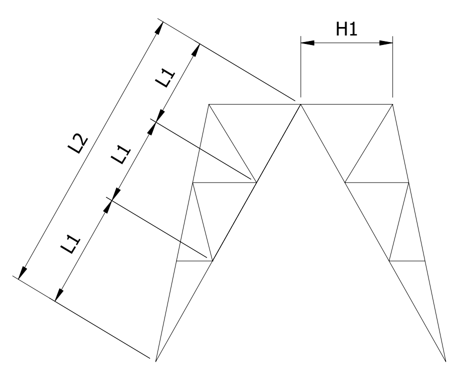
Table 4-7: Buckling Length Considerations for K-Type or Portal Bracing



Horizontal Member Continuous	
Plan Bracing Support at Apex[5]	No Plan Bracing
L1/r_{min} H1/r_{min}	L1/r_{min} H1/r_{min} 1.5 H1/r_{out} (see note 4)



Horizontal Member Continuous	
Plan Bracing Support at Apex[5]	No Plan Bracing
L1/r_{min} L2/r_{out} H1/r_{min}	L1/r_{min} L2/r_{out} H1/r_{min} 1.5 H1/r_{out} (see note 4)



Horizontal Member Not Continuous Plan Bracing Required at Apex[5]	
Hip Bracing Provided[5]	Hip Bracing Not Provided
L1/r_{min} H1/r_{min}	L1/r_{min} L2/r_{out} H1/r_{min}

Notes:

1. L shall be determined using the length between the centers of connecting bolt or weld patterns.
2. "r_{min}" refers to the minimum radius of gyration for a member (i.e. the z-z axis for a single angle member, r_x or r_y for a round member).
3. "r_{out}" refers to the radius of gyration associated with out-of-plane buckling.
4. 2.0H1/r_{out} shall be considered to determine strength for providing support to a leg as defined in 4.4.1.
5. Plan and Hip bracing must be triangulated (refer to Fig. 4-2) and meet the requirement of 4.4.1.

Table 4-8: Effective Yield Stress for Polygonal Tubular Members

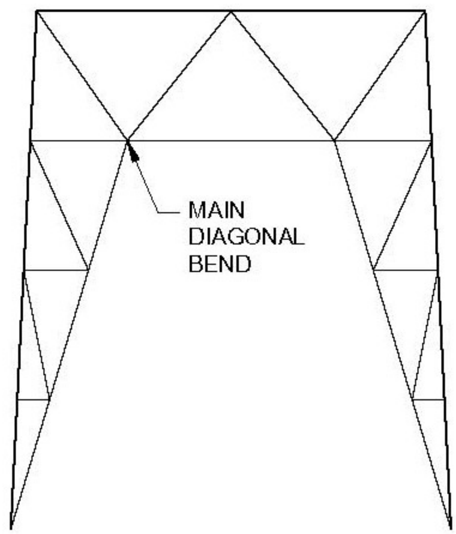
Shape	(w/t) Ratios	Effective Yield Stress
18-Sided	$(F_Y/E)^{1/2}(w/t) < 1.17$	$F'_Y = F_Y$
	$1.17 \leq (F_Y/E)^{1/2}(w/t) \leq 2.14$	$F'_Y = 1.404\ F_Y\ [1.0 - 0.245\ (F_Y/E)^{1/2}\ (w/t)]$
16-Sided	$(F_Y/E)^{1/2}(w/t) < 1.26$	$F'_Y = F_Y$
	$1.26 \leq (F_Y/E)^{1/2}(w/t) \leq 2.14$	$F'_Y = 1.420\ F_Y\ [1.0 - 0.233\ (F_Y/E)^{1/2}\ (w/t)]$
12-Sided	$(F_Y/E)^{1/2}(w/t) < 1.41$	$F'_Y = F_Y$
	$1.41 \leq (F_Y/E)^{1/2}(w/t) \leq 2.14$	$F'_Y = 1.450\ F_Y\ [1.0 - 0.220\ (F_Y/E)^{1/2}\ (w/t)]$
8-Sided	$(F_Y/E)^{1/2}(w/t) < 1.53$	$F'_Y = F_Y$
	$1.53 \leq (F_Y/E)^{1/2}(w/t) \leq 2.14$	$F'_Y = 1.420\ F_Y\ [1.0 - 0.194\ (F_Y/E)^{1/2}\ (w/t)]$

Where:

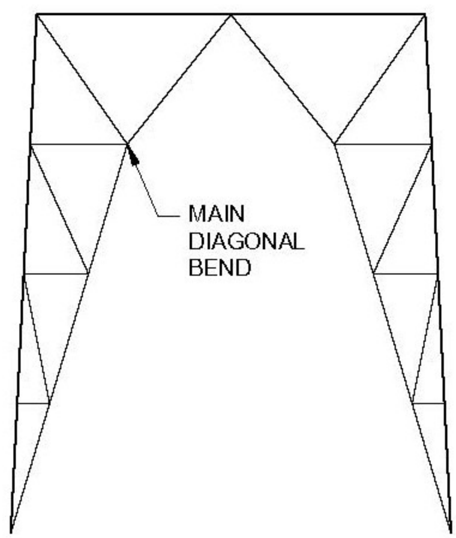
F_Y = specified minimum steel yield strength, ksi [MPa]
t = wall thickness, inches [mm]
w = flat side dimension calculated using an inside bend radius equal to 4t
E = modulus of elasticity, ksi [MPa]

Notes: 1. For polygonal members, w/t shall not exceed $2.14\ (E/F_Y)^{1/2}$

2. Polygonal members with more than 18 sides, shall be considered as round members for strength investigation purposes using a diameter equal to distance across flats.



PORTAL BRACE



CRANKED K-BRACE

NOTE: TRIANGULATED HIP BRACING (REFER TO FIG. 4-2) REQUIRED AT THE MAIN DIAGONAL BEND.

Figure 4-1: Cranked K-Type or Portal Bracing

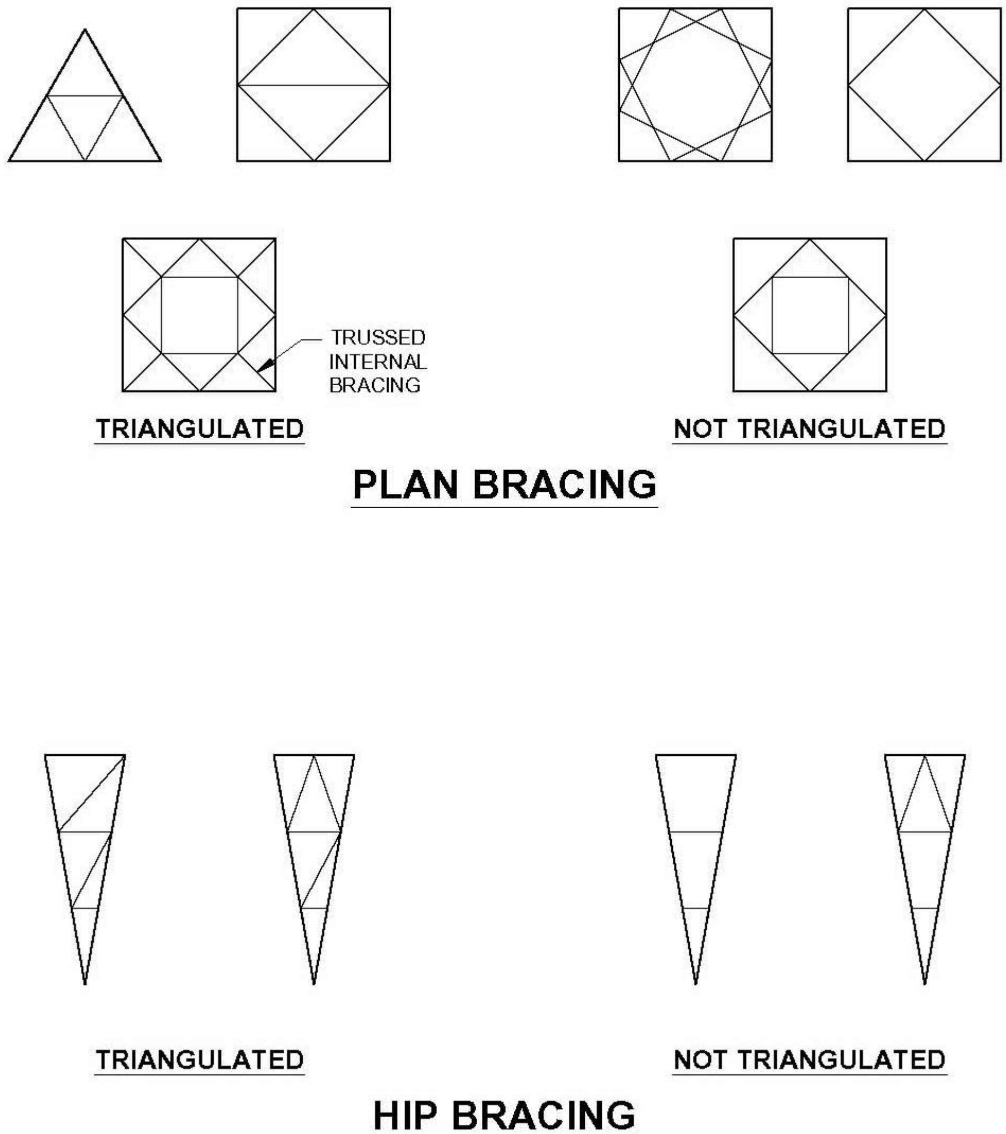


Figure 4-2: Plan and Hip Bracing

NOTES:

1. PLAN OR HIP BRACING MUST BE TRIANGULATED AND MEET THE REQUIREMENTS OF 4.4.1 TO PROVIDE LATERAL SUPPORT TO A MEMBER.
2. EFFECTIVE SLENDERNESS RATIOS FOR MAIN DIAGONALS WITH STAGGERED HIP/FACE BRACING SHALL BE DETERMINED IN ACCORDANCE WITH TABLE 4-3 USING THE EQUATIONS PROVIDED FOR LEG MEMBERS WITH STAGGERED BRACING PATTERNS.
3. THE MINIMUM REQUIRED RESISTANCE OF HIP BRACING SHALL BE DETERMINED IN ACCORDANCE WITH TABLE 4-1 WITH $P_r = 1.15\ P_S$. (P_S BASED ON THE GOVERNING EFFECTIVE SLENDERNESS RATIO OF THE MAIN DIAGONAL).

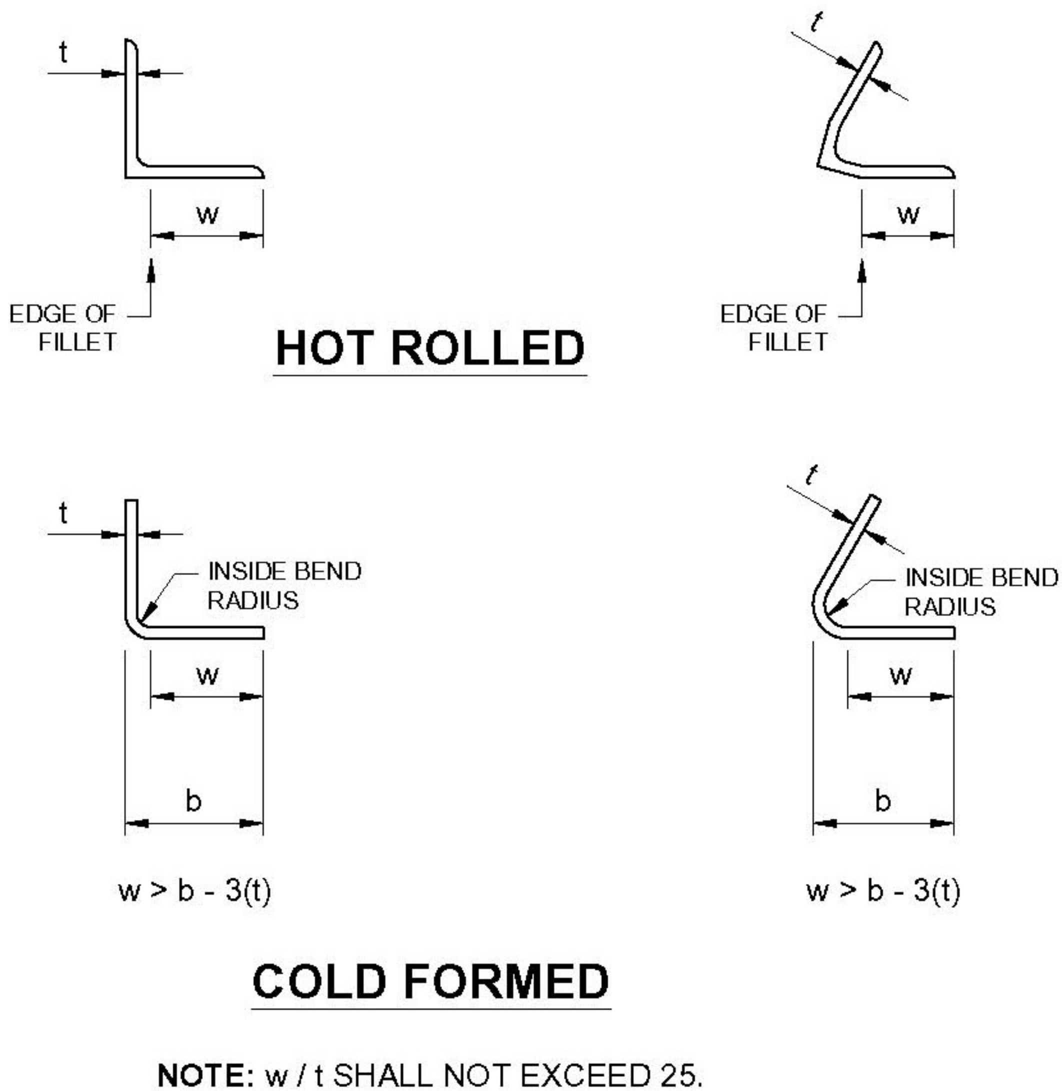


Figure 4-3: Width-to-Thickness Ratios (w/t) for Angle Members

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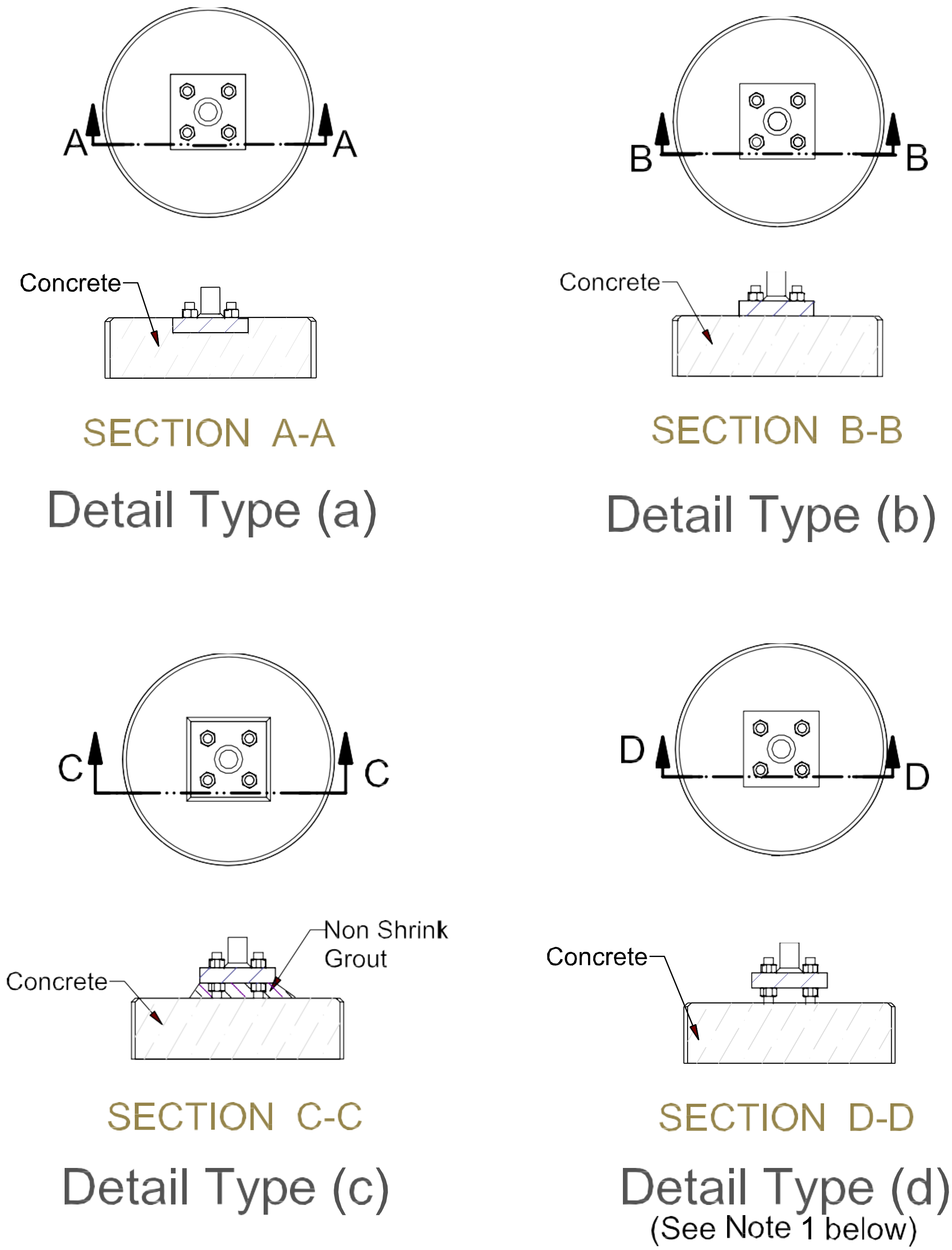

Note:

1. When clear distance from top of concrete to the bottom face of the leveling nut exceeds 1.5 times the diameter of the anchor rod, bending of the anchor rod shall be considered (refer to 4.9.9).

Figure 4-4: Anchor Rod Detail Types

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5.0 MANUFACTURING

5.1 Scope

This section outlines the structural steel material requirements, fabrication tolerances, and corrosion control applicable for the structures designed and manufactured to this Standard.

5.2 Definitions

Structural steel: Steel material used for structural members and components excluding guys, fasteners and hardware.

5.3 Symbols and Notations

CVN = Charpy V-notch value;
F_y = minimum specified yield stress;
pH = hydrogen ion concentration of soil (acidity/alkalinity index)
t = thickness (diameter) of material;
c = coefficient for CVN;

5.4 Material, Structural Steel

5.4.1 General

Structural steels used for structures designed to this Standard shall conform to one of the pre-qualified steel material standards listed in Table 5-1. Other steel materials suitable for the application and site and conforming to 5.4.2 shall be considered acceptable.

Structural steel for polygonal tubular poles and butt-welded flange plates for polygonal tubular poles shall have longitudinal Charpy V-notch values not less than 15.0 ft-lb [21 J] at -20°F [-29°C].

All Charpy V-notch (CVN) tests shall be in accordance with American Society for Testing and Materials (ASTM) A370.

5.4.2 Non Pre-Qualified Steel

The Carbon Equivalent shall not exceed 0.65 as calculated by the following formula:

$$C + \frac{Mn + Si}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Note: Special welding procedures may be required in accordance with AWS D1.1-04.

The elongation shall not be less than 18%.

For solid round shapes, the nominal design values for the yield strength and ultimate tensile strength shall be based at the half-radius point.

For members and components with thickness greater than 5 in. [127 mm] and a minimum yield stress of 50 ksi [350 MPa] or greater, the required Charpy V-Notch (CVN) value shall not be less than 15 ft-lb [21 J] at 0°F [-17°C]. Alternatively, the CVN at the lowest monthly mean temperature for the site shall not be less than the following:

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$$CVN = \frac{F_y t}{5.54\ c} ft - lb \quad \text{or } CVN = \frac{F_y\ t}{710\ c} Joules$$

where:

F_y = the minimum specified yield stress of the type of steel being used, ksi [MPa]

t = the thickness (diameter) of the material, in. [mm]

c = 2 for drilled, reamed holes and non-welded components and for all members subjected to a design tensile stress less than 15 ksi [100 MPa].
= 1 for punched and welded components subjected to a design tensile stress greater than or equal to 15 ksi [100 MPa].

For solid round shapes, the CVN values shall be based on a longitudinal sample located at 1 in. [25 mm] below the surface.

5.4.3 Test Reports

Certified mill test reports or certified reports of tests made by the fabricator or a testing laboratory in accordance with ASTM A6 or A568, as applicable, shall constitute sufficient evidence of conformity to the requirements of 5.4.1 and 5.4.2.

5.4.4 Tolerances

Acceptable dimensional tolerances shall be determined from ASTM A6.

5.5 Fabrication

Fabrication shall be in accordance with AISC-LRFD-99 section M2.

Unless otherwise specified, structural members shall be fabricated to the tolerances given in ASTM A6 for the type of material being utilized. Completed members shall be free from twists and bends.

Fabricated compression members shall not deviate from straightness by more then one in five hundred (1/500), but not more stringent than 1/16 in. [1.5 mm], of the length between points that are to be laterally supported.

Splices in compression members that are designed for direct bearing shall have at least 75% of the nominal area in contact.

Welding shall be in accordance with AWS D1.1-04 Structural Welding Code-Steel.

5.6 Corrosion Control

5.6.1 General

All structural steel members and components shall have a zinc coating. Hot-dip galvanizing is the preferred process. Other methods that provide equivalent corrosion control are acceptable.

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5.6.2 Structural Steel

Structural steel members shall be hot dipped galvanized in accordance with ASTM Standard A123. Alternative methods shall provide minimum corrosion control equal to the requirements of ASTM A123.

5.6.3 Fasteners and Hardware

Fasteners and hardware shall be galvanized in accordance with ASTM Standard A153 (hot-dipped) or ASTM Standard B695 Class 50 (mechanical). Alternative methods shall provide minimum corrosion control equal to the requirements of ASTM A153.

5.6.4 Repair

Repairs shall be in accordance with ASTM Standard A780 or as required by the providers of alternate corrosion control processes.

5.6.5 Guy Strand

Zinc coated guy strand shall be galvanized in accordance with ASTM A475 or ASTM A586 as applicable. A minimum class A coating shall be supplied.

5.6.6 Guy Anchorages

Galvanized portions of anchorage steel and anchor rods shall extend a minimum of 2 in. [50 mm] into the concrete.

Steel guy anchorages in direct contact with the soil shall as a minimum, have corrosion control in accordance with 5.6.2. When the measured soil electrical resistivity is less than 50 ohm-m and/or the measured soil pH values are below 3 or greater than 9, additional corrosion control shall be required for Class II and III structures. Refer to Annex H for acceptable corrosion control methods.

5.6.7 Ground Embedded Poles

Steel poles in direct contact with the soil shall as a minimum, have corrosion control in accordance with 5.6.2 with an additional protective coating. When the measured soil electrical resistivity is less than 50 ohm-m and/or the measured soil pH values are below 3 or greater than 9, additional corrosion control shall be required for Class II and III structures. Refer to Annex H for acceptable corrosion control methods.

Table 5-1
Pre-Qualified Structural Steels

API – 5L	API Specification (Spec. 5L)
ASTM A36	Structural Steel.
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
ASTM A106	Seamless Carbon Steel Pipe.
ASTM A242	High-Strength Low-Alloy Structural Steel.
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
ASTM A501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A514	High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
ASTM A529	High-Strength Carbon-Manganese Steel of Structural Quality.
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
ASTM A588	High-Strength Low-Alloy Structural Steel with 50 ksi Minimum Yield
ASTM A606	Steel, Sheet and Strip, High-strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
ASTM A618	Hot-Formed Welded and Seamless High-strength Low-Alloy Structural Tubing.
ASTM A633	Normalized High-Strength Low-Alloy Structural Steel Plates.
ASTM A871	High-Strength Low-Alloy Structural Steel Plate with Atmospheric Corrosion Resistance.
ASTM A913	High-Strength Low-Alloy Steel Shapes of Structural Quality.
ASTM A992	Steel for Structural Shapes for Use in Building Framing.
ASTM A1008/A	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
ASTM A1011	Steel, Sheet and Strip, Carbon, Hot-rolled Structural Quality.
CSA G40.20/.21	General Requirements for Rolled or Welded Structural Quality Steels.

Note: Shapes and sizes outside the scope of an ASTM standard shall be considered as non-pre-qualified steel.

6.0 OTHER STRUCTURAL MATERIALS

6.1 Scope

This section provides criteria for the design of structures using materials other than steel.

6.2 General

Other structural materials may be used for the supply of structures in accordance with the requirements of this Standard. Conventional materials, such as concrete, aluminum and wood, shall conform to current limit states design standards for these materials. For other materials, which do not have established limit states design standards, factored resistances shall be established to ensure that the level of reliability implied by this Standard is achieved.

6.3 Loads

Strength and serviceability limit states load combinations shall be in accordance with Section 2.0.

6.4 Analysis

Analysis models and procedures shall be in accordance with Section 3.0.

6.5 Design Strength

Appropriate resistance factors shall be established such that the level of reliability implied by this Standard is achieved.

7.0 GUY ASSEMBLIES

7.1 Scope

This section provides the minimum requirements for the design and supply of the guy cables, end fittings, and components used in guy assemblies for guyed masts supplied in accordance with this Standard.

7.2 Definitions

For the purpose of this Standard, the following definitions apply.

Cable: a flexible tension member consisting of strand or rope.

Strand: a plurality of wires either parallel or helically twisted about an axis, usually about a central wire.

Rope: a plurality of strands twisted about an axis, or about a core, which may be a strand or another wire rope.

Wire: a single continuous length of steel with a circular cross-section cold-drawn from rod.

Guy assemblies: a cable used to support a structure including accessories used as an attachment for the ends and for adjusting the tension in the assembly, insulators and nonmetallic material where applicable.

Fitting: any accessory used as an attachment to, or support for, the cable or its component.

Damper: a device, attached to the cable that modifies the structural response to dynamic loads.

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Clamp: a cable fitting that transfers force by friction.

Manufacturer's rated breaking strength: ultimate guaranteed tensile breaking strength of a cable also known as minimum breaking force.

Pre-stressing of guys: the removal of inherent constructional stretch of a cable under a sustained tensile load.

Proof loading: the assurance of mechanical strength of factory assembled end connections.

7.3 Cables

7.3.1 Guy Strand

Galvanized steel guy strand shall conform to the minimum requirements of ASTM Standard A475 Extra High Strength (EHS) or equivalent recognized standard. Aluminum clad steel guy strand shall conform to ASTM B416 or equivalent recognized standard.

7.3.2 Structural Strand

Structural Strand shall conform to the minimum requirements of ASTM Standard A586 or equivalent recognized standard.

7.3.3 Wire Rope

Wire rope shall not be used for guy assemblies unless higher flexibility is required for special applications. When utilized, wire rope shall conform to ASTM A603 or equivalent recognized standard. Aluminum clad steel guy wire shall conform to ASTM B415 or equivalent recognized standard.

7.4 End Attachments

7.4.1 Thimbles

An adequate bend radius, as per the manufacturer's recommendations, at the inside of cable attachments consisting of a thimble or an equivalent approach shall be provided.

7.4.2 Preformed Guy Grips and Preformed Wire Dead-Ends

Preformed guy grips and dead-ends shall be designed specifically for the length, size and type of cable being used. This shall include the size, number, and lay of the wires and the electrochemical compatibility of the material. The preformed manufacturer shall perform tests to demonstrate the capacity and efficiency of the product for different size cables.

Preformed guy grips shall not be reused after being in service and removed.

7.4.3 Clips

U-bolt or twin base clips that are used to secure looped ends shall match the size of the cable within a tolerance of 1/16 in. [1.6 mm].

7.4.4 Sockets

Sockets shall be of the open or closed type. They shall be manufactured in accordance with ASTM Standards A27 and A148.

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Sockets manufactured for use only with wire rope shall not be used for strand, nor shall sockets made for galvanized strand be used for aluminum-coated strand.

Sockets for use with other types of cables may be made from other materials providing they conform to recognized standards and demonstrate the same performance characteristics as implied by this Standard.

7.4.4.1 Zinc-Poured Attachments

Zinc for zinc-poured attachments shall conform to a prime western, high grade or higher purity zinc as defined in ASTM B6.

7.4.4.2 Resin-Poured Attachments

The resin-poured attachments shall be acceptable when installed per the resin manufacturer's recommendations.

7.4.5 Shackles

Shackles used to connect guy assemblies shall be forged from AISI grade 1035 or 1045 steel or equivalent, and suitably heat-treated (quenched and tempered, normalized or annealed).

7.4.6 Take-up Devices

A take-up device shall be supplied at the anchor end of the guy assembly for adjusting the guy tension.

7.4.6.1 Turnbuckles

Turnbuckles used to connect guy assemblies, shall be forged from AISI grade 1035 or 1045 steel or equivalent, and suitably heat-treated (quenched and tempered, normalized or annealed).

7.4.6.2 Bridge Sockets

Take-up devices used in conjunction with bridge sockets or similar devices shall be suitably heat- treated (normalized or annealed).

7.5 Guy Dampers

High frequency low amplitude (Aeolian) and low frequency high amplitude (galloping) vibrations are difficult to predict prior to the installation of a structure. Dampers can be retrofitted when necessary. For guyed masts with structure heights above 1200 ft [366 m], high frequency dampers shall be provided for cables with rigid end connections such as bridge sockets or similar devices unless otherwise determined by a site-specific analysis.

The size, number and position of dampers shall be in accordance with the recommendations of the damper manufacturer.

7.6 Design

7.6.1 Initial Tension

The initial tension in guys, for design purposes, at an ambient temperature of 60° F [16° C] shall be within upper and lower limits of 15 and 7 percent, respectively, of the manufacturer's rated breaking strength of the strand. Values of initial tension beyond these limits may be used provided consideration is given to the sensitivity of the structure to variations in initial tension. The design ambient temperature may be adjusted based on site-specific data.

Notes:

1. Initial tension is defined as the guy tension at an anchor point corresponding to the unfactored dead load condition at the design ambient temperature.

2. When using initial tension values above 15 percent, consideration shall be given to the possible effects of Aeolian vibration. Likewise, when using initial tension values less than 7 percent, consideration shall be given to the effects of galloping and slack-taut pounding.

7.6.2 Design Strength

The design strength of guy assemblies shall be taken as $\phi_g T_g$:

where:

ϕ_g = 0.6 for metallic guy cables
= 0.5 for non-metallic cables

T_g = the ultimate breaking strength of the guy assembly from 7.6.2.1

7.6.2.1 Ultimate Breaking Strength

The ultimate breaking strength of a guy assembly shall be the lesser of: (a) the manufacturer's rated breaking strength of the guy times the end fitting efficiency factor from 7.6.2.2, or (b) the rated breaking strength of the end fittings or take-up device.

7.6.2.2 End Fittings Efficiency Factor

The end fitting efficiency factor for twin base and U-bolt clips used on guy strand through 7/8 in. [22. mm] diameter shall be equal to 90% and shall be equal to 75% for other strand sizes. For all other types of end connections, the end fitting efficiency factor shall be in accordance with the end fitting manufacturer's recommendation.

7.6.3 Modulus of Elasticity

In the absence of specific cable manufacturer's data, the modulus of elasticity of a steel cable used for analysis shall be 23,000 ksi [159 MPa] except for pre-stretched cables 2-9/16 in. [65 mm] diameter and smaller, a modulus of elasticity of 24,000 ksi [166 MPa] shall be used.

7.6.4 Articulation

Articulation at both ends of guy assemblies shall be provided for assemblies consisting of non-metallic guys with rigid end connections such as end sockets or similar devices that do not include low frequency dampers. Articulation shall provide a minimum 10^o rotation in both the vertical and the horizontal directions.

7.7 Manufacture

Manufacturers of non-metallic components of guy assemblies shall provide the expected life of the component.

7.7.1 Proof Loading of Assemblies

Factory installed end sockets shall be proof loaded to 55 percent of the manufacturer's rated breaking strength of the cable and held for a minimum of three cycles with a minimum duration of five minutes for each cycle.

7.7.2 Pre-stressing

Pre-stressing shall be required for guy assemblies (excluding insulators) with factory installed end fittings at both ends. The pre-stressing force for a cable shall be equal to 45 percent of the manufacturer's rated breaking strength of the cable.

7.7.3 Length Measurements

Length measurements for guy assemblies with factory installed end fittings at both ends shall be made under the design initial tension of the cable. Measurements shall be taken after pre-stressing.

7.7.4 Striping

When pre-stressing is specified, a longitudinal paint stripe shall be applied to the cable while it is subjected to the tension specified for length measurements.

7.8 Installation

Cable or other devices shall be installed on turnbuckles to prevent disengagement under wind loading.

Striped cables shall be erected such that the paint stripe applied during measuring is straight after erection.

Initial tensions shall be measured by either direct or indirect methods (examples are provided in Annex K).

8.0 INSULATORS

8.1 Scope

This section provides the minimum requirements for the design of base and guy insulators for structures supplied in accordance with this Standard.

8.2 Design

For the design of base insulators, tension and compression forces, horizontal shear and moments shall be taken into account.

Where steel end fittings are used, they shall be forged from AISI grade 1035 or 1045 steel or equivalent or cast from steel according to the requirements of ASTM Standards A27 or A148, and suitably heat-treated (quenched and tempered, normalized or annealed).

The design strength of base and guy insulators shall be taken as $\phi_i R_i$:

where:

ϕ_i = 0.5 for non-metallic fail-safe insulators
= 0.4 for other non-metallic insulators

R_i = the ultimate strength of the insulator

8.3 Manufacture

Insulator assemblies shall be proof loaded to 60 percent of the manufacturer's rated ultimate strength.

Insulator manufacturers shall provide the expected life of base and guy insulators.

Note: For strain insulators, the manufacturer shall define shipping, handling, and inspection procedures to insure the integrity of the product.

9.0 FOUNDATIONS AND ANCHORAGES

9.1 Scope

This section defines criteria for foundations and anchors for structures designed in accordance with this Standard.

9.2 Definitions

Foundation or anchorage: Substructures designed to transmit reactions to the underlying soil or rock or supporting structure.

Soil: a natural aggregate of mineral grains, with or without organic constituents that can be separated by gentle mechanical means, such as agitation in water.

Rock: a natural aggregate of mineral grains connected by strong and permanent cohesive forces.

9.3 Site Investigation

In the absence of a geotechnical report, presumptive soil parameters are provided in Annex F.

A site investigation shall be required for a Class III structure and is preferred for Class I and II structures. Recommendations for geotechnical investigations are contained in Annex G.

9.4 Design Strength

The nominal resistance multiplied by the appropriate resistance factor specified herein shall be equal to or greater than the reactions from all factored load combinations defined in 2.3.2.

(Note: When geotechnical recommendations are based on allowable resistances, the nominal resistance of soil or rock shall be determined by multiplying the allowable resistances by the corresponding factor of safety reported in the geotechnical recommendations. When the factor of safety is not reported in the geotechnical recommendations, a factor of safety equal to 2.0 shall be used).

9.4.1 Design Strength of Soil or Rock

The design strength of soil or rock shall be equal to $\phi_s R_s$.

where:

ϕ_s = 0.50 for bearing on rock or soil for bases of guyed masts including spread footings driven piles, drilled caissons, steel grillages.

ϕ_s = 0.75 for bearing on rock or soil for bases of self-supporting structures including spread footings, mats, driven piles, drilled caissons, steel grillages.

ϕ_s = 0.75 for pull-out or uplift in rock or soil for foundations and anchorages including spread footings, deadman anchors, drilled caissons, steel grillages and battered piles.

ϕ_s = 0.50 for pull-out or uplift in rock or soil for foundations and anchorages which utilize one rock/soil bolt, dowel or anchoring device.

ϕ_s = 0.40 for pull-out or uplift in rock or soil for foundations and anchorages which utilize non-battered piles with a tapered cross-section.

ϕ_s = 0.75 for friction or lateral resistance of soil or rock for all types of foundations. (Note: for foundation analyses which model the lateral stiffness of the soil, factored reactions for the analysis shall be divided by ϕ_s. The foundation internal forces and moments from the foundation analysis shall be multiplied by ϕ_s for the strength design of the foundation. Unfactored reactions shall not be modified by ϕ_s when investigating displacements for serviceability limit states conditions).

R_s = nominal soil resistance

9.4.2 Design Strength of SubStructure

The design strength of concrete and steel foundations, and anchorages shall be in accordance with ACI 318-05 and AISC-LRFD-99, respectively, or the appropriate material specification for other materials.

9.5 Displacements

Foundation and anchorage displacements need not be considered for the strength and serviceability limit states analysis of structures, except for structures solely supported by a single caisson foundation or for other foundation types for site-specific conditions identified as having critical displacement sensitive soils. For this condition, displacements may only be ignored when the lateral displacement at grade level is less than or equal to 0.75 inch [20 mm] for the serviceability limit state condition specified in 2.8.

9.6 Seismic Considerations

When a self-supporting latticed structure is supported by independent foundations and is located in a region where the earthquake spectral response acceleration at short period, S_s, from 2.7.5 is greater than 1.00, the foundations shall be connected together at the base by a grade beam or similar device. The grade beam or similar device shall resist 2/3 of the total seismic shear as calculated in 2.7.3 in compression and in tension.

Exception: Other approved methods may be used where it can be demonstrated that equivalent restraint can be provided.

9.7 Frost Depth Considerations

When a structure is supported on soil, which displays significant ice lens development during freezing, the minimum foundation base depth shall be at or below the frost depth listed in Annex B. Alternatively, the provisions of SEI/ASCE 32-01 “Design and Construction of Frost-Protected Shallow Foundations” may be satisfied.

9.8 Submerged Conditions

Reduction in the weight of material due to buoyancy and the effect on soil properties shall be considered when submerged conditions are a design consideration.

10.0 PROTECTIVE GROUNDING

10.1 Scope

This section defines: (a) the maximum acceptable electrical resistance of the structural grounding system, and (b) the minimum acceptable materials for the grounding system design.

10.2 Definitions

Grounding: The means of establishing an electrical connection between the structure and the earth, adequate to permit lightning, high voltage, or static discharges to safely enter or leave the earth.

Primary ground: a low resistance, electrically conducting connection between the structure and earth or some conducting body which serves in place of earth. The primary ground consists of grounding leads and grounding electrodes or anodes.

Secondary ground: a low resistance, electrically conducting connection or bond between an appurtenance and the structure.

Grounding electrodes: underground, metallic, conductive members installed for the purpose of grounding including; copper, copper clad steel, galvanized steel or stainless steel alloy buried grounding rods, plates, buried strips, cables, or grids.

Grounding anodes: underground, metallic, conductive members installed for the purpose of grounding in soils with electrical corrosion potential including buried grounding rods or plates, constructed of alloys above steel in the galvanic series.

Remote earth: earth outside of the sphere of influence of the grounding system, which shall be at least eight times the maximum horizontal separation distance between connected grounding electrodes or anodes.

10.3 General

Structures shall be connected to earth by primary grounds. For guyed masts, the anchor shafts or guy cables shall also be connected to earth by a primary ground.

All electrically active equipment and appurtenances supported by a structure shall be connected to the structure by a secondary ground.

10.4 Electrical Resistance

The total resistance of a structure's electrically connected primary grounds as referenced to remote earth shall not exceed 10 ohms. The total resistance shall be measured or calculated in accordance with the Institute of Electrical and Electronics Engineers (IEEE) Standard 142-1991.

10.5 Grounding Materials

Connections between a structure and grounding electrodes or grounding anodes or connections between electrodes shall be compatible with the electrodes and be accomplished by leads not smaller in surface area than 2/0 solid.

Grounding electrodes shall as a minimum, be equivalent to 5/8 in. [16 mm] diameter, 10 ft [3 m] long metal rods constructed of copper, copper clad steel, galvanized steel or stainless steel alloy. The minimum embedment depth of grounding electrodes shall be 10 ft [3 m]. All

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electrodes must be electrically connected to the structure, however, all electrodes need not be interconnected.

For soils with resistivities less than 50 ohm-m, copper or copper plated grounding electrodes may contribute to galvanic corrosion. Under these conditions, grounding electrodes may be replaced by grounding anodes or other corrosion control methods may be employed.

Special considerations shall apply for AM towers installations.

11.0 OBSTRUCTION MARKING

Structures shall be marked in accordance with Federal Communications Commission (FCC), Federal Aviation Authority (FAA), and/or the local aviation authority requirements.

For structures requiring painting for obstruction marking purposes, the termination of a color band shall be permitted to coincide with a panel point on the structure provided that the panel point is within 10 ft [3 m] of the calculated termination point based on equal color bands.

12.0 CLIMBING FACILITIES

12.1 Scope

This section provides minimum requirements for the design and construction of fixed ladders, safety devices, climber attachment anchorages, platforms and cages used for climbing or working on communications structures.

12.2 Definitions

Authorized (Basic) climber: an individual with the physical capabilities to climb who may or may not have previous climbing experience but has training in fall protection regulations, the equipment that applies to the field including instruction for their proper use; able to climb designated fixed access routes equipped with safety climb devices.

Cage: a barrier, which may be referred to as a cage guard or basket guard, that is an enclosure mounted on the side rails of the fixed ladder or fastened to the structure to enclose the climbing space of the ladder.

Carrier: the track of a ladder safety device consisting of a flexible cable or rigid rail.

Climber attachment anchorage: an anchorage point for attaching a lanyard or similar fall protection device.

Climbing facilities: a climbing facility is a series of attachments installed on a support structure, or antenna, on which a climber may step while ascending or descending, and which may incorporate or employ:

(a) steps, rungs, cleats and/or structural members which form an integral part of the structure;
(b) rungs, cleats or step bolts which are attached to the structure; or
(c) climber attachment anchorages.

Competent (Skilled) climber: an individual with the physical capabilities to climb, has actual climbing experience and training in fall protection regulations including the equipment that applies to the field and who is capable of identifying existing and potential fall hazards; and who has the authority to take prompt corrective action to eliminate those hazards; and who is able to climb safely a structure away from fixed access routes.

Hand or guardrails: horizontal barriers erected along the sides or ends of platforms.

Ladder: a device incorporating or employing steps, rungs, or cleats.

Landing: an area such as the ground, roof, or platform that provides access/egress for a fixed ladder.

Length of climb: the total vertical distance a person could climb in traveling between the extreme points of access/egress for a fixed ladder, whether the ladder is of an unbroken length or consists of multiple sections. This total vertical distance is determined by including all spaces between all ladder steps or rungs and all other vertical intervening spaces between the extreme points of access/egress.

Pitch: the included (acute) angle between the horizontal and the ladder, which is measured on the opposite side of the ladder from the climbing side.

Platform: a landing surface that is used as a working or standing location.

Rail ladder: a fixed ladder consisting of side rails joined at regular intervals by rungs.

Safety climb device: a support system that may be a cable or solid rail attached to the structure.

Safety harness: a full body harness attached to a fall-limiting device.

Safety sleeve: that part of a ladder safety climb device consisting of the moving component with locking mechanism that travels on the carrier and makes the connection between the carrier and the safety belt.

Side-step ladder: a rail ladder that requires stepping sideways from the ladder in order to reach a landing.

Step bolt: a round or flat member affixed to the structure on one end with the other end having a means to prevent the foot from sliding off.

Through ladder: a rail ladder that requires stepping through the ladder in order to reach a landing.

Toeboard: a barrier erected along the exposed edges of a platform or landing surface.

12.3 General

Unless otherwise required, antenna supporting structures exceeding 10 ft [3 m] in height and antennas intended for climbing shall be equipped with a minimum of one climbing facility equipped with a safety climb device.

To ensure compatibility with a climber's safety sleeve, the cable support system of a safety climb device shall have a stamped or engraved metal identification tag affixed at the base of the structure indicating the size and type of cable.

For cable support systems, a 3/8 in. [10 mm] diameter cable shall be considered as standard in order to minimize safety sleeve size requirements.

Notes:

1. When a safety climb device is not continuous over the entire height, climber attachment anchorages shall be available at a maximum spacing of 4 ft [1.2 m] over the height not equipped with a safety climb device.
2. A safety climb device is not required for each climbing facility when multiple climbing facilities are provided. The safety climb device shall be provided for the climbing facility that is continuous over the height of the structure.
3. Ladder cages and hoops are not recommended for communication structures due to the need to service the structure at various locations. If provided, a separate safety climb device is not required.
4. Climbing and safety climb devices need not be installed over the entire height of a structure when their installation would adversely affect the performance of an antenna. In such case, the structure shall be equipped with a warning sign or climber attachment anchorages shall be provided in accordance with the requirements of Note 1.
5. Structures not designed for nor equipped with a climbing facility over their entire height (i.e. structures not intended to be climbed that are maintained by other access means), need not have warning signs.

12.4 Strength Requirements

A load factor, α_L = 1.5, shall be applied to the nominal loads specified herein:

The minimum nominal load on individual rungs or steps shall be equal to a normal concentrated load of 250 lbs [1.1 kN] applied at the worst-case location and direction.

The minimum nominal load on ladders shall be 500 lbs [2.2 kN] vertical and 100 lbs [445 N] horizontal applied simultaneously, concentrated at the worst-case location between consecutive attachment points to the structure.

The nominal load on rest platforms or antenna mounts designed for access shall be equal to 250 lbs [1.1 kN].

The minimum uniform nominal live load, in addition to dead loads, on working platforms shall be equal to 25 pounds per square foot [1.2 kPa] over the entire platform working area but not less than 500 lbs [2.2 kN] nominal load.

The minimum nominal concentrated live load on a handrail shall be equal to 150 lbs [670 N] and applied in any direction. The minimum nominal uniform live load on a handrail shall be equal to 40 lb/ft [580 N/m] and applied in any direction (not simultaneous with concentrated load).

Safety climb devices shall meet the requirements of ANSI A14.3-1992 Section 7.0. The anchor points of cable-type safety climb devices shall be designed for a nominal vertical load of 2,700 lbs [12 kN]. For rail-type safety climb devices that are attached to the ladder, the ladder supports shall be designed for a nominal vertical load of 1,400 lbs [6 kN] for each 20 ft [6 m] length.

The minimum vertical nominal load on a climbing attachment anchorage shall be 3300 lbs [14.7 kN].

Notes:

1. The strength requirements for climbing and working facilities need not be considered in conjunction with any other loading combination.
2. The nominal flexural strength of a threaded step bolt shall be determined in accordance with 4.7.1 using a plastic section modulus, Z, based on the tensile root diameter of the step bolt (refer to 4.9.9).

12.5 Dimensional Requirements

Climbing and working facilities shall be classified according to Table 12-1 (Class A or B) for the purpose of determining dimensional requirements. The following dimensional requirements apply to all class systems except as noted:

a) center-to-center spacing between rungs, alternately spaced step bolts, or structural members used for climbing shall be 10 in. [250 mm] minimum and 16 in. [406 mm] maximum; for Class A systems, the spacing shall remain uniform over a continuous length of climb within a tolerance of ± 1 in. [25 mm];
b) clear spacing between side rails shall not be less than 12 in. [300 mm]; the clear spacing shall be increased by the width of the safety rail when used;
c) all rungs, cleats, steps, step bolts, and rails shall be free from splinters, sharp edges, burrs, or projections which may pose a hazard;
d) step bolts shall not be less than 0.625 in. [16 mm] in diameter;
e) rungs shall not be less than 0.625 in. [16 mm] in width, round rungs shall not be greater than 1.50 in. [38 mm] in diameter and flat rungs shall not be greater than 2.0 in. [50 mm] in width;
f) clear width for step bolts shall not be less than 4.5 in. [110 mm]; provisions shall be made to ensure a climber's foot cannot slide off the end of a step bolt;
g) for Class A systems, a minimum clear space shall be provided at rungs, steps, step bolts, or applicable tower members equal to 4 in. [100 mm] vertically, 4.5 in. [110 mm] horizontally, and 7 in. [180 mm] deep.
h) the horizontal spread between the attachment points of step bolts shall not exceed 24 in. [610 m].
i) for Class A systems, a minimum 24 in. [610 mm] clearance shall be provided from the center line of a climbing facility to any obstruction on the climbing side (see Figure 12-1).
j) the slope of a ladder or climbing facility shall be between 90 degrees and 60 degrees to the horizontal. In no case shall the ladder or climbing facility slope toward the climber.
k) the size of steps, rungs and side rails shall be uniform in the same continuous length of climb.
l) the minimum height of a handrail above a platform surface shall be 42 in. [1070 mm].
m) the maximum spacing of rest platforms for structures greater than 500 ft [152 m] shall be 150 ft [46 m].

Note: Structures that do not meet the requirements of this section shall be equipped with warning signs.

12.6 Climber Attachment Anchorages

Refer to Annex I for examples of suitable climber attachment anchorages.

12.7 Platforms

Toe boards are not required for platforms on antennas and antenna supporting structures. Handrails are required for platforms where climber attachment anchorages are not provided.

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Table 12-1: Classification of Climbing and Working Facilities

User	Class
Authorized (Basic) or Competent (Skilled) Climbers	A
Competent (Skilled) Climbers only	B

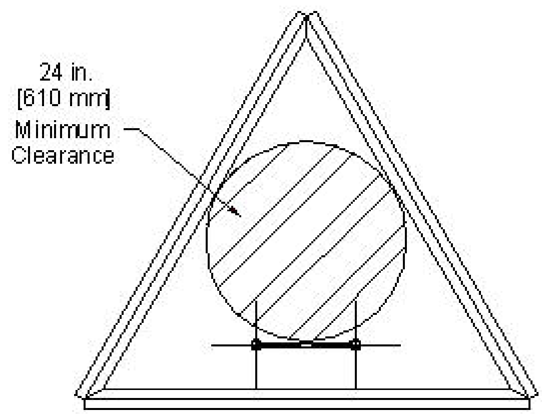

Figure 12-1: Minimum Clearance for Class A Systems

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13.0 PLANS, ASSEMBLY TOLERANCES, AND MARKING

13.1 Scope

The purpose of this section is to define the requirements for plans, assembly tolerances and marking appropriate for structures designed in accordance with this Standard. This section does not address the safety and stability of the structure during assembly and erection, which are the responsibility of the erector, based on the means and methods chosen by the erector.

13.2 Plans

Complete plans, assembly drawings, or other documentation shall be supplied showing the necessary marking and details for the proper assembly and installation of the components, including the member sizes, design yield strength of the structural members and the grade of structural bolts required. Foundation reactions, when provided, shall be based on factored loads.

The tower plans shall detail each attachment height, antenna quantity, antenna model or type, mount quantity, mount type and line size that was included in the structural analysis. Alternatively, the total effective projected area representative of all of the antennas and mounts at each elevation may be provided along with the associated line sizes.

The tower plans shall detail the following data for the site specified used in the structural analysis:

1. Basic wind speed (3 second gust, 50 year return period) without ice.
2. Basic wind speed (50 year return period) with ice.
3. Design ice thickness (50 year return period).
4. Exposure category (B, C or D) for the site specified.
5. Structure classification (I, II, or III) used to classify the structure.
6. Topography category (1,2, 3,4, or 5).
7. Earthquake spectral response acceleration at short periods.
8. Foundation reactions for the loading combinations considered.
9. Soil design parameters or source of data.

13.3 Tolerances

13.3.1 Overall Height

The overall height of an assembled structure shall be within +1% and -1/2% of the specified height, not to exceed +5 ft [1.5 m] or -2 ft [0.6 m].

13.3.2 Guy Tensions

The maximum deviation from the design initial tension shall be (i) ± 10% for guys up to and including 1 in. [25 mm] diameter and (ii) ± 5% for guys greater than 1 in. [25 mm] diameter, of the specified design initial tension at an anchorage, corrected for the ambient temperature.

13.3.3 Plumb

The horizontal distance between the vertical centerlines at any two elevations shall not exceed 0.25 percent of the vertical distance between the two elevations.

13.3.4 Twist

The twist between any two elevations shall not exceed 0.5 degrees in 10 ft [3 m]. The maximum twist over the structure height shall not exceed 5 degrees.

13.3.5 Slip Splice

The slip splice length tolerance shall not exceed ±10% of the design slip splice length. Splices shall be pulled together to ensure firm contact.

13.3.6 Straightness

The straightness of the individual members shall be within a tolerance of 1 in 500 but not more stringent than 1/16 in. [1.6 mm] of the length between points that are laterally supported.

13.3.7 Measurements

Measurements shall be taken at a time when the wind velocity is less than 10 mph [4.5 m/s] at ground level and with no ice on the structure or the guys.

13.3.8 Take-Up Devices

For initial installations, the minimum take-up adjustment available after the structure is plumb and the guy tensions are set, shall be:

a) 6 in. [152 mm] for guys with nominal diameter of 0.5 in. [13 mm] or less;
b) 10 in. [254 mm] for guys with nominal diameter greater than 0.5 in. [13 mm].

13.4 Marking

All structural members or welded structural assemblies, except for hardware, shall have a part number. The part numbers shall correspond with the assembly drawings. The part number is to be permanently attached (stamped, welded lettering, stamped on a plate that is welded to the member, etc.) to the member before all protective coatings are applied. The part number shall have a minimum character height of 0.50 in. [13 mm].

14.0 MAINTENANCE AND CONDITION ASSESSMENT

14.1 Scope

This section addresses the maintenance and condition assessment of structures.

14.2 Maximum Intervals

Maintenance and condition assessment shall be performed as follows:

a) Three-year intervals for guyed masts and five-year intervals for self-supporting structures.
b) After severe wind and /or ice storms or other extreme conditions.
c) Shorter inspection intervals may be required for Class III structures and structures in coastal regions, in corrosive environments, and in areas subject to frequent vandalism.

Maintenance and condition assessment guidelines are provided in Annex J.

15.0 EXISTING STRUCTURES

15.1 Scope

This section addresses the evaluation and modification of existing structures.

15.2 Definitions

Design documents: Documents indicating the proposed design and related details for the modification of an existing structure including the reinforcement or replacement of existing members and/or their connections.

Existing structure: An erected structure.

Fabrication drawings: Drawings required for the fabrication of components for a proposed modification of an existing structure including member cut length, hole sizes, edge distance, tolerances, weld details and other related fabrication details.

Feasibility structural analysis: A preliminary review to determine the overall stability and the adequacy of the main structural members of an existing structure to accommodate a proposed changed condition in accordance with this Standard.

Installation documents: Documents indicating the implementation procedures for a proposed changed condition and/or modification of an existing structure including rigging methods, temporary support requirements and other related construction considerations to provide for the safety and stability of the existing structure during construction.

Rigorous structural analysis: A comprehensive structural analysis to determine the overall stability and the adequacy of structural members, foundations and connections of an existing structure to accommodate a changed condition in accordance with this Standard.

Rigging: Equipment and techniques used during the installation and modification of the structure and/or its appurtenances.

15.3 Classification

The classification of an existing structure shall be determined in accordance with Table 2-1, considering the reliability requirement of the structure based on the land use surrounding the structure and the performance requirements of the services provided.

15.4 Changed Conditions Requiring a Structural Analysis

As a minimum, existing structures shall be analyzed in accordance with this Standard, regardless of the standard used for the design of the original structure, under any of the following conditions:

a) a change in type, size, or number of appurtenances such as antennas, transmission lines, platforms, ladders, etc.
b) a structural modification, excepting maintenance, is made to the structure
c) a change in serviceability requirements
d) a change in the classification of the structure to a higher class in accordance with Table 2-1.

Note: Existing structures need not be re-analyzed for each revision of this Standard unless there are changed conditions as outlined above.

15.5 Structural Analysis

15.5.1 Feasibility Structural Analysis

A feasibility structural analysis is used as a preliminary review to identify the impact of proposed changed conditions. This type of analysis determines the overall stability and the adequacy of the main structural members to support a proposed changed condition. Acceptance of changed conditions shall be based upon a rigorous structural analysis in accordance with 15.5.2. A feasibility structural analysis does not include the evaluation of connections and may consider that the structure has been properly installed and maintained.

The reactions from a feasibility structural analysis may be compared to the original design reactions to identify the impact on foundations due to proposed changed conditions. When the original design reactions are based upon an Allowable Stress Design procedure, the original reactions shall be multiplied by a 1.35 factor for comparison to the reactions determined in accordance with this Standard.

15.5.2 Rigorous Structural Analysis

A rigorous structural analysis is used to determine the final acceptance of proposed changed conditions and/or required modifications. This type of analysis determines the overall stability and the adequacy of structural members, foundations and connection details. A rigorous structural analysis may consider that the structure has been properly installed and maintained.

For a rigorous analysis of a foundation, site-specific geotechnical and foundation data are required.

Note: Certain foundation details and connection details (such as inside weld sizes of flanged leg connections) cannot be determined without dismantling the structure or extensive field non-destructive testing. The assumptions regarding these types of details shall be documented along with the results of the rigorous structural analysis.

15.5.3 Source of Data

Sufficient up-to-date information shall be used in the evaluation to accurately represent the existing structure. The following sources may provide the information necessary for an evaluation:

a. Previous structural analysis
b. Installation, material lists and fabrication drawings
c. Geotechnical reports
d. As-built drawings of the original installation and/or subsequent modifications
e. Field mapping, measurements and/or material testing (refer to Annex J)
f. Existing and proposed appurtenances listing.

15.5.4 Structural Analysis Report

The structural analysis report shall specify the type of analysis (feasibility or rigorous). A feasibility report shall state that final acceptance of changed conditions shall be based upon a rigorous structural analysis.

15.6 Exemptions

Existing structures originally designed in accordance with a previous revision of this Standard are exempt from the provisions of this Standard pertaining to manufacturing and installation that do not pertain to strength requirements when investigating changed conditions.

Existing structures originally designed in accordance with a previous revision of this Standard shall also be exempt from the following provisions of this Standard pertaining to strength requirements when investigating changed conditions:

a. Section 3.7 Mast shear and torsion: 40% minimum requirement need not apply
b. Section 4.4.1 Minimum bracing resistance: P_r = 1.5% F_s may be used
c. Section 4.6.2 Tension-only bracing members
d. Section 4.9.7 Minimum leg tension splice capacity
e. Section 7.6.4 Guy articulation
f. Section 8.3 Insulators: proof loading need not apply to existing insulators
g. Section 10.0 Protective grounding
h. Section 12.0 Climbing facility requirements

15.7 Modification of Existing Structures

15.7.1 Design

Modifications to existing structures shall be based on a rigorous structural analysis. A design document shall be prepared indicating the proposed reinforcement of existing members and/or connections and all proposed additional members.

Prior to implementation of the changed conditions and/or modifications, the data designated on the design document requiring verification shall be validated.

16.0 INSTALLATION

Rigging and temporary supports such as temporary guys, braces, false work, cribbing or other elements required for the erection/modification shall be determined, documented, furnished and installed by the erector accounting for the loads imposed on the structure due to the proposed construction method.

ANNEX A: PROCUREMENT AND USER GUIDELINES (Normative)

This Annex is intended to assist in the procurement of antenna supporting structures and antennas designed in accordance with the ANSI/TIA-222-G Standard. Sections referenced in this annex correspond to sections in the Standard with an A prefix.

Default design parameters appropriate for the referenced sections are provided to simplify the procurement specifications for a structure. It is intended that the default design parameters presented in this annex be used for design unless otherwise specified in the procurement specifications for a structure. In addition, sections are referenced where site-specific or supplementary design requirements are often required when preparing procurement specifications for a structure.

A.2.0 Loads

Site-specific loading or local building code requirements may be more stringent than the minimum loading requirements specified in the Standard. These and other unique load or loading combination requirements are to be included in the procurement specifications.

A.2.2 Classification of Structures

The Standard establishes three classifications of structures based on reliability criteria.

The default Structure Classification is Class II.

The following descriptions indicate the appropriate Classification for a new structure based on the type of service to be provided:

Class I: Structures used for services that are optional or where a delay in returning the services would be acceptable such as: residential wireless and conventional 2-way radio communications; television, radio and scanner reception; wireless cable; amateur and CB radio communications.

Class II: Structures used for services that may be provided by other means such as: commercial wireless communications; television and radio broadcasting; cellular, PCS, CATV, and microwave communications.

Class III: Structures used primarily for essential communications such as: civil or national defense; emergency, rescue or disaster operations; military and navigation facilities.

A.2.3.2 Strength Limit State Load Combinations

The Standard is based on limit states design and specifies appropriate load factors to be applied to the nominal loads defined in the Standard. When supplementary loading requirements for “withstand” or “survival” conditions are specified, load factors, gust factors, limit state conversion factor for ice, and directionality factors equal to a minimum of 1.0 shall be used. Unless otherwise specified in the procurement specifications, structures shall also be designed for the load factors and nominal loads contained in the Standard. For locations not included in Annex B, the minimum basic wind speed considered for nominal loads shall be 75 mph [34 m/s] 3-sec gust or as determined in accordance with Section 2.6.4.1 for the site location.

A.2.4 Temperature Effects

The Standard specifies a 50 degrees F [28 degrees C] reduction in temperature for loading conditions that include ice. Based on site-specific requirements, a greater reduction may be appropriate and is to be included in the procurement specifications.

A.2.6.4 Basic Wind Speed and Design Ice Thickness

The Standard is based on 3-second gust wind speeds and radial glaze ice thicknesses. Wind speeds averaged over different time periods are to be converted to 3-second gust wind speeds for use with the Standard. (Refer to ANNEX L for wind speed conversion factors.)

Supplementary rime ice and in-cloud ice loadings (including thickness, density, escalation with height and corresponding wind speed) are to be included in the procurement specification when appropriate for a given site location.

A.2.6.5 Exposure Categories

The default Exposure Category is Exposure C.

A.2.6.6 Topographic Categories

The default Topographic Category is Category 1.

For Topographic Categories 2, 3 and 4, the height of the topographic feature is to be included in the procurement specifications.

Detailed site information is required for the use of Topographic Category 5. A methodology for determining wind speed-up criteria based on site-specific data is contained in the ASCE 7-02 Standard, “Minimum Design Loads for Buildings and Other Structures”.

For guyed masts in any topographic category, the elevation of the ground guy anchor supports is to be assumed at the same elevation as the base of the mast unless otherwise specified in the procurement specifications.

When relative differences exist in elevation between the base of a guyed mast and the ground guy anchor supports, the differences are to be included in the procurement specifications. Alternatively, a topographic survey for the site may be provided with the procurement specifications. The relative elevations are required in order to properly model a guyed mast in accordance with the Standard. Note that although a structure may be located on terrain with no abrupt changes (Category 1), there may be significant differences in elevation between the ground anchor supports and the base of the mast.

A.2.6.6.3 Structures Supported on Buildings or Other Structures

The height of the supporting structure is to be included in the procurement specifications in order to properly determine design loads in accordance with the Standard. In addition, for guyed masts, the locations of the guy anchor supports are also to be included.

A.2.6.9.5 Transmission Lines Mounted in Clusters or Blocks

The distribution of lines on a latticed structure has a significant effect on the wind loads applied to the structures. As a default, lines may be distributed on multiple faces in clusters or blocks in order to minimize wind loads on the structure. When other arrangements are required, the distribution and location of lines are to be specified in detail in the procurement specifications.

A.2.6.9.6 Velocity Pressure

The constant 0.00256 [0.613] is based on the air mass density of the standard atmosphere defined at a temperature of 59 degree F [15 degrees C] and sea level pressure of 29.9 inches of mercury [101.3 kPa]. The air mass density varies as a function of altitude, latitude, temperature, weather, and season. It is the intent of the Standard to use the numerical value of 0.00256 [0.613] for determining velocity pressures unless a different value is included in the procurement specifications.

A.2.7.3 General (Earthquake Loads)

The default Site Class for earthquake analysis is Class D.

A.2.8 Serviceability Requirements

The service loads and deformation limits specified in the Standard are the minimum requirements for communication structures. When more stringent requirements are required for a specific application, the serviceability limit state basic wind speed and if required, the serviceability limit state design ice thickness; the deformation limitations (twist, sway and horizontal displacement) and the location/elevation where the deformation limitations apply are to be included in the procurement specifications.

As a default, the twist and sway deformations at microwave antenna mounting points shall not exceed the values specified in Annex D based on an overall allowable 10 db degradation in radio frequency signal level.

A.5.6.6 Guy Anchorages (Corrosion Control)

The default soil condition is non-corrosive soil unless a geotechnical report containing the corrosive properties of the soil (electrical resistivity and pH values) for the site is provided with the procurement specifications.

The Standard specifies minimum corrosion control when steel anchors are in direct contact with soil. Requirements for supplemental corrosion control are to be included in the procurement specifications.

A.5.6.7 Ground Embedded Poles (Corrosion Control)

The default soil condition is non-corrosive soil unless a geotechnical report containing the corrosive properties of the soil (electrical resistivity and pH values) for the site is provided with the procurement specifications.

The Standard specifies minimum corrosion control for ground embedded poles. Requirements for supplemental corrosion control are to be included in the procurement specifications.

A.7.5 Guy Dampers

The Standard specifies minimum requirements for high frequency guy dampers. High frequency low amplitude (Aeolian) and low frequency high amplitude (galloping) vibrations are difficult to predict prior to the installation of a structure due to unique site and environmental variables. High and Low frequency dampers can be retrofitted when necessary. Additional damper requirements are to be included in the procurement specifications.

A.9.0 Foundations and Anchorages

The Standard refers to Annex F for presumptive soil parameters, which are intended to be used for foundation and anchorage designs in the absence of a geotechnical report for Class I or II structures. It is intended that actual site conditions will be investigated by the owner or the owner's representative prior to the installation of foundations and anchorages designed in accordance with presumptive soil parameters. The default soil type is clay unless otherwise specified in the procurement specifications. The default frost depth is 3.5 ft [1.1 m] when the site location is undetermined unless otherwise specified in the procurement specifications.

Foundations and anchorages may be designed by a third party subsequent to the design of the structure. The proper development of anchor rods and anchorages supplied with a structure is to be verified by the foundation engineer. Site-specific requirements for anchorages, such as roof-mounted structures, pile caps or other similar situations are to be included in the procurement specifications.

A.10.0 Protective Grounding

The Standard provides grounding requirements to limit damage to the structure or foundation resulting from high fault currents. Alternate or special grounding systems or special grounding requirements for the protection of equipment or appurtenances are to be included in the procurement specifications.

The following grounding systems shall be considered as default grounding configurations. It is intended that the owner or the owner's representative will verify that the total resistance will not exceed 10 ohms based on the actual site soil conditions. Additional grounding electrodes may be required.

For guyed masts the default grounding configuration shall be a minimum of three grounding electrodes installed symmetrically around the base of the structure at a minimum 20 ft [6m] spacing and each symmetrically connected to the base of the structure. A minimum of one grounding electrode shall be installed and connected at each anchor.

For self-supporting structures the default grounding configuration shall be a minimum of six grounding electrodes installed symmetrically around the base of the structure at a minimum 20 ft [6m] spacing. A minimum of one lead shall be connected to each leg for latticed structures and a minimum of three leads shall be symmetrically connected to the base for pole structures.

A.11.0 Obstruction Markings

Requirements for obstruction markings are to be included in the procurement specifications. The default condition is that no obstruction markings are required.

A.12.0 Climbing and Working Facilities

The default classification of climbing and working facilities is Class B.

The Standard specifies minimum climbing facility and platform requirements considering that either competent (skilled) or authorized (basic) personnel will be accessing the structure. Additional climbing facilities and platform requirements are to be included in the procurement specifications.

A.15.3 Classification of Existing Structures

The default Structure Classification for existing structures is Class II.

ANNEX B: U.S. COUNTY LISTINGS OF DESIGN CRITERIA (Normative)

This Annex contains tables listing design criteria for the counties of the United States and its Territories. Design criteria maps are provided in Appendix 1.

The design criteria for wind, ice, and earthquake loads provided in this Annex, are based on ASCE 7-05 and additional validated data. The minimum frost depth values are based on NAVFAC DM 7.01.

The design criteria for sites located on islands and coastal areas or locations not designated as a county shall be equal to the design criteria for the closest location shown on the maps in Appendix 1.

Mountainous terrains and gorges shall be examined for unusual wind, wind on ice and ice conditions.

State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
AK	ALEUTIANS EAST	130	130	70	70	0.25	0.25	-	0.72	1.91	2, 3
AK	ALEUTIANS WEST	130	130	70	70	0.25	0.25	-	0.24	2.36	2, 3
AK	ANCHORAGE	90	105	60	60	0.25	0.25	-	1.43	1.78	2, 3
AK	BETHEL	90	130	60	70	0.25	0.25	-	0.05	0.93	2, 3
AK	BRISTOL BAY	100	130	70	70	0.25	0.25	-	0.50	0.68	2, 3
AK	DENALI	90	90	60	60	0.00	0.25	-	0.88	2.18	2, 3
AK	DILLINGHAM	100	130	60	70	0.25	0.25	-	0.15	0.46	2, 3
AK	FAIRBANKS NORTH STAR	90	90	60	60	0.00	0.25	-	0.29	1.13	2, 3
AK	HAINES	90	100	50	50	0.25	0.25	-	0.56	1.27	2, 3
AK	JUNEAU	90	110	60	60	0.25	0.25	-	0.25	1.20	2, 3
AK	KENAI PENINSULA	90	120	60	60	0.25	0.25	-	0.65	1.81	2, 3
AK	KETCHIKAN GATEWAY	100	120	50	50	0.25	0.25	-	0.16	0.32	2, 3
AK	KODIAK ISLAND	110	130	60	60	0.25	0.25	-	1.11	1.83	2, 3
AK	LAKE AND PENINSULA	100	130	60	70	0.25	0.25	-	0.31	1.41	2, 3
AK	MATANUSKA SUSITNA	90	90	60	60	0.00	0.25	-	0.87	1.87	2, 3
AK	NOME	130	130	70	80	0.25	0.25	-	0.07	0.64	2, 3
AK	NORTH SLOPE	90	130	60	80	0.25	0.25	-	0.01	0.75	2, 3
AK	NW ARCTIC - KOBUK	100	130	60	80	0.25	0.25	-	0.27	0.91	2, 3
AK	PRINCE WALES KETCHIKAN	90	125	50	50	0.25	0.25	-	0.12	1.12	2, 3
AK	SITKA	100	120	50	50	0.25	0.25	-	0.64	2.01	2, 3
AK	SKAGWAY YAKUTAT ANGOON	90	115	50	50	0.25	0.25	-	0.17	2.18	2, 3
AK	SOUTHEAST FAIRBANKS	90	90	60	60	0.00	0.25	-	0.19	2.18	2, 3
AK	VALDEZ CORDOVA	90	110	50	60	0.00	0.50	-	0.56	2.18	2, 3
AK	WADE HAMPTON	120	130	60	80	0.25	0.25	-	0.14	0.59	2, 3
AK	WRANGELL PETERSBURG	100	110	50	50	0.25	0.25	-	0.12	0.97	2, 3
AK	YUKON KOYUKUK	90	130	60	70	0.00	0.25	-	0.17	1.11	2, 3
AL	AUTAUGA	95	100	30	30	0.25	0.25	10	0.17	0.19	-
AL	BALDWIN	115	150	30	30	0.25	0.25	5	0.10	0.15	-
AL	BARBOUR	95	105	30	30	0.25	0.25	5	0.13	0.15	-
AL	BIBB	90	95	30	30	0.25	0.25	10	0.22	0.27	-
AL	BLOUNT	90	90	30	30	0.25	0.50	10	0.31	0.34	-
AL	BULLOCK	95	100	30	30	0.25	0.25	5	0.13	0.16	-
AL	BUTLER	100	105	30	30	0.25	0.25	5	0.13	0.15	-
AL	CALHOUN	90	90	30	30	0.25	0.50	10	0.28	0.36	-
AL	CHAMBERS	90	95	30	30	0.25	0.50	10	0.18	0.23	-
AL	CHEROKEE	90	90	30	30	0.50	0.75	10	0.35	0.47	-
AL	CHILTON	90	95	30	30	0.25	0.25	10	0.19	0.26	-
AL	CHOCTAW	100	105	30	30	0.25	0.25	5	0.17	0.19	-
AL	CLARKE	100	115	30	30	0.25	0.25	5	0.14	0.18	-
AL	CLAY	90	90	30	30	0.25	0.25	10	0.23	0.29	-
AL	CLEBURNE	90	90	30	30	0.25	0.50	10	0.26	0.36	-
AL	COFFEE	105	110	30	30	0.25	0.25	5	0.12	0.13	-
AL	COLBERT	90	90	30	30	0.75	0.75	10	0.28	0.38	-
AL	CONECUH	105	115	30	30	0.25	0.25	5	0.12	0.14	-
AL	COOSA	90	95	30	30	0.25	0.25	10	0.19	0.26	-

State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
AL	COVINGTON	105	120	30	30	0.25	0.25	5	0.11	0.13	-
AL	CRENSHAW	100	105	30	30	0.25	0.25	5	0.12	0.15	-
AL	CULLMAN	90	90	30	30	0.25	0.50	10	0.28	0.32	-
AL	DALE	100	110	30	30	0.25	0.25	5	0.12	0.13	-
AL	DALLAS	95	100	30	30	0.25	0.25	10	0.15	0.20	-
AL	DE KALB	90	90	30	30	0.50	0.75	10	0.35	0.48	-
AL	ELMORE	95	95	30	30	0.25	0.25	10	0.17	0.20	-
AL	ESCAMBIA	110	120	30	30	0.25	0.25	5	0.12	0.14	-
AL	ETOWAH	90	90	30	30	0.50	0.50	10	0.33	0.38	-
AL	FAYETTE	90	90	30	30	0.25	0.50	10	0.26	0.28	-
AL	FRANKLIN	90	90	30	30	0.50	0.75	10	0.28	0.33	-
AL	GENEVA	110	115	30	30	0.25	0.25	5	0.11	0.12	-
AL	GREENE	90	95	30	30	0.25	0.25	10	0.19	0.24	-
AL	HALE	95	95	30	30	0.25	0.25	10	0.18	0.24	-
AL	HENRY	100	105	30	30	0.25	0.25	5	0.12	0.13	-
AL	HOUSTON	105	110	30	30	0.25	0.25	5	0.11	0.12	-
AL	JACKSON	90	90	30	30	0.25	0.25	10	0.31	0.46	-
AL	JEFFERSON	90	90	30	30	0.25	0.25	10	0.27	0.33	-
AL	LAMAR	90	90	30	30	0.50	0.50	10	0.25	0.27	-
AL	LAUDERDALE	90	90	30	30	0.75	0.75	10	0.28	0.41	-
AL	LAWRENCE	90	90	30	30	0.50	0.75	10	0.28	0.29	-
AL	LEE	95	95	30	30	0.25	0.50	10	0.17	0.18	-
AL	LIMESTONE	90	90	30	30	0.75	0.75	10	0.28	0.29	-
AL	LOWNDES	100	100	30	30	0.25	0.25	5	0.14	0.17	-
AL	MACON	95	95	30	30	0.25	0.25	10	0.16	0.18	-
AL	MADISON	90	90	30	30	0.75	0.75	10	0.28	0.33	-
AL	MARENGO	95	105	30	30	0.25	0.25	10	0.17	0.19	-
AL	MARION	90	90	30	30	0.50	0.75	10	0.27	0.29	-
AL	MARSHALL	90	90	30	30	0.50	0.75	10	0.30	0.37	-
AL	MOBILE	115	150	30	30	0.25	0.25	5	0.11	0.15	-
AL	MONROE	105	115	30	30	0.25	0.25	5	0.13	0.16	-
AL	MONTGOMERY	95	100	30	30	0.25	0.25	10	0.14	0.18	-
AL	MORGAN	90	90	30	30	0.50	0.75	10	0.28	0.30	-
AL	PERRY	95	100	30	30	0.25	0.25	10	0.17	0.22	-
AL	PICKENS	90	95	30	30	0.25	0.50	10	0.21	0.26	-
AL	PIKE	100	105	30	30	0.25	0.25	5	0.13	0.15	-
AL	RANDOLPH	90	90	30	30	0.25	0.50	10	0.21	0.27	-
AL	RUSSELL	95	95	30	30	0.25	0.50	10	0.15	0.17	-
AL	SAINT CLAIR	90	90	30	30	0.25	0.50	10	0.30	0.34	-
AL	SHELBY	90	90	30	30	0.25	0.25	10	0.25	0.32	-
AL	SUMTER	95	100	30	30	0.25	0.25	10	0.18	0.22	-
AL	TALLADEGA	90	90	30	30	0.25	0.25	10	0.25	0.33	-
AL	TALLAPOOSA	90	95	30	30	0.25	0.25	10	0.17	0.25	-
AL	TUSCALOOSA	90	90	30	30	0.25	0.25	10	0.23	0.29	-
AL	WALKER	90	90	30	30	0.25	0.50	10	0.27	0.32	-
AL	WASHINGTON	105	115	30	30	0.25	0.25	5	0.14	0.18	-

State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
AL	WILCOX	100	105	30	30	0.25	0.25	5	0.14	0.17	-
AL	WINSTON	90	90	30	30	0.50	0.50	10	0.27	0.29	-
AR	ARKANSAS	90	90	30	30	0.75	1.00	20	0.41	0.60	-
AR	ASHLEY	90	90	30	30	0.75	0.75	10	0.23	0.29	-
AR	BAXTER	90	90	30	30	1.00	1.00	20	0.34	0.46	-
AR	BENTON	90	90	30	30	1.00	1.00	20	0.16	0.20	-
AR	BOONE	90	90	30	30	1.00	1.00	20	0.25	0.31	-
AR	BRADLEY	90	90	30	30	0.75	1.00	10	0.24	0.32	-
AR	CALHOUN	90	90	30	30	0.75	1.00	10	0.25	0.32	-
AR	CARROLL	90	90	30	30	1.00	1.00	20	0.19	0.26	-
AR	CHICOT	90	90	30	30	0.75	0.75	10	0.24	0.34	-
AR	CLARK	90	90	30	30	1.00	1.00	20	0.25	0.32	-
AR	CLAY	90	90	30	30	1.00	1.00	20	0.98	2.22	-
AR	CLEBURNE	90	90	30	30	1.00	1.00	20	0.52	0.68	-
AR	CLEVELAND	90	90	30	30	0.75	1.00	10	0.30	0.39	-
AR	COLUMBIA	90	90	30	30	0.75	0.75	10	0.18	0.23	-
AR	CONWAY	90	90	30	30	1.00	1.00	20	0.33	0.49	-
AR	CRAIGHEAD	90	90	30	30	1.00	1.00	20	1.23	3.16	-
AR	CRAWFORD	90	90	30	30	1.00	1.00	20	0.19	0.21	-
AR	CRITTENDEN	90	90	30	30	1.00	1.00	20	1.07	3.29	-
AR	CROSS	90	90	30	30	1.00	1.00	120	1.17	3.12	-
AR	DALLAS	90	90	30	30	1.00	1.00	20	0.27	0.37	-
AR	DESHA	90	90	30	30	0.75	1.00	10	0.32	0.48	-
AR	DREW	90	90	30	30	0.75	1.00	10	0.27	0.37	-
AR	FAULKNER	90	90	30	30	1.00	1.00	20	0.43	0.60	-
AR	FRANKLIN	90	90	30	30	1.00	1.00	20	0.20	0.24	-
AR	FULTON	90	90	30	30	1.00	1.00	20	0.40	0.65	-
AR	GARLAND	90	90	30	30	1.00	1.00	20	0.27	0.36	-
AR	GRANT	90	90	30	30	1.00	1.00	20	0.34	0.43	-
AR	GREENE	90	90	30	30	1.00	1.00	20	1.09	2.41	-
AR	HEMPSTEAD	90	90	30	30	1.00	1.00	20	0.19	0.24	-
AR	HOT SPRING	90	90	30	30	1.00	1.00	20	0.26	0.37	-
AR	HOWARD	90	90	30	30	1.00	1.00	20	0.19	0.22	-
AR	INDEPENDENCE	90	90	30	30	1.00	1.00	20	0.61	1.09	-
AR	IZARD	90	90	30	30	1.00	1.00	20	0.43	0.65	-
AR	JACKSON	90	90	30	30	1.00	1.00	20	0.81	1.57	-
AR	JEFFERSON	90	90	30	30	1.00	1.00	20	0.37	0.52	-
AR	JOHNSON	90	90	30	30	1.00	1.00	20	0.23	0.29	-
AR	LAFAYETTE	90	90	30	30	0.75	1.00	10	0.18	0.21	-
AR	LAWRENCE	90	90	30	30	1.00	1.00	20	0.77	1.46	-
AR	LEE	90	90	30	30	1.00	1.00	20	0.69	1.18	-
AR	LINCOLN	90	90	30	30	0.75	1.00	10	0.34	0.43	-
AR	LITTLE RIVER	90	90	30	30	1.00	1.00	20	0.17	0.19	-
AR	LOGAN	90	90	30	30	1.00	1.00	20	0.21	0.28	-
AR	LONOKE	90	90	30	30	1.00	1.00	20	0.47	0.63	-
AR	MADISON	90	90	30	30	1.00	1.00	20	0.19	0.25	-

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AR	MARION	90	90	30	30	1.00	1.00	20	0.28	0.41	-
AR	MILLER	90	90	30	30	0.75	1.00	10	0.18	0.19	-
AR	MISSISSIPPI	90	90	30	30	1.00	1.00	20	2.22	3.41	-
AR	MONROE	90	90	30	30	1.00	1.00	20	0.55	0.95	-
AR	MONTGOMERY	90	90	30	30	1.00	1.00	20	0.21	0.27	-
AR	NEVADA	90	90	30	30	0.75	1.00	20	0.20	0.26	-
AR	NEWTON	90	90	30	30	1.00	1.00	20	0.24	0.34	-
AR	OUACHITA	90	90	30	30	0.75	1.00	10	0.22	0.29	-
AR	PERRY	90	90	30	30	1.00	1.00	20	0.28	0.46	-
AR	PHILLIPS	90	90	30	30	0.75	1.00	20	0.47	0.82	-
AR	PIKE	90	90	30	30	1.00	1.00	20	0.21	0.26	-
AR	POINSETT	90	90	30	30	1.00	1.00	20	1.44	3.23	-
AR	POLK	90	90	30	30	1.00	1.00	20	0.18	0.22	-
AR	POPE	90	90	30	30	1.00	1.00	20	0.28	0.38	-
AR	PRAIRIE	90	90	30	30	1.00	1.00	20	0.52	0.83	-
AR	PULASKI	90	90	30	30	1.00	1.00	20	0.39	0.58	-
AR	RANDOLPH	90	90	30	30	1.00	1.00	20	0.62	1.17	-
AR	SAINT FRANCIS	90	90	30	30	1.00	1.00	20	0.86	2.02	-
AR	SALINE	90	90	30	30	1.00	1.00	20	0.32	0.44	-
AR	SCOTT	90	90	30	30	1.00	1.00	20	0.19	0.24	-
AR	SEARCY	90	90	30	30	1.00	1.00	20	0.30	0.44	-
AR	SEBASTIAN	90	90	30	30	1.00	1.00	20	0.19	0.21	-
AR	SEVIER	90	90	30	30	1.00	1.00	20	0.18	0.19	-
AR	SHARP	90	90	30	30	1.00	1.00	20	0.59	0.94	-
AR	STONE	90	90	30	30	1.00	1.00	20	0.42	0.63	-
AR	UNION	90	90	30	30	0.75	0.75	10	0.20	0.25	-
AR	VAN BUREN	90	90	30	30	1.00	1.00	20	0.36	0.56	-
AR	WASHINGTON	90	90	30	30	1.00	1.00	20	0.18	0.21	-
AR	WHITE	90	90	30	30	1.00	1.00	20	0.58	1.02	-
AR	WOODRUFF	90	90	30	30	1.00	1.00	20	0.73	1.36	-
AR	YELL	90	90	30	30	1.00	1.00	20	0.24	0.37	-
AZ	APACHE	90	90	30	30	0.00	0.25	30	0.18	0.33	1, 2
AZ	COCHISE	90	90	30	30	0.00	0.00	10	0.24	0.43	-
AZ	COCONINO	90	90	30	30	0.00	0.25	30	0.25	0.89	1, 2
AZ	GILA	90	90	30	30	0.00	0.00	10	0.29	0.43	-
AZ	GRAHAM	90	90	30	30	0.00	0.00	10	0.28	0.42	-
AZ	GREENLEE	90	90	30	30	0.00	0.00	10	0.29	0.38	-
AZ	LA PAZ	90	90	30	30	0.00	0.00	10	0.23	0.60	-
AZ	MARICOPA	90	90	30	30	0.00	0.00	10	0.21	0.57	-
AZ	MOHAVE	90	90	30	30	0.00	0.25	20	0.23	0.97	-
AZ	NAVAJO	90	90	30	30	0.00	0.25	30	0.18	0.35	1, 2
AZ	PIMA	90	90	30	30	0.00	0.00	10	0.19	0.79	-
AZ	PINAL	90	90	30	30	0.00	0.00	10	0.21	0.41	-
AZ	SANTA CRUZ	90	90	30	30	0.00	0.00	5	0.18	0.29	-
AZ	YAVAPAI	90	90	30	30	0.00	0.00	20	0.28	0.53	-
AZ	YUMA	90	90	30	30	0.00	0.00	10	0.24	1.12	-

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CA	ALAMEDA	85	85	30	30	0.00	0.00	5	1.50	2.10	-
CA	ALPINE	85	85	30	30	0.00	0.00	10	0.97	2.12	1, 2
CA	AMADOR	85	85	30	30	0.00	0.00	10	0.38	1.17	1, 2
CA	BUTTE	85	85	30	30	0.00	0.00	10	0.47	1.03	2
CA	CALAVERAS	85	85	30	30	0.00	0.00	10	0.38	1.04	1, 2
CA	COLUSA	85	85	30	30	0.00	0.00	10	0.60	1.72	-
CA	CONTRA COSTA	85	85	30	30	0.00	0.00	10	1.21	2.10	-
CA	DEL NORTE	85	85	30	30	0.00	0.25	5	1.20	1.50	1, 2
CA	EL DORADO	85	85	30	30	0.00	0.00	10	0.39	1.75	1, 2
CA	FRESNO	85	85	30	30	0.00	0.00	10	0.42	2.00	1, 2
CA	GLENN	85	85	30	30	0.00	0.00	10	0.58	1.50	-
CA	HUMBOLDT	85	85	30	30	0.00	0.25	5	1.21	2.18	2
CA	IMPERIAL	85	85	30	30	0.00	0.00	5	0.41	2.15	1
CA	INYO	85	85	30	30	0.00	0.00	10	0.42	2.12	1,2
CA	KERN	85	85	30	30	0.00	0.00	10	0.67	2.54	1
CA	KINGS	85	85	30	30	0.00	0.00	10	0.45	1.50	-
CA	LAKE	85	85	30	30	0.00	0.00	5	1.17	2.10	-
CA	LASSEN	85	85	30	30	0.00	0.25	20	0.61	2.05	1, 2
CA	LOS ANGELES	85	85	30	30	0.00	0.00	5	0.60	2.48	1
CA	MADERA	85	85	30	30	0.00	0.00	10	0.43	1.55	1, 2
CA	MARIN	85	85	30	30	0.00	0.00	5	1.48	2.18	-
CA	MARIPOSA	85	85	30	30	0.00	0.00	10	0.40	1.23	1, 2
CA	MENDOCINO	85	85	30	30	0.00	0.00	5	1.03	2.18	-
CA	MERCED	85	85	30	30	0.00	0.00	10	0.41	2.05	-
CA	MODOC	85	85	30	40	0.25	0.25	20	0.71	1.81	1, 2
CA	MONO	85	85	30	30	0.00	0.00	10	1.09	2.09	1, 2
CA	MONTEREY	85	85	30	30	0.00	0.00	5	1.20	2.18	-
CA	NAPA	85	85	30	30	0.00	0.00	5	1.50	2.05	-
CA	NEVADA	85	85	30	30	0.00	0.00	10	0.42	1.31	1, 2
CA	ORANGE	85	85	30	30	0.00	0.00	5	1.21	2.05	1
CA	PLACER	85	85	30	30	0.00	0.00	10	0.40	1.50	1, 2
CA	PLUMAS	85	85	30	30	0.00	0.25	20	0.62	1.69	1, 2
CA	RIVERSIDE	85	85	30	30	0.00	0.00	10	0.26	2.15	1
CA	SACRAMENTO	85	85	30	30	0.00	0.00	10	0.39	1.69	-
CA	SAN BENITO	85	85	30	30	0.00	0.00	5	1.23	2.18	-
CA	SAN BERNARDINO	85	85	30	30	0.00	0.00	10	0.23	2.48	1
CA	SAN DIEGO	85	85	30	30	0.00	0.00	0	0.90	2.12	1
CA	SAN FRANCISCO	85	85	30	30	0.00	0.00	5	0.74	2.08	-
CA	SAN JOAQUIN	85	85	30	30	0.00	0.00	10	0.40	2.01	-
CA	SAN LUIS OBISPO	85	85	30	30	0.00	0.00	5	1.09	2.18	-
CA	SAN MATEO	85	85	30	30	0.00	0.00	5	1.50	2.41	-
CA	SANTA BARBARA	85	85	30	30	0.00	0.00	5	0.64	2.41	-
CA	SANTA CLARA	85	85	30	30	0.00	0.00	5	1.50	2.41	-
CA	SANTA CRUZ	85	85	30	30	0.00	0.00	5	1.50	2.18	-
CA	SHASTA	85	85	30	30	0.00	0.25	10	0.77	1.97	1, 2
CA	SIERRA	85	85	30	30	0.00	0.00	20	0.59	1.41	1, 2
CA	SISKIYOU	85	85	30	40	0.00	0.25	10	0.63	1.90	1, 2

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CA	SOLANO	85	85	30	30	0.00	0.00	10	0.93	2.05	-
CA	SONOMA	85	85	30	30	0.00	0.00	5	1.50	2.18	-
CA	STANISLAUS	85	85	30	30	0.00	0.00	10	0.40	2.05	-
CA	SUTTER	85	85	30	30	0.00	0.00	10	0.42	0.80	-
CA	TEHAMA	85	85	30	30	0.00	0.25	10	0.61	1.30	2
CA	TRINITY	85	85	30	30	0.00	0.25	10	0.73	1.99	2
CA	TULARE	85	85	30	30	0.00	0.00	10	0.42	1.26	1, 2
CA	TUOLUMNE	85	85	30	30	0.00	0.00	10	0.38	1.50	1, 2
CA	VENTURA	85	85	30	30	0.00	0.00	5	0.52	2.41	-
CA	YOLO	85	85	30	30	0.00	0.00	10	0.57	1.72	-
CA	YUBA	85	85	30	30	0.00	0.00	10	0.42	0.73	2
CO	ADAMS	90	90	50	50	0.00	0.25	50	0.12	0.21	1. 2
CO	ALAMOSA	90	90	40	50	0.00	0.00	40	0.35	0.42	1, 2
CO	ARAPAHOE	90	90	50	50	0.00	0.25	50	0.13	0.21	1, 2
CO	ARCHULETA	90	90	40	40	0.00	0.00	30	0.28	0.41	2
CO	BACA	90	90	50	50	0.25	0.50	30	0.11	0.13	-
CO	BENT	90	90	50	50	0.00	0.50	40	0.12	0.15	2
CO	BOULDER	90	90	50	50	0.00	0.00	50	0.20	0.26	2
CO	CHAFFEE	90	90	50	50	0.00	0.00	40	0.30	0.50	2
CO	CHEYENNE	90	90	50	50	0.25	0.50	40	0.10	0.13	-
CO	CLEAR CREEK	90	90	50	50	0.00	0.00	50	0.24	0.28	1, 2
CO	CONEJOS	90	90	40	40	0.00	0.00	30	0.34	0.38	2
CO	COSTILLA	90	90	40	50	0.00	0.00	40	0.34	0.41	1, 2
CO	CROWLEY	90	90	50	50	0.00	0.25	40	0.14	0.16	2
CO	CUSTER	90	90	50	50	0.00	0.00	40	0.19	0.39	1, 2
CO	DELTA	90	90	40	50	0.00	0.25	40	0.40	0.54	2
CO	DENVER	90	90	50	50	0.00	0.00	50	0.18	0.21	1, 2
CO	DOLORES	90	90	40	40	0.00	0.25	40	0.21	0.42	2
CO	DOUGLAS	90	90	50	50	0.00	0.00	50	0.18	0.22	1, 2
CO	EAGLE	90	90	50	50	0.00	0.00	50	0.29	0.48	2
CO	EL PASO	90	90	50	50	0.00	0.00	40	0.16	0.20	1, 2
CO	ELBERT	90	90	50	50	0.00	0.25	50	0.13	0.18	2
CO	FREMONT	90	90	50	50	0.00	0.00	40	0.18	0.44	1, 2
CO	GARFIELD	90	90	40	50	0.00	0.25	50	0.28	0.51	2
CO	GILPIN	90	90	50	50	0.00	0.00	50	0.24	0.26	1, 2
CO	GRAND	90	90	50	50	0.00	0.00	50	0.25	0.30	1, 2
CO	GUNNISON	90	90	40	50	0.00	0.00	40	0.37	0.56	2
CO	HINSDALE	90	90	40	40	0.00	0.00	40	0.40	0.56	2
CO	HUERFANO	90	90	40	50	0.00	0.00	40	0.18	0.41	1, 2
CO	JACKSON	90	90	50	50	0.00	0.00	50	0.24	0.26	2
CO	JEFFERSON	90	90	50	50	0.00	0.00	50	0.20	0.24	1, 2
CO	KIOWA	90	90	50	50	0.25	0.50	40	0.10	0.14	2
CO	KIT CARSON	90	90	50	50	0.25	0.50	50	0.09	0.12	-
CO	LA PLATA	90	90	40	40	0.00	0.25	40	0.21	0.46	2
CO	LAKE	90	90	50	50	0.00	0.00	50	0.32	0.39	2
CO	LARIMER	90	90	50	50	0.00	0.00	50	0.19	0.25	1, 2
CO	LAS ANIMAS	90	90	40	50	0.00	0.25	40	0.13	0.37	1, 2

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CO	LINCOLN	90	90	50	50	0.00	0.25	50	0.12	0.16	2
CO	LOGAN	90	90	50	60	0.25	0.25	50	0.09	0.11	-
CO	MESA	90	90	40	50	0.00	0.25	50	0.27	0.54	2
CO	MINERAL	90	90	40	40	0.00	0.00	40	0.37	0.49	2
CO	MOFFAT	90	90	50	50	0.00	0.25	50	0.26	0.37	2
CO	MONTEZUMA	90	90	40	40	0.00	0.25	30	0.19	0.37	2
CO	MONTROSE	90	90	40	40	0.00	0.25	40	0.26	0.55	2
CO	MORGAN	90	90	50	50	0.00	0.25	50	0.11	0.15	2
CO	OTERO	90	90	50	50	0.00	0.25	40	0.14	0.18	2
CO	OURAY	90	90	40	40	0.00	0.25	40	0.43	0.56	2
CO	PARK	90	90	50	50	0.00	0.00	50	0.22	0.35	2
CO	PHILLIPS	90	90	50	60	0.25	0.50	50	0.08	0.09	-
CO	PITKIN	90	90	50	50	0.00	0.00	50	0.37	0.54	2
CO	PROWERS	90	90	50	50	0.25	0.50	40	0.11	0.12	-
CO	PUEBLO	90	90	50	50	0.00	0.00	40	0.16	0.23	1, 2
CO	RIO BLANCO	90	90	40	50	0.00	0.25	50	0.27	0.40	2
CO	RIO GRANDE	90	90	40	40	0.00	0.00	40	0.34	0.39	2
CO	ROUTT	90	90	50	50	0.00	0.00	50	0.25	0.31	2
CO	SAGUACHE	90	90	40	50	0.00	0.00	40	0.35	0.49	1, 2
CO	SAN JUAN	90	90	40	40	0.00	0.00	40	0.37	0.54	2
CO	SAN MIGUEL	90	90	40	40	0.00	0.25	40	0.24	0.51	2
CO	SEDGWICK	90	90	60	60	0.25	0.50	50	0.08	0.09	-
CO	SUMMIT	90	90	50	50	0.00	0.00	50	0.27	0.33	2
CO	TELLER	90	90	50	50	0.00	0.00	40	0.18	0.22	1, 2
CO	WASHINGTON	90	90	50	50	0.00	0.25	50	0.09	0.13	-
CO	WELD	90	90	50	50	0.00	0.25	50	0.11	0.21	1, 2
CO	YUMA	90	90	50	50	0.25	0.50	50	0.08	0.11	-
CT	FAIRFIELD	90	110	40	50	0.75	0.75	40	0.30	0.41	1, 2
CT	HARTFORD	90	105	40	50	1.00	1.00	40	0.26	0.28	-
CT	LITCHFIELD	90	100	40	40	0.75	1.00	40	0.26	0.33	1, 2
CT	MIDDLESEX	100	120	50	50	0.75	0.75	40	0.25	0.28	-
CT	NEW HAVEN	95	115	50	50	0.75	0.75	40	0.26	0.32	-
CT	NEW LONDON	105	120	50	50	0.75	0.75	40	0.24	0.27	-
CT	TOLLAND	95	105	40	50	0.75	1.00	40	0.26	0.27	-
CT	WINDHAM	100	110	40	50	0.75	1.00	40	0.26	0.27	-
DE	KENT	90	105	30	40	0.50	0.75	30	0.17	0.25	-
DE	NEW CASTLE	90	90	40	40	0.75	0.75	30	0.24	0.33	-
DE	SUSSEX	95	120	40	40	0.50	0.50	20	0.13	0.18	-
FL	ALACHUA	100	105	30	30	0.00	0.00	0	0.11	0.13	-
FL	BAKER	100	105	30	30	0.00	0.00	0	0.13	0.15	-
FL	BAY	115	130	30	30	0.00	0.25	0	0.08	0.11	-
FL	BRADFORD	100	105	30	30	0.00	0.00	0	0.12	0.14	-
FL	BREVARD	115	135	30	30	0.00	0.00	0	0.08	0.11	-
FL	BROWARD	120	140	30	30	0.00	0.00	0	0.06	0.08	-
FL	CALHOUN	110	120	30	30	0.00	0.00	0	0.09	0.11	-
FL	CHARLOTTE	110	130	30	30	0.00	0.00	0	0.08	0.09	-
FL	CITRUS	100	115	30	30	0.00	0.00	0	0.09	0.11	-

State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
FL	CLAY	100	115	30	30	0.00	0.00	0	0.12	0.14	-
FL	COLLIER	120	140	30	30	0.00	0.00	0	0.07	0.09	-
FL	COLUMBIA	100	105	30	30	0.00	0.00	0	0.12	0.15	-
FL	DADE	125	150	30	30	0.00	0.00	0	0.05	0.05	-
FL	DE SOTO	110	115	30	30	0.00	0.00	0	0.08	0.09	-
FL	DIXIE	105	120	30	30	0.00	0.00	0	0.09	0.12	-
FL	DUVAL	105	120	30	30	0.00	0.00	0	0.14	0.16	-
FL	ESCAMBIA	120	145	30	30	0.00	0.25	0	0.10	0.13	-
FL	FLAGLER	110	120	30	30	0.00	0.00	0	0.12	0.12	-
FL	FRANKLIN	120	130	30	30	0.00	0.00	0	0.08	0.10	-
FL	GADSDEN	105	110	30	30	0.00	0.00	0	0.11	0.12	-
FL	GILCHRIST	100	110	30	30	0.00	0.00	0	0.11	0.12	-
FL	GLADES	110	115	30	30	0.00	0.00	0	0.09	0.09	-
FL	GULF	120	135	30	30	0.00	0.00	0	0.08	0.10	-
FL	HAMILTON	100	100	30	30	0.00	0.00	0	0.12	0.14	-
FL	HARDEE	105	110	30	30	0.00	0.00	0	0.09	0.10	-
FL	HENDRY	115	120	30	30	0.00	0.00	0	0.08	0.09	-
FL	HERNANDO	100	120	30	30	0.00	0.00	0	0.09	0.11	-
FL	HIGHLANDS	105	115	30	30	0.00	0.00	0	0.09	0.10	-
FL	HILLSBOROUGH	105	120	30	30	0.00	0.00	0	0.07	0.10	-
FL	HOLMES	110	120	30	30	0.00	0.25	0	0.11	0.11	-
FL	INDIAN RIVER	115	140	30	30	0.00	0.00	0	0.08	0.10	-
FL	JACKSON	105	115	30	30	0.00	0.25	0	0.11	0.12	-
FL	JEFFERSON	105	115	30	30	0.00	0.00	0	0.10	0.12	-
FL	LAFAYETTE	105	110	30	30	0.00	0.00	0	0.11	0.12	-
FL	LAKE	100	110	30	30	0.00	0.00	0	0.11	0.12	-
FL	LEE	115	130	30	30	0.00	0.00	0	0.07	0.09	-
FL	LEON	105	110	30	30	0.00	0.00	0	0.11	0.12	-
FL	LEVY	100	125	30	30	0.00	0.00	0	0.09	0.12	-
FL	LIBERTY	110	120	30	30	0.00	0.00	0	0.09	0.11	-
FL	MADISON	100	105	30	30	0.00	0.00	0	0.11	0.13	-
FL	MANATEE	110	130	30	30	0.00	0.00	0	0.07	0.09	-
FL	MARION	100	110	30	30	0.00	0.00	0	0.10	0.12	-
FL	MARTIN	115	140	30	30	0.00	0.00	0	0.07	0.09	-
FL	MIAMI-DADE	125	150	30	30	0.00	0.00	0	0.05	0.08	-
FL	MONROE	130	150	30	30	0.00	0.00	0	0.02	0.07	-
FL	NASSAU	105	120	30	30	0.00	0.00	0	0.14	0.17	-
FL	OKALOOSA	115	135	30	30	0.00	0.25	0	0.09	0.12	-
FL	OKEECHOBEE	110	120	30	30	0.00	0.00	0	0.08	0.10	-
FL	ORANGE	105	120	30	30	0.00	0.00	0	0.10	0.11	-
FL	OSCEOLA	105	120	30	30	0.00	0.00	0	0.09	0.11	-
FL	PALM BEACH	115	140	30	30	0.00	0.00	0	0.07	0.09	-
FL	PASCO	100	125	30	30	0.00	0.00	0	0.08	0.10	-
FL	PINELLAS	120	130	30	30	0.00	0.00	0	0.08	0.08	-
FL	POLK	100	110	30	30	0.00	0.00	0	0.09	0.11	-
FL	PUTNAM	100	115	30	30	0.00	0.00	0	0.12	0.13	-
FL	SAINT JOHNS	115	120	30	30	0.00	0.00	0	0.12	0.15	-

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FL	SAINT LUCIE	120	140	30	30	0.00	0.00	0	0.08	0.09	-
FL	SANTA ROSA	120	140	30	30	0.00	0.25	0	0.10	0.12	-
FL	SARASOTA	110	130	30	30	0.00	0.00	0	0.07	0.08	-
FL	SEMINOLE	105	120	30	30	0.00	0.00	0	0.11	0.11	-
FL	SUMTER	100	105	30	30	0.00	0.00	0	0.10	0.11	-
FL	SUWANNEE	100	105	30	30	0.00	0.00	0	0.12	0.13	-
FL	TAYLOR	105	120	30	30	0.00	0.00	0	0.10	0.12	-
FL	UNION	100	100	30	30	0.00	0.00	0	0.12	0.13	-
FL	VOLUSIA	105	125	30	30	0.00	0.00	0	0.10	0.12	-
FL	WAKULLA	110	120	30	30	0.00	0.00	0	0.09	0.11	-
FL	WALTON	115	130	30	30	0.00	0.00	0	0.09	0.11	-
FL	WASHINGTON	110	125	30	30	0.00	0.25	0	0.10	0.11	-
GA	APPLING	100	105	30	30	0.25	0.25	5	0.20	0.25	-
GA	ATKINSON	100	100	30	30	0.25	0.25	5	0.15	0.18	-
GA	BACON	100	100	30	30	0.25	0.25	5	0.18	0.20	-
GA	BAKER	100	100	30	30	0.25	0.25	5	0.12	0.13	-
GA	BALDWIN	90	90	30	30	0.50	0.75	10	0.25	0.27	-
GA	BANKS	90	90	30	30	0.75	0.75	10	0.30	0.35	-
GA	BARROW	90	90	30	30	0.75	0.75	10	0.27	0.28	-
GA	BARTOW	90	90	30	30	0.75	0.75	10	0.32	0.46	-
GA	BEN HILL	95	95	30	30	0.25	0.25	5	0.16	0.18	-
GA	BERRIEN	100	100	30	30	0.00	0.25	5	0.14	0.16	-
GA	BIBB	90	90	30	30	0.50	0.50	10	0.20	0.23	-
GA	BLECKLEY	95	95	30	30	0.25	0.50	5	0.19	0.22	-
GA	BRANTLEY	100	110	30	30	0.00	0.25	5	0.17	0.22	-
GA	BROOKS	100	105	30	30	0.00	0.25	5	0.12	0.13	-
GA	BRYAN	105	130	30	30	0.25	0.25	5	0.30	0.38	-
GA	BULLOCH	100	110	30	30	0.25	0.50	5	0.29	0.40	-
GA	BURKE	95	100	30	30	0.50	0.50	5	0.30	0.49	-
GA	BUTTS	90	90	30	30	0.50	0.75	10	0.22	0.24	-
GA	CALHOUN	100	100	30	30	0.25	0.25	5	0.12	0.13	-
GA	CAMDEN	105	130	30	30	0.00	0.25	5	0.17	0.20	-
GA	CANDLER	100	100	30	30	0.25	0.50	5	0.27	0.32	-
GA	CARROLL	90	90	30	30	0.50	0.75	10	0.24	0.29	-
GA	CATOOSA	90	90	30	30	0.75	0.75	10	0.53	0.57	-
GA	CHARLTON	100	105	30	30	0.00	0.25	5	0.14	0.18	-
GA	CHATHAM	110	130	30	30	0.25	0.25	5	0.31	0.42	-
GA	CHATTAHOOCHEE	95	95	30	30	0.50	0.50	10	0.16	0.17	-
GA	CHATTOOGA	90	90	30	30	0.75	0.75	10	0.42	0.53	-
GA	CHEROKEE	90	90	30	30	0.75	0.75	10	0.29	0.41	-
GA	CLARKE	90	90	30	30	0.75	0.75	10	0.28	0.30	-
GA	CLAY	100	100	30	30	0.25	0.25	5	0.12	0.13	-
GA	CLAYTON	90	90	30	30	0.75	0.75	10	0.22	0.25	-
GA	CLINCH	100	100	30	30	0.00	0.25	5	0.14	0.17	-
GA	COBB	90	90	30	30	0.75	0.75	10	0.26	0.34	-
GA	COFFEE	100	100	30	30	0.25	0.25	5	0.16	0.19	-
GA	COLQUITT	100	100	30	30	0.00	0.25	5	0.13	0.15	-

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GA	COLUMBIA	90	95	30	30	0.50	0.75	10	0.37	0.42	-
GA	COOK	100	100	30	30	0.00	0.25	5	0.13	0.15	-
GA	COWETA	90	90	30	30	0.50	0.75	10	0.20	0.24	-
GA	CRAWFORD	90	95	30	30	0.50	0.50	10	0.18	0.21	-
GA	CRISP	95	95	30	30	0.25	0.25	5	0.15	0.17	-
GA	DADE	90	90	30	30	0.75	0.75	10	0.43	0.51	-
GA	DAWSON	90	90	30	30	0.75	0.75	10	0.31	0.41	-
GA	DECATUR	100	105	30	30	0.00	0.25	5	0.11	0.12	-
GA	DEKALB	90	90	30	30	0.75	0.75	10	0.24	0.28	-
GA	DODGE	95	95	30	30	0.25	0.50	5	0.18	0.21	-
GA	DOOLY	95	95	30	30	0.25	0.50	5	0.16	0.18	-
GA	DOUGHERTY	100	100	30	30	0.25	0.25	5	0.13	0.14	-
GA	DOUGLAS	90	90	30	30	0.75	0.75	10	0.25	0.28	-
GA	EARLY	100	105	30	30	0.25	0.25	5	0.12	0.13	-
GA	ECHOLS	100	100	30	30	0.00	0.00	5	0.13	0.15	-
GA	EFFINGHAM	105	115	30	30	0.25	0.25	5	0.36	0.49	-
GA	ELBERT	90	90	30	30	0.75	0.75	10	0.34	0.41	-
GA	EMANUEL	95	100	30	30	0.25	0.50	5	0.25	0.33	-
GA	EVANS	100	105	30	30	0.50	0.50	5	0.27	0.31	-
GA	FANNIN	90	90	30	30	0.75	0.75	10	0.40	0.56	2
GA	FAYETTE	90	90	30	30	0.75	0.75	10	0.21	0.24	-
GA	FLOYD	90	90	30	30	0.75	0.75	10	0.38	0.53	-
GA	FORSYTH	90	90	30	30	0.75	0.75	10	0.28	0.34	-
GA	FRANKLIN	90	90	30	30	0.75	0.75	10	0.31	0.38	-
GA	FULTON	90	90	30	30	0.75	0.75	10	0.24	0.31	-
GA	GILMER	90	90	30	30	0.75	0.75	10	0.39	0.54	-
GA	GLASCOCK	90	95	30	30	0.50	0.50	10	0.29	0.35	-
GA	GLYNN	110	130	30	30	0.25	0.25	5	0.19	0.24	-
GA	GORDON	90	90	30	30	0.75	0.75	10	0.41	0.53	-
GA	GRADY	100	105	30	30	0.00	0.25	5	0.12	0.12	-
GA	GREENE	90	90	30	30	0.75	0.75	10	0.28	0.33	-
GA	GWINNETT	90	90	30	30	0.75	0.75	10	0.26	0.29	-
GA	HABERSHAM	90	90	30	30	0.75	0.75	10	0.33	0.40	2
GA	HALL	90	90	30	30	0.75	0.75	10	0.28	0.35	-
GA	HANCOCK	90	90	30	30	0.50	0.75	10	0.27	0.32	-
GA	HARALSON	90	90	30	30	0.50	0.75	10	0.27	0.34	-
GA	HARRIS	90	95	30	30	0.50	0.50	10	0.17	0.19	-
GA	HART	90	90	30	30	0.75	0.75	10	0.35	0.39	-
GA	HEARD	90	90	30	30	0.50	0.50	10	0.21	0.25	-
GA	HENRY	90	90	30	30	0.75	0.75	10	0.22	0.25	-
GA	HOUSTON	95	95	30	30	0.25	0.50	10	0.18	0.21	-
GA	IRWIN	100	100	30	30	0.25	0.25	5	0.16	0.18	-
GA	JACKSON	90	90	30	30	0.75	0.75	10	0.28	0.31	-
GA	JASPER	90	90	30	30	0.50	0.75	10	0.23	0.26	-
GA	JEFF DAVIS	100	100	30	30	0.25	0.25	5	0.18	0.23	-
GA	JEFFERSON	95	95	30	30	0.50	0.50	10	0.28	0.37	-
GA	JENKINS	100	100	30	30	0.25	0.50	5	0.32	0.41	-

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GA	JOHNSON	95	95	30	30	0.25	0.50	5	0.25	0.28	-
GA	JONES	90	90	30	30	0.50	0.75	10	0.23	0.26	-
GA	LAMAR	90	90	30	30	0.50	0.75	10	0.19	0.22	-
GA	LANIER	100	100	30	30	0.00	0.25	5	0.14	0.16	-
GA	LAURENS	95	95	30	30	0.25	0.50	5	0.20	0.26	-
GA	LEE	95	100	30	30	0.25	0.25	5	0.14	0.16	-
GA	LIBERTY	105	130	30	30	0.25	0.25	5	0.27	0.33	-
GA	LINCOLN	90	90	30	30	0.75	0.75	10	0.39	0.42	-
GA	LONG	105	115	30	30	0.25	0.25	5	0.24	0.28	-
GA	LOWNDES	100	100	30	30	0.00	0.25	5	0.13	0.14	-
GA	LUMPKIN	90	90	30	30	0.75	0.75	10	0.33	0.40	2
GA	MACON	95	95	30	30	0.50	0.50	10	0.16	0.18	-
GA	MADISON	90	90	30	30	0.75	0.75	10	0.29	0.35	-
GA	MARION	95	95	30	30	0.25	0.50	10	0.16	0.17	-
GA	MCDUFFIE	90	90	30	30	0.50	0.75	10	0.34	0.40	-
GA	MCINTOSH	110	130	30	30	0.25	0.25	5	0.23	0.28	-
GA	MERIWETHER	90	90	30	30	0.50	0.75	10	0.18	0.21	-
GA	MILLER	100	105	30	30	0.25	0.25	5	0.12	0.12	-
GA	MITCHELL	100	100	30	30	0.25	0.25	5	0.12	0.14	-
GA	MONROE	90	90	30	30	0.50	0.75	10	0.19	0.23	-
GA	MONTGOMERY	95	100	30	30	0.25	0.25	5	0.22	0.26	-
GA	MORGAN	90	90	30	30	0.75	0.75	10	0.26	0.28	-
GA	MURRAY	90	90	30	30	0.75	0.75	10	0.46	0.57	-
GA	MUSCOGEE	95	95	30	30	0.50	0.50	10	0.16	0.17	-
GA	NEWTON	90	90	30	30	0.75	0.75	10	0.24	0.26	-
GA	OCONEE	90	90	30	30	0.75	0.75	10	0.27	0.29	-
GA	OGLETHORPE	90	90	30	30	0.75	0.75	10	0.29	0.38	-
GA	PAULDING	90	90	30	30	0.75	0.75	10	0.27	0.36	-
GA	PEACH	90	95	30	30	0.50	0.50	10	0.18	0.20	-
GA	PICKENS	90	90	30	30	0.75	0.75	10	0.35	0.45	-
GA	PIERCE	100	105	30	30	0.25	0.25	5	0.18	0.21	-
GA	PIKE	90	90	30	30	0.50	0.75	10	0.19	0.21	-
GA	POLK	90	90	30	30	0.75	0.75	10	0.32	0.39	-
GA	PULASKI	95	95	30	30	0.25	0.50	5	0.17	0.19	-
GA	PUTNAM	90	90	30	30	0.50	0.75	10	0.25	0.28	-
GA	QUITMAN	100	100	30	30	0.25	0.25	5	0.13	0.14	-
GA	RABUN	90	90	30	30	0.75	0.75	10	0.39	0.43	2
GA	RANDOLPH	100	100	30	30	0.25	0.25	5	0.13	0.14	-
GA	RICHMOND	95	95	30	30	0.50	0.50	10	0.36	0.43	-
GA	ROCKDALE	90	90	30	30	0.75	0.75	10	0.24	0.26	-
GA	SCHLEY	95	95	30	30	0.25	0.50	10	0.16	0.17	-
GA	SCREVEN	100	105	30	30	0.25	0.50	5	0.36	0.50	-
GA	SEMINOLE	105	105	30	30	0.00	0.25	5	0.11	0.12	-
GA	SPALDING	90	90	30	30	0.50	0.75	10	0.20	0.22	-
GA	STEPHENS	90	90	30	30	0.75	0.75	10	0.34	0.39	-
GA	STEWART	95	95	30	30	0.25	0.50	10	0.14	0.16	-
GA	SUMTER	95	95	30	30	0.25	0.50	5	0.15	0.17	-

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GA	TALBOT	90	95	30	30	0.50	0.50	10	0.17	0.19	-
GA	TALIAFERRO	90	90	30	30	0.50	0.75	10	0.30	0.36	-
GA	TATTNALL	100	105	30	30	0.50	0.50	5	0.24	0.29	-
GA	TAYLOR	90	95	30	30	0.50	0.50	10	0.17	0.19	-
GA	TELFAIR	95	100	30	30	0.25	0.25	5	0.18	0.21	-
GA	TERRELL	95	100	30	30	0.25	0.25	5	0.13	0.15	-
GA	THOMAS	100	105	30	30	0.00	0.25	5	0.12	0.13	-
GA	TIFT	100	100	30	30	0.25	0.25	5	0.14	0.16	-
GA	TOOMBS	100	100	30	30	0.25	0.25	5	0.23	0.27	-
GA	TOWNS	90	90	30	30	0.75	0.75	10	0.40	0.46	2
GA	TREUTLEN	95	100	30	30	0.25	0.50	5	0.23	0.27	-
GA	TROUP	90	90	30	30	0.50	0.50	10	0.18	0.21	-
GA	TURNER	95	95	30	30	0.25	0.25	5	0.15	0.17	-
GA	TWIGGS	90	95	30	30	0.50	0.50	10	0.19	0.24	-
GA	UNION	90	90	30	30	0.75	0.75	10	0.39	0.49	2
GA	UPSON	90	90	30	30	0.50	0.50	10	0.18	0.20	-
GA	WALKER	90	90	30	30	0.75	0.75	10	0.48	0.55	-
GA	WALTON	90	90	30	30	0.75	0.75	10	0.26	0.28	-
GA	WARE	100	100	30	30	0.00	0.25	5	0.15	0.18	-
GA	WARREN	90	90	30	30	0.50	0.75	10	0.30	0.37	-
GA	WASHINGTON	90	95	30	30	0.50	0.50	10	0.25	0.30	-
GA	WAYNE	105	115	30	30	0.25	0.25	5	0.20	0.25	-
GA	WEBSTER	95	95	30	30	0.25	0.50	10	0.14	0.16	-
GA	WHEELER	95	100	30	30	0.25	0.25	5	0.20	0.24	-
GA	WHITE	90	90	30	30	0.75	0.75	10	0.34	0.40	2
GA	WHITFIELD	90	90	30	30	0.75	0.75	10	0.52	0.57	-
GA	WILCOX	95	95	30	30	0.25	0.25	5	0.16	0.18	-
GA	WILKES	90	90	30	30	0.75	0.75	10	0.33	0.40	-
GA	WILKINSON	90	95	30	30	0.50	0.50	10	0.22	0.26	-
GA	WORTH	95	100	30	30	0.25	0.25	5	0.13	0.16	-
HI	HAWAII	105	105	0.00	0.00	0.00	0.00	0	1.14	2.67	-
HI	HONOLULU	105	105	0.00	0.00	0.00	0.00	0	0.54	0.63	-
HI	KALAWAO	105	105	0.00	0.00	0.00	0.00	0	0.80	0.85	-
HI	KAUAI	105	105	0.00	0.00	0.00	0.00	0	0.17	0.25	-
HI	MAUI	105	105	0.00	0.00	0.00	0.00	0	0.65	1.05	-
IA	ADAIR	90	90	40	40	0.75	0.75	60	0.08	0.08	-
IA	ADAMS	90	90	40	40	0.75	0.75	50	0.08	0.10	-
IA	ALLAMAKEE	90	90	40	40	0.75	0.75	70	0.06	0.08	-
IA	APPANOOSE	90	90	40	40	0.75	0.75	40	0.08	0.10	-
IA	AUDUBON	90	90	40	50	0.75	0.75	60	0.07	0.08	-
IA	BENTON	90	90	40	40	0.75	0.75	60	0.07	0.09	-
IA	BLACK HAWK	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	BOONE	90	90	40	50	0.75	0.75	60	0.07	0.07	-
IA	BREMER	90	90	40	50	0.75	1.00	70	0.06	0.07	-
IA	BUCHANAN	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	BUENA VISTA	90	90	50	50	0.75	1.00	70	0.07	0.08	-
IA	BUTLER	90	90	50	50	0.75	1.00	70	0.06	0.07	-

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IA	CALHOUN	90	90	50	50	0.75	0.75	70	0.07	0.07	-
IA	CARROLL	90	90	50	50	0.75	0.75	60	0.07	0.08	-
IA	CASS	90	90	40	40	0.75	0.75	50	0.08	0.09	-
IA	CEDAR	90	90	40	40	0.75	0.75	60	0.10	0.12	-
IA	CERRO GORDO	90	90	50	50	1.00	1.00	70	0.06	0.06	-
IA	CHEROKEE	90	90	50	50	0.75	1.00	70	0.07	0.08	-
IA	CHICKASAW	90	90	50	50	0.75	1.00	70	0.06	0.07	-
IA	CLARKE	90	90	40	40	0.75	0.75	50	0.08	0.08	-
IA	CLAY	90	90	50	50	1.00	1.00	70	0.07	0.07	-
IA	CLAYTON	90	90	40	40	0.75	0.75	70	0.07	0.08	-
IA	CLINTON	90	90	40	40	0.75	0.75	60	0.11	0.14	-
IA	CRAWFORD	90	90	50	50	0.75	0.75	60	0.07	0.09	-
IA	DALLAS	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	DAVIS	90	90	40	40	0.75	0.75	40	0.09	0.11	-
IA	DECATUR	90	90	40	40	0.75	0.75	40	0.08	0.09	-
IA	DELAWARE	90	90	40	40	0.75	0.75	60	0.08	0.09	-
IA	DES MOINES	90	90	40	40	0.75	0.75	40	0.12	0.14	-
IA	DICKINSON	90	90	50	50	1.00	1.00	70	0.07	0.07	-
IA	DUBUQUE	90	90	40	40	0.75	0.75	60	0.08	0.11	-
IA	EMMET	90	90	50	50	1.00	1.00	70	0.06	0.07	-
IA	FAYETTE	90	90	40	40	0.75	0.75	70	0.06	0.08	-
IA	FLOYD	90	90	50	50	0.75	1.00	70	0.06	0.06	-
IA	FRANKLIN	90	90	50	50	0.75	1.00	70	0.06	0.06	-
IA	FREMONT	90	90	40	40	0.75	0.75	50	0.11	0.13	-
IA	GREENE	90	90	40	50	0.75	0.75	60	0.07	0.07	-
IA	GRUNDY	90	90	40	40	0.75	0.75	60	0.06	0.07	-
IA	GUTHRIE	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	HAMILTON	90	90	40	50	0.75	0.75	70	0.06	0.07	-
IA	HANCOCK	90	90	50	50	1.00	1.00	70	0.06	0.06	-
IA	HARDIN	90	90	40	50	0.75	0.75	70	0.06	0.07	-
IA	HARRISON	90	90	40	50	0.75	0.75	60	0.08	0.12	-
IA	HENRY	90	90	40	40	0.75	0.75	50	0.11	0.12	-
IA	HOWARD	90	90	50	50	0.75	1.00	70	0.06	0.06	-
IA	HUMBOLDT	90	90	50	50	0.75	1.00	70	0.06	0.06	-
IA	IDA	90	90	50	50	0.75	0.75	70	0.08	0.08	-
IA	IOWA	90	90	40	40	0.75	0.75	60	0.08	0.10	-
IA	JACKSON	90	90	40	40	0.75	0.75	60	0.10	0.13	-
IA	JASPER	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	JEFFERSON	90	90	40	40	0.75	0.75	50	0.09	0.11	-
IA	JOHNSON	90	90	40	40	0.75	0.75	60	0.09	0.11	-
IA	JONES	90	90	40	40	0.75	0.75	60	0.08	0.11	-
IA	KEOKUK	90	90	40	40	0.75	0.75	60	0.08	0.10	-
IA	KOSSUTH	90	90	50	50	1.00	1.00	70	0.06	0.06	-
IA	LEE	90	90	40	40	0.75	0.75	40	0.12	0.14	-
IA	LINN	90	90	40	40	0.75	0.75	60	0.08	0.10	-
IA	LOUISA	90	90	40	40	0.75	0.75	50	0.11	0.13	-
IA	LUCAS	90	90	40	40	0.75	0.75	50	0.08	0.08	-

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IA	LYON	90	90	50	50	0.75	1.00	70	0.08	0.11	-
IA	MADISON	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	MAHASKA	90	90	40	40	0.75	0.75	60	0.08	0.09	-
IA	MARION	90	90	40	40	0.75	0.75	60	0.08	0.08	-
IA	MARSHALL	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	MILLS	90	90	40	40	0.75	0.75	50	0.10	0.12	-
IA	MITCHELL	90	90	50	50	1.00	1.00	70	0.06	0.06	-
IA	MONONA	90	90	50	50	0.75	0.75	60	0.08	0.10	-
IA	MONROE	90	90	40	40	0.75	0.75	50	0.08	0.09	-
IA	MONTGOMERY	90	90	40	40	0.75	0.75	50	0.09	0.11	-
IA	MUSCATINE	90	90	40	40	0.75	0.75	50	0.11	0.12	-
IA	O'BRIEN	90	90	50	50	1.00	1.00	70	0.07	0.08	-
IA	OSCEOLA	90	90	50	50	1.00	1.00	70	0.07	0.08	-
IA	PAGE	90	90	40	40	0.75	0.75	50	0.10	0.12	-
IA	PALO ALTO	90	90	50	50	1.00	1.00	70	0.06	0.07	-
IA	PLYMOUTH	90	90	50	50	0.75	1.00	70	0.08	0.11	-
IA	POCAHONTAS	90	90	50	50	0.75	1.00	70	0.06	0.07	-
IA	POLK	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	POTTAWATTAMIE	90	90	40	50	0.75	0.75	50	0.08	0.12	-
IA	POWESHIEK	90	90	40	40	0.75	0.75	60	0.08	0.08	-
IA	RINGGOLD	90	90	40	40	0.75	0.75	40	0.08	0.09	-
IA	SAC	90	90	50	50	0.75	0.75	70	0.07	0.08	-
IA	SCOTT	90	90	40	40	0.75	0.75	60	0.12	0.14	-
IA	SHELBY	90	90	40	50	0.75	0.75	60	0.08	0.09	-
IA	SIOUX	90	90	50	50	0.75	1.00	70	0.08	0.11	-
IA	STORY	90	90	40	40	0.75	0.75	60	0.07	0.07	-
IA	TAMA	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	TAYLOR	90	90	40	40	0.75	0.75	40	0.08	0.11	-
IA	UNION	90	90	40	40	0.75	0.75	50	0.08	0.08	-
IA	VAN BUREN	90	90	40	40	0.75	0.75	40	0.10	0.12	-
IA	WAPELLO	90	90	40	40	0.75	0.75	50	0.08	0.10	-
IA	WARREN	90	90	40	40	0.75	0.75	60	0.07	0.08	-
IA	WASHINGTON	90	90	40	40	0.75	0.75	50	0.09	0.11	-
IA	WAYNE	90	90	40	40	0.75	0.75	40	0.08	0.09	-
IA	WEBSTER	90	90	50	50	0.75	0.75	70	0.06	0.07	-
IA	WINNEBAGO	90	90	50	50	1.00	1.00	70	0.06	0.06	-
IA	WINNESHIEK	90	90	40	50	0.75	1.00	70	0.06	0.07	-
IA	WOODBURY	90	90	50	50	0.75	0.75	70	0.08	0.10	-
IA	WORTH	90	90	50	50	1.00	1.00	70	0.06	0.06	-
IA	WRIGHT	90	90	50	50	0.75	1.00	70	0.06	0.06	-
ID	ADA	90	90	40	40	0.25	0.25	40	0.29	0.42	-
ID	ADAMS	90	90	40	40	0.25	0.25	40	0.40	0.59	-
ID	BANNOCK	90	90	50	50	0.25	0.25	50	0.36	0.95	-
ID	BEAR LAKE	90	90	50	50	0.25	0.25	50	1.00	1.36	2
ID	BENEWAH	90	90	40	40	0.25	0.25	40	0.30	0.38	-
ID	BINGHAM	90	90	50	50	0.25	0.25	50	0.28	1.08	-
ID	BLAINE	90	90	40	50	0.25	0.25	50	0.25	1.03	-

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ID	BOISE	90	90	40	40	0.25	0.25	40	0.39	1.07	-
ID	BONNER	90	90	40	40	0.25	0.25	40	0.29	0.40	-
ID	BONNEVILLE	90	90	50	50	0.25	0.25	50	0.36	1.65	2
ID	BOUNDARY	90	90	40	40	0.25	0.25	40	0.29	0.34	2
ID	BUTTE	90	90	50	50	0.00	0.25	50	0.28	1.22	1
ID	CAMAS	90	90	40	40	0.25	0.25	40	0.36	0.89	-
ID	CANYON	90	90	40	40	0.25	0.25	40	0.29	0.37	-
ID	CARIBOU	90	90	50	50	0.25	0.25	50	0.63	1.60	2
ID	CASSIA	90	90	40	50	0.25	0.25	40	0.27	0.73	-
ID	CLARK	90	90	50	50	0.00	0.25	50	0.41	1.59	1, 2
ID	CLEARWATER	90	90	40	40	0.25	0.25	50	0.28	0.36	1, 2
ID	CUSTER	90	90	40	50	0.00	0.25	50	0.50	1.27	1
ID	ELMORE	90	90	40	40	0.25	0.25	40	0.27	0.98	-
ID	FRANKLIN	90	90	50	50	0.25	0.25	50	0.87	1.05	-
ID	FREMONT	90	90	50	50	0.25	0.25	60	0.40	1.71	1, 2
ID	GEM	90	90	40	40	0.25	0.25	40	0.34	0.57	-
ID	GOODING	90	90	40	40	0.25	0.25	40	0.27	0.39	-
ID	IDAHO	90	90	40	40	0.00	0.25	50	0.28	0.62	1, 2
ID	JEFFERSON	90	90	50	50	0.25	0.25	50	0.35	0.70	-
ID	JEROME	90	90	40	40	0.25	0.25	40	0.26	0.29	-
ID	KOOTENAI	90	90	40	40	0.25	0.25	40	0.32	0.40	-
ID	LATAH	90	90	40	40	0.25	0.25	40	0.29	0.33	-
ID	LEMHI	90	90	40	50	0.00	0.00	50	0.35	1.26	1, 2
ID	LEWIS	90	90	40	40	0.25	0.25	40	0.28	0.29	-
ID	LINCOLN	90	90	40	50	0.25	0.25	40	0.25	0.38	-
ID	MADISON	90	90	50	50	0.25	0.25	50	0.42	0.88	-
ID	MINIDOKA	90	90	40	50	0.25	0.25	40	0.25	0.28	-
ID	NEZ PERCE	90	90	40	40	0.25	0.25	40	0.28	0.30	-
ID	ONEIDA	90	90	40	50	0.25	0.25	50	0.53	1.11	-
ID	OWYHEE	90	90	40	40	0.25	0.25	40	0.24	0.37	-
ID	PAYETTE	90	90	40	40	0.25	0.25	40	0.31	0.48	-
ID	POWER	90	90	50	50	0.25	0.25	50	0.26	0.66	-
ID	SHOSHONE	90	90	40	40	0.25	0.25	40	0.31	0.41	1, 2
ID	TETON	90	90	50	50	0.25	0.25	60	0.63	1.19	2
ID	TWIN FALLS	90	90	40	40	0.25	0.25	40	0.25	0.40	-
ID	VALLEY	90	90	40	40	0.00	0.25	40	0.41	1.08	1
ID	WASHINGTON	90	90	40	40	0.25	0.25	40	0.35	0.60	-
IL	ADAMS	90	90	40	40	1.00	1.00	40	0.15	0.20	-
IL	ALEXANDER	90	90	40	40	1.00	1.00	20	1.85	3.41	-
IL	BOND	90	90	40	40	1.00	1.00	30	0.50	0.63	-
IL	BOONE	90	90	40	40	0.75	0.75	60	0.15	0.18	-
IL	BROWN	90	90	40	40	1.00	1.00	40	0.18	0.21	-
IL	BUREAU	90	90	40	40	0.75	0.75	50	0.16	0.19	-
IL	CALHOUN	90	90	40	40	1.00	1.00	30	0.25	0.42	-
IL	CARROLL	90	90	40	40	0.75	0.75	60	0.12	0.16	-
IL	CASS	90	90	40	40	1.00	1.00	40	0.19	0.23	-
IL	CHAMPAIGN	90	90	40	40	1.00	1.00	40	0.19	0.27	-

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IL	CHRISTIAN	90	90	40	40	1.00	1.00	30	0.26	0.40	-
IL	CLARK	90	90	40	40	1.00	1.00	30	0.35	0.48	-
IL	CLAY	90	90	40	40	1.00	1.00	30	0.60	0.80	-
IL	CLINTON	90	90	40	40	1.00	1.00	30	0.61	0.77	-
IL	COLES	90	90	40	40	1.00	1.00	30	0.30	0.40	-
IL	COOK	90	90	40	40	0.75	0.75	50	0.17	0.22	-
IL	CRAWFORD	90	90	40	40	1.00	1.00	30	0.45	0.62	-
IL	CUMBERLAND	90	90	40	40	1.00	1.00	30	0.40	0.49	-
IL	DE KALB	90	90	40	40	0.75	0.75	60	0.18	0.22	-
IL	DEWITT	90	90	40	40	1.00	1.00	40	0.20	0.24	-
IL	DOUGLAS	90	90	40	40	1.00	1.00	40	0.27	0.32	-
IL	DU PAGE	90	90	40	40	0.75	0.75	50	0.19	0.23	-
IL	EDGAR	90	90	40	40	1.00	1.00	40	0.26	0.37	-
IL	EDWARDS	90	90	30	40	1.00	1.00	20	0.78	0.95	-
IL	EFFINGHAM	90	90	40	40	1.00	1.00	30	0.45	0.61	-
IL	FAYETTE	90	90	40	40	1.00	1.00	30	0.43	0.63	-
IL	FORD	90	90	40	40	1.00	1.00	40	0.18	0.19	-
IL	FRANKLIN	90	90	30	40	1.00	1.00	20	0.95	1.09	-
IL	FULTON	90	90	40	40	0.75	1.00	40	0.16	0.19	-
IL	GALLATIN	90	90	30	30	1.00	1.00	20	0.97	1.11	-
IL	GREENE	90	90	40	40	1.00	1.00	30	0.26	0.37	-
IL	GRUNDY	90	90	40	40	0.75	1.00	50	0.19	0.22	-
IL	HAMILTON	90	90	30	40	1.00	1.00	20	0.95	1.07	-
IL	HANCOCK	90	90	40	40	0.75	1.00	40	0.13	0.17	-
IL	HARDIN	90	90	40	40	1.00	1.00	20	1.01	1.17	-
IL	HENDERSON	90	90	40	40	0.75	0.75	40	0.13	0.15	-
IL	HENRY	90	90	40	40	0.75	0.75	50	0.14	0.17	-
IL	IROQUOIS	90	90	40	40	1.00	1.00	40	0.17	0.19	-
IL	JACKSON	90	90	30	40	1.00	1.00	20	0.96	1.29	-
IL	JASPER	90	90	40	40	1.00	1.00	30	0.47	0.63	-
IL	JEFFERSON	90	90	30	40	1.00	1.00	20	0.79	1.00	-
IL	JERSEY	90	90	40	40	1.00	1.00	30	0.32	0.45	-
IL	JO DAVIESS	90	90	40	40	0.75	0.75	60	0.10	0.13	-
IL	JOHNSON	90	90	40	40	1.00	1.00	20	1.21	2.48	-
IL	KANE	90	90	40	40	0.75	0.75	60	0.19	0.23	-
IL	KANKAKEE	90	90	40	40	0.75	1.00	40	0.17	0.20	-
IL	KENDALL	90	90	40	40	0.75	0.75	50	0.21	0.23	-
IL	KNOX	90	90	40	40	0.75	1.00	50	0.15	0.17	-
IL	LA SALLE	90	90	40	40	0.75	1.00	50	0.18	0.22	-
IL	LAKE	90	90	40	40	0.75	0.75	60	0.14	0.19	-
IL	LAWRENCE	90	90	40	40	1.00	1.00	20	0.56	0.77	-
IL	LEE	90	90	40	40	0.75	0.75	60	0.16	0.20	-
IL	LIVINGSTON	90	90	40	40	0.75	1.00	40	0.18	0.19	-
IL	LOGAN	90	90	40	40	1.00	1.00	40	0.19	0.25	-
IL	MACON	90	90	40	40	1.00	1.00	40	0.23	0.31	-
IL	MACOUPIN	90	90	40	40	1.00	1.00	30	0.28	0.50	-
IL	MADISON	90	90	40	40	1.00	1.00	30	0.42	0.63	-

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IL	MARION	90	90	40	40	1.00	1.00	30	0.61	0.85	-
IL	MARSHALL	90	90	40	40	0.75	1.00	40	0.17	0.18	-
IL	MASON	90	90	40	40	1.00	1.00	40	0.18	0.21	-
IL	MASSAC	90	90	40	40	1.00	1.00	20	1.36	2.51	-
IL	MCDONOUGH	90	90	40	40	0.75	1.00	40	0.15	0.18	-
IL	MCHENRY	90	90	40	40	0.75	0.75	60	0.16	0.19	-
IL	MCLEAN	90	90	40	40	1.00	1.00	40	0.18	0.21	-
IL	MENARD	90	90	40	40	1.00	1.00	40	0.20	0.24	-
IL	MERCER	90	90	40	40	0.75	0.75	50	0.12	0.15	-
IL	MONROE	90	90	40	40	1.00	1.00	30	0.60	0.80	-
IL	MONTGOMERY	90	90	40	40	1.00	1.00	30	0.31	0.53	-
IL	MORGAN	90	90	40	40	1.00	1.00	30	0.21	0.29	-
IL	MOULTRIE	90	90	40	40	1.00	1.00	30	0.28	0.38	-
IL	OGLE	90	90	40	40	0.75	0.75	60	0.14	0.19	-
IL	PEORIA	90	90	40	40	0.75	1.00	40	0.16	0.18	-
IL	PERRY	90	90	30	40	1.00	1.00	20	0.85	1.03	-
IL	PIATT	90	90	40	40	1.00	1.00	40	0.21	0.28	-
IL	PIKE	90	90	40	40	1.00	1.00	30	0.18	0.27	-
IL	POPE	90	90	40	40	1.00	1.00	20	1.12	1.58	-
IL	PULASKI	90	90	40	40	1.00	1.00	20	2.18	3.32	-
IL	PUTNAM	90	90	40	40	0.75	0.75	50	0.18	0.18	-
IL	RANDOLPH	90	90	30	40	1.00	1.00	20	0.75	1.01	-
IL	RICHLAND	90	90	40	40	1.00	1.00	30	0.62	0.82	-
IL	ROCK ISLAND	90	90	40	40	0.75	0.75	50	0.12	0.15	-
IL	SAINT CLAIR	90	90	40	40	1.00	1.00	30	0.58	0.83	-
IL	SALINE	90	90	30	30	1.00	1.00	20	1.05	1.21	-
IL	SANGAMON	90	90	40	40	1.00	1.00	40	0.23	0.32	-
IL	SCHUYLER	90	90	40	40	1.00	1.00	40	0.17	0.19	-
IL	SCOTT	90	90	40	40	1.00	1.00	30	0.22	0.27	-
IL	SHELBY	90	90	40	40	1.00	1.00	30	0.30	0.46	-
IL	STARK	90	90	40	40	0.75	1.00	50	0.16	0.17	-
IL	STEPHENSON	90	90	40	40	0.75	0.75	60	0.12	0.16	-
IL	TAZEWELL	90	90	40	40	1.00	1.00	40	0.17	0.19	-
IL	UNION	90	90	40	40	1.00	1.00	20	1.22	2.41	-
IL	VERMILION	90	90	40	40	1.00	1.00	40	0.18	0.27	-
IL	WABASH	90	90	30	40	1.00	1.00	20	0.65	0.91	-
IL	WARREN	90	90	40	40	0.75	1.00	40	0.13	0.16	-
IL	WASHINGTON	90	90	40	40	1.00	1.00	20	0.71	0.91	-
IL	WAYNE	90	90	40	40	1.00	1.00	20	0.77	0.98	-
IL	WHITE	90	90	30	40	1.00	1.00	20	0.90	1.05	-
IL	WHITESIDE	90	90	40	40	0.75	0.75	60	0.13	0.17	-
IL	WILL	90	90	40	40	0.75	1.00	50	0.18	0.23	-
IL	WILLIAMSON	90	90	30	30	1.00	1.00	20	1.08	1.30	-
IL	WINNEBAGO	90	90	40	40	0.75	0.75	60	0.14	0.18	-
IL	WOODFORD	90	90	40	40	0.75	0.75	40	0.17	0.18	-
IN	ADAMS	90	90	40	40	0.75	1.00	40	0.18	0.25	-
IN	ALLEN	90	90	40	40	1.00	1.00	40	0.14	0.20	-

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IN	BARTHOLOMEW	90	90	40	40	0.75	0.75	30	0.18	0.24	-
IN	BENTON	90	90	40	40	1.00	1.00	40	0.16	0.18	-
IN	BLACKFORD	90	90	40	40	0.75	1.00	40	0.17	0.19	-
IN	BOONE	90	90	40	40	1.00	1.00	40	0.17	0.21	-
IN	BROWN	90	90	40	40	0.75	0.75	30	0.21	0.27	-
IN	CARROLL	90	90	40	40	1.00	1.00	40	0.15	0.17	-
IN	CASS	90	90	40	40	1.00	1.00	40	0.13	0.15	-
IN	CLARK	90	90	30	30	0.75	0.75	20	0.21	0.26	-
IN	CLAY	90	90	40	40	0.75	1.00	30	0.27	0.40	-
IN	CLINTON	90	90	40	40	1.00	1.00	40	0.16	0.18	-
IN	CRAWFORD	90	90	30	30	0.75	0.75	20	0.29	0.39	-
IN	DAVIESS	90	90	40	40	0.75	0.75	20	0.39	0.54	-
IN	DE KALB	90	90	40	40	1.00	1.00	40	0.13	0.16	-
IN	DEARBORN	90	90	30	40	0.75	0.75	30	0.18	0.19	-
IN	DECATUR	90	90	40	40	0.75	0.75	30	0.18	0.19	-
IN	DELAWARE	90	90	40	40	0.75	1.00	40	0.17	0.19	-
IN	DUBOIS	90	90	30	40	0.75	0.75	20	0.37	0.51	-
IN	ELKHART	90	90	40	40	0.75	1.00	50	0.12	0.13	-
IN	FAYETTE	90	90	40	40	0.75	0.75	40	0.17	0.18	-
IN	FLOYD	90	90	30	30	0.75	0.75	20	0.24	0.27	-
IN	FOUNTAIN	90	90	40	40	1.00	1.00	40	0.18	0.24	-
IN	FRANKLIN	90	90	40	40	0.75	0.75	30	0.18	0.18	-
IN	FULTON	90	90	40	40	1.00	1.00	40	0.13	0.14	-
IN	GIBSON	90	90	30	40	0.75	1.00	20	0.59	0.91	-
IN	GRANT	90	90	40	40	1.00	1.00	40	0.15	0.17	-
IN	GREENE	90	90	40	40	0.75	1.00	30	0.30	0.46	-
IN	HAMILTON	90	90	40	40	0.75	1.00	40	0.16	0.18	-
IN	HANCOCK	90	90	40	40	0.75	0.75	40	0.17	0.18	-
IN	HARRISON	90	90	30	30	0.75	0.75	20	0.26	0.31	-
IN	HENDRICKS	90	90	40	40	0.75	1.00	40	0.19	0.25	-
IN	HENRY	90	90	40	40	0.75	0.75	40	0.17	0.18	-
IN	HOWARD	90	90	40	40	1.00	1.00	40	0.15	0.16	-
IN	HUNTINGTON	90	90	40	40	1.00	1.00	40	0.14	0.17	-
IN	JACKSON	90	90	40	40	0.75	0.75	20	0.20	0.27	-
IN	JASPER	90	90	40	40	1.00	1.00	40	0.15	0.17	-
IN	JAY	90	90	40	40	0.75	1.00	40	0.19	0.26	-
IN	JEFFERSON	90	90	30	40	0.75	0.75	20	0.19	0.22	-
IN	JENNINGS	90	90	40	40	0.75	0.75	20	0.18	0.22	-
IN	JOHNSON	90	90	40	40	0.75	0.75	30	0.18	0.23	-
IN	KNOX	90	90	40	40	0.75	1.00	20	0.42	0.76	-
IN	KOSCIUSKO	90	90	40	40	1.00	1.00	40	0.12	0.14	-
IN	LA PORTE	90	90	40	40	0.75	1.00	50	0.12	0.15	-
IN	LAGRANGE	90	90	40	40	0.75	1.00	50	0.12	0.13	-
IN	LAKE	90	90	40	40	0.75	1.00	50	0.16	0.18	-
IN	LAWRENCE	90	90	40	40	0.75	0.75	20	0.26	0.36	-
IN	MADISON	90	90	40	40	0.75	1.00	40	0.16	0.17	-
IN	MARION	90	90	40	40	0.75	1.00	40	0.17	0.21	-

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IN	MARSHALL	90	90	40	40	0.75	1.00	40	0.12	0.13	-
IN	MARTIN	90	90	40	40	0.75	0.75	20	0.34	0.43	-
IN	MIAMI	90	90	40	40	1.00	1.00	40	0.13	0.15	-
IN	MONROE	90	90	40	40	0.75	0.75	30	0.25	0.33	-
IN	MONTGOMERY	90	90	40	40	1.00	1.00	40	0.18	0.24	-
IN	MORGAN	90	90	40	40	0.75	1.00	30	0.20	0.27	-
IN	NEWTON	90	90	40	40	1.00	1.00	40	0.16	0.18	-
IN	NOBLE	90	90	40	40	1.00	1.00	40	0.12	0.15	-
IN	OHIO	90	90	30	40	0.75	0.75	20	0.18	0.19	-
IN	ORANGE	90	90	30	40	0.75	0.75	20	0.28	0.38	-
IN	OWEN	90	90	40	40	0.75	1.00	30	0.26	0.38	-
IN	PARKE	90	90	40	40	1.00	1.00	40	0.23	0.30	-
IN	PERRY	90	90	30	30	0.75	0.75	20	0.34	0.42	-
IN	PIKE	90	90	30	40	0.75	0.75	20	0.48	0.62	-
IN	PORTER	90	90	40	40	0.75	1.00	50	0.14	0.17	-
IN	POSEY	90	90	30	30	0.75	1.00	20	0.77	0.99	-
IN	PULASKI	90	90	40	40	1.00	1.00	40	0.13	0.15	-
IN	PUTNAM	90	90	40	40	1.00	1.00	40	0.22	0.30	-
IN	RANDOLPH	90	90	40	40	0.75	0.75	40	0.18	0.25	-
IN	RIPLEY	90	90	40	40	0.75	0.75	30	0.18	0.19	-
IN	RUSH	90	90	40	40	0.75	0.75	40	0.17	0.18	-
IN	SCOTT	90	90	30	40	0.75	0.75	20	0.21	0.24	-
IN	SHELBY	90	90	40	40	0.75	0.75	30	0.18	0.20	-
IN	SPENCER	90	90	30	30	0.75	0.75	20	0.41	0.58	-
IN	ST JOSEPH	90	90	40	40	0.75	1.00	50	0.12	0.13	-
IN	STARKE	90	90	40	40	0.75	1.00	40	0.13	0.15	-
IN	STEUBEN	90	90	40	40	1.00	1.00	50	0.13	0.15	-
IN	SULLIVAN	90	90	40	40	0.75	1.00	30	0.38	0.54	-
IN	SWITZERLAND	90	90	30	40	0.75	0.75	20	0.19	0.19	-
IN	TIPPECANOE	90	90	40	40	1.00	1.00	40	0.16	0.19	-
IN	TIPTON	90	90	40	40	1.00	1.00	40	0.16	0.17	-
IN	UNION	90	90	40	40	0.75	0.75	40	0.18	0.19	-
IN	VANDERBURGH	90	90	30	30	0.75	1.00	20	0.63	0.80	-
IN	VERMILLION	90	90	40	40	1.00	1.00	40	0.22	0.31	-
IN	VIGO	90	90	40	40	1.00	1.00	30	0.28	0.41	-
IN	WABASH	90	90	40	40	1.00	1.00	40	0.13	0.16	-
IN	WARREN	90	90	40	40	1.00	1.00	40	0.18	0.22	-
IN	WARRICK	90	90	30	30	0.75	0.75	20	0.48	0.64	-
IN	WASHINGTON	90	90	30	40	0.75	0.75	20	0.24	0.29	-
IN	WAYNE	90	90	40	40	0.75	0.75	40	0.18	0.22	-
IN	WELLS	90	90	40	40	1.00	1.00	40	0.16	0.20	-
IN	WHITE	90	90	40	40	1.00	1.00	40	0.14	0.17	-
IN	WHITLEY	90	90	40	40	1.00	1.00	40	0.13	0.16	-
KS	ALLEN	90	90	40	40	1.00	1.00	20	0.11	0.12	-
KS	ANDERSON	90	90	40	40	1.00	1.00	30	0.12	0.12	-
KS	ATCHISON	90	90	40	40	0.75	0.75	30	0.13	0.17	-
KS	BARBER	90	90	40	40	0.75	0.75	30	0.12	0.14	-

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KS	BARTON	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	BOURBON	90	90	40	40	1.00	1.00	20	0.12	0.12	-
KS	BROWN	90	90	40	40	0.75	0.75	30	0.13	0.18	-
KS	BUTLER	90	90	40	40	0.75	0.75	30	0.12	0.14	-
KS	CHASE	90	90	40	40	0.75	0.75	30	0.12	0.16	-
KS	CHAUTAUQUA	90	90	40	40	0.75	1.00	20	0.12	0.12	-
KS	CHEROKEE	90	90	30	40	1.00	1.00	20	0.12	0.14	-
KS	CHEYENNE	90	90	50	50	0.50	0.50	40	0.08	0.09	-
KS	CLARK	90	90	40	40	0.75	0.75	30	0.10	0.12	-
KS	CLAY	90	90	40	40	0.75	0.75	30	0.15	0.19	-
KS	CLOUD	90	90	40	40	0.75	0.75	30	0.12	0.15	-
KS	COFFEY	90	90	40	40	0.75	1.00	30	0.12	0.14	-
KS	COMANCHE	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	COWLEY	90	90	40	40	0.75	0.75	30	0.12	0.14	-
KS	CRAWFORD	90	90	40	40	1.00	1.00	20	0.12	0.13	-
KS	DECATUR	90	90	50	50	0.50	0.50	40	0.09	0.11	-
KS	DICKINSON	90	90	40	40	0.75	0.75	30	0.13	0.19	-
KS	DONIPHAN	90	90	40	40	0.75	0.75	30	0.12	0.15	-
KS	DOUGLAS	90	90	40	40	0.75	1.00	30	0.13	0.16	-
KS	EDWARDS	90	90	40	40	0.75	0.75	30	0.10	0.11	-
KS	ELK	90	90	40	40	0.75	1.00	30	0.11	0.12	-
KS	ELLIS	90	90	40	40	0.75	0.75	30	0.12	0.13	-
KS	ELLSWORTH	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	FINNEY	90	90	40	50	0.50	0.75	30	0.09	0.10	-
KS	FORD	90	90	40	40	0.75	0.75	30	0.09	0.11	-
KS	FRANKLIN	90	90	40	40	0.75	1.00	30	0.12	0.14	-
KS	GEARY	90	90	40	40	0.75	0.75	30	0.18	0.22	-
KS	GOVE	90	90	50	50	0.50	0.75	30	0.09	0.11	-
KS	GRAHAM	90	90	50	50	0.75	0.75	30	0.11	0.13	-
KS	GRANT	90	90	50	50	0.50	0.75	30	0.10	0.11	-
KS	GRAY	90	90	40	50	0.75	0.75	30	0.09	0.10	-
KS	GREELEY	90	90	50	50	0.50	0.50	30	0.09	0.11	-
KS	GREENWOOD	90	90	40	40	0.75	1.00	30	0.11	0.13	-
KS	HAMILTON	90	90	50	50	0.50	0.50	30	0.10	0.11	-
KS	HARPER	90	90	40	40	0.75	0.75	30	0.13	0.15	-
KS	HARVEY	90	90	40	40	0.75	0.75	30	0.13	0.14	-
KS	HASKELL	90	90	50	50	0.75	0.75	30	0.10	0.10	-
KS	HODGEMAN	90	90	40	40	0.75	0.75	30	0.09	0.10	-
KS	JACKSON	90	90	40	40	0.75	0.75	30	0.16	0.21	-
KS	JEFFERSON	90	90	40	40	0.75	0.75	30	0.14	0.17	-
KS	JEWELL	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	JOHNSON	90	90	40	40	0.75	1.00	30	0.12	0.13	-
KS	KEARNY	90	90	50	50	0.50	0.75	30	0.09	0.10	-
KS	KINGMAN	90	90	40	40	0.75	0.75	30	0.12	0.14	-
KS	KIOWA	90	90	40	40	0.75	0.75	30	0.10	0.12	-
KS	LABETTE	90	90	40	40	1.00	1.00	20	0.12	0.13	-
KS	LANE	90	90	40	50	0.75	0.75	30	0.09	0.10	-

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KS	LEAVENWORTH	90	90	40	40	0.75	0.75	30	0.12	0.14	-
KS	LINCOLN	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	LINN	90	90	40	40	1.00	1.00	30	0.12	0.12	-
KS	LOGAN	90	90	50	50	0.50	0.75	40	0.09	0.09	-
KS	LYON	90	90	40	40	0.75	0.75	30	0.12	0.18	-
KS	MARION	90	90	40	40	0.75	0.75	30	0.13	0.16	-
KS	MARSHALL	90	90	40	40	0.75	0.75	30	0.17	0.21	-
KS	MCPHERSON	90	90	40	40	0.75	0.75	30	0.12	0.13	-
KS	MEADE	90	90	40	40	0.75	0.75	30	0.10	0.11	-
KS	MIAMI	90	90	40	40	0.75	1.00	30	0.12	0.13	-
KS	MITCHELL	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	MONTGOMERY	90	90	40	40	1.00	1.00	20	0.12	0.12	-
KS	MORRIS	90	90	40	40	0.75	0.75	30	0.15	0.20	-
KS	MORTON	90	90	50	50	0.50	0.75	30	0.11	0.11	-
KS	NEMAHA	90	90	40	40	0.75	0.75	30	0.16	0.21	-
KS	NEOSHO	90	90	40	40	1.00	1.00	20	0.11	0.12	-
KS	NESS	90	90	40	50	0.75	0.75	30	0.09	0.12	-
KS	NORTON	90	90	50	50	0.50	0.75	40	0.10	0.12	-
KS	OSAGE	90	90	40	40	0.75	1.00	30	0.13	0.18	-
KS	OSBORNE	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	OTTAWA	90	90	40	40	0.75	0.75	30	0.12	0.15	-
KS	PAWNEE	90	90	40	40	0.75	0.75	30	0.10	0.11	-
KS	PHILLIPS	90	90	40	50	0.75	0.75	30	0.10	0.12	-
KS	POTTAWATOMIE	90	90	40	40	0.75	0.75	30	0.19	0.24	-
KS	PRATT	90	90	40	40	0.75	0.75	30	0.11	0.13	-
KS	RAWLINS	90	90	50	50	0.50	0.50	40	0.08	0.09	-
KS	RENO	90	90	40	40	0.75	0.75	30	0.12	0.14	-
KS	REPUBLIC	90	90	40	40	0.75	0.75	30	0.12	0.15	-
KS	RICE	90	90	40	40	0.75	0.75	30	0.11	0.13	-
KS	RILEY	90	90	40	40	0.75	0.75	30	0.18	0.23	-
KS	ROOKS	90	90	40	50	0.75	0.75	30	0.11	0.13	-
KS	RUSH	90	90	40	40	0.75	0.75	30	0.10	0.12	-
KS	RUSSELL	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	SALINE	90	90	40	40	0.75	0.75	30	0.12	0.14	-
KS	SCOTT	90	90	50	50	0.50	0.75	30	0.09	0.09	-
KS	SEDGWICK	90	90	40	40	0.75	0.75	30	0.13	0.14	-
KS	SEWARD	90	90	40	50	0.75	0.75	30	0.10	0.11	-
KS	SHAWNEE	90	90	40	40	0.75	0.75	30	0.15	0.22	-
KS	SHERIDAN	90	90	50	50	0.50	0.75	40	0.09	0.11	-
KS	SHERMAN	90	90	50	50	0.50	0.50	40	0.08	0.10	-
KS	SMITH	90	90	40	50	0.75	0.75	30	0.10	0.11	-
KS	STAFFORD	90	90	40	40	0.75	0.75	30	0.11	0.12	-
KS	STANTON	90	90	50	50	0.50	0.50	30	0.10	0.11	-
KS	STEVENS	90	90	50	50	0.50	0.75	30	0.10	0.11	-
KS	SUMNER	90	90	40	40	0.75	0.75	30	0.13	0.15	-
KS	THOMAS	90	90	50	50	0.50	0.50	40	0.08	0.09	-
KS	TREGO	90	90	40	50	0.75	0.75	30	0.10	0.13	-

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KS	WABAUNSEE	90	90	40	40	0.75	0.75	30	0.17	0.23	-
KS	WALLACE	90	90	50	50	0.50	0.50	40	0.09	0.10	-
KS	WASHINGTON	90	90	40	40	0.75	0.75	30	0.14	0.19	-
KS	WICHITA	90	90	50	50	0.50	0.50	30	0.09	0.10	-
KS	WILSON	90	90	40	40	1.00	1.00	20	0.11	0.12	-
KS	WOODSON	90	90	40	40	1.00	1.00	30	0.11	0.12	-
KS	WYANDOTTE	90	90	40	40	0.75	0.75	30	0.12	0.13	-
KY	ADAIR	90	90	30	30	0.75	0.75	20	0.22	0.24	-
KY	ALLEN	90	90	30	30	0.75	0.75	20	0.26	0.29	-
KY	ANDERSON	90	90	30	30	0.75	0.75	20	0.22	0.23	-
KY	BALLARD	90	90	30	30	1.00	1.00	20	2.39	3.40	-
KY	BARREN	90	90	30	30	0.75	0.75	20	0.25	0.27	-
KY	BATH	90	90	30	30	0.75	0.75	30	0.27	0.28	-
KY	BELL	90	90	30	30	0.50	0.75	30	0.36	0.45	2
KY	BOONE	90	90	30	40	0.75	0.75	20	0.18	0.20	-
KY	BOURBON	90	90	30	30	0.75	0.75	20	0.25	0.28	-
KY	BOYD	90	90	30	30	0.75	0.75	30	0.22	0.23	2
KY	BOYLE	90	90	30	30	0.75	0.75	20	0.22	0.23	-
KY	BRACKEN	90	90	30	30	0.75	0.75	20	0.22	0.26	-
KY	BREATHITT	90	90	30	30	0.50	0.75	30	0.26	0.28	2
KY	BRECKINRIDGE	90	90	30	30	0.75	0.75	20	0.28	0.39	-
KY	BULLITT	90	90	30	30	0.75	0.75	20	0.23	0.26	-
KY	BUTLER	90	90	30	30	0.75	0.75	20	0.31	0.43	-
KY	CALDWELL	90	90	30	30	0.75	1.00	20	0.74	1.05	-
KY	CALLOWAY	90	90	30	30	0.75	1.00	20	0.89	1.25	-
KY	CAMPBELL	90	90	30	40	0.75	0.75	20	0.19	0.21	-
KY	CARLISLE	90	90	30	30	1.00	1.00	20	1.86	3.25	-
KY	CARROLL	90	90	30	30	0.75	0.75	20	0.19	0.20	-
KY	CARTER	90	90	30	30	0.75	0.75	30	0.23	0.27	-
KY	CASEY	90	90	30	30	0.75	0.75	30	0.22	0.23	-
KY	CHRISTIAN	90	90	30	30	0.75	0.75	20	0.51	0.78	-
KY	CLARK	90	90	30	30	0.75	0.75	30	0.26	0.28	-
KY	CLAY	90	90	30	30	0.50	0.75	30	0.27	0.37	2
KY	CLINTON	90	90	30	30	0.75	0.75	30	0.24	0.26	-
KY	CRITTENDEN	90	90	30	30	0.75	1.00	20	0.85	1.15	-
KY	CUMBERLAND	90	90	30	30	0.75	0.75	20	0.24	0.25	-
KY	DAVIESS	90	90	30	30	0.75	0.75	20	0.42	0.62	-
KY	EDMONSON	90	90	30	30	0.75	0.75	20	0.27	0.34	-
KY	ELLIOTT	90	90	30	30	0.75	0.75	30	0.24	0.26	-
KY	ESTILL	90	90	30	30	0.75	0.75	30	0.26	0.27	-
KY	FAYETTE	90	90	30	30	0.75	0.75	20	0.24	0.26	-
KY	FLEMING	90	90	30	30	0.75	0.75	30	0.27	0.28	-
KY	FLOYD	90	90	30	30	0.50	0.75	40	0.25	0.30	2
KY	FRANKLIN	90	90	30	30	0.75	0.75	20	0.22	0.24	-
KY	FULTON	90	90	30	30	1.00	1.00	20	1.36	3.41	-
KY	GALLATIN	90	90	30	30	0.75	0.75	20	0.19	0.20	-
KY	GARRARD	90	90	30	30	0.75	0.75	20	0.23	0.25	-

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KY	GRANT	90	90	30	30	0.75	0.75	20	0.19	0.24	-
KY	GRAVES	90	90	30	30	1.00	1.00	20	1.14	2.37	-
KY	GRAYSON	90	90	30	30	0.75	0.75	20	0.27	0.39	-
KY	GREEN	90	90	30	30	0.75	0.75	20	0.23	0.24	-
KY	GREENUP	90	90	30	30	0.75	0.75	30	0.22	0.25	-
KY	HANCOCK	90	90	30	30	0.75	0.75	20	0.38	0.48	-
KY	HARDIN	90	90	30	30	0.75	0.75	20	0.24	0.30	-
KY	HARLAN	90	90	30	30	0.50	0.50	30	0.36	0.44	2
KY	HARRISON	90	90	30	30	0.75	0.75	20	0.23	0.27	-
KY	HART	90	90	30	30	0.75	0.75	20	0.24	0.28	-
KY	HENDERSON	90	90	30	30	0.75	0.75	20	0.58	0.93	-
KY	HENRY	90	90	30	30	0.75	0.75	20	0.20	0.22	-
KY	HICKMAN	90	90	30	30	1.00	1.00	20	1.32	3.01	-
KY	HOPKINS	90	90	30	30	0.75	0.75	20	0.57	0.89	-
KY	JACKSON	90	90	30	30	0.75	0.75	30	0.25	0.28	-
KY	JEFFERSON	90	90	30	30	0.75	0.75	20	0.22	0.27	-
KY	JESSAMINE	90	90	30	30	0.75	0.75	20	0.23	0.25	-
KY	JOHNSON	90	90	30	30	0.50	0.75	40	0.24	0.26	2
KY	KENTON	90	90	30	40	0.75	0.75	20	0.18	0.21	-
KY	KNOTT	90	90	30	30	0.50	0.75	30	0.27	0.33	2
KY	KNOX	90	90	30	30	0.50	0.75	30	0.30	0.40	2
KY	LARUE	90	90	30	30	0.75	0.75	20	0.23	0.26	-
KY	LAUREL	90	90	30	30	0.75	0.75	30	0.26	0.32	-
KY	LAWRENCE	90	90	30	30	0.50	0.75	40	0.23	0.25	2
KY	LEE	90	90	30	30	0.75	0.75	30	0.26	0.27	-
KY	LESLIE	90	90	30	30	0.50	0.75	30	0.29	0.39	2
KY	LETCHER	90	90	30	30	0.50	0.50	30	0.30	0.38	2
KY	LEWIS	90	90	30	30	0.75	0.75	20	0.22	0.27	-
KY	LINCOLN	90	90	30	30	0.75	0.75	30	0.22	0.24	-
KY	LIVINGSTON	90	90	30	30	1.00	1.00	20	1.11	1.55	-
KY	LOGAN	90	90	30	30	0.75	0.75	20	0.34	0.45	-
KY	LYON	90	90	30	30	0.75	0.75	20	0.89	1.15	-
KY	MADISON	90	90	30	30	0.75	0.75	30	0.24	0.27	-
KY	MAGOFFIN	90	90	30	30	0.50	0.75	30	0.25	0.27	2
KY	MARION	90	90	30	30	0.75	0.75	20	0.22	0.23	-
KY	MARSHALL	90	90	30	30	0.75	1.00	20	1.03	1.42	-
KY	MARTIN	90	90	30	30	0.75	0.75	40	0.24	0.26	2
KY	MASON	90	90	30	30	0.75	0.75	30	0.24	0.27	-
KY	MCCRACKEN	90	90	30	30	1.00	1.00	20	1.37	2.64	-
KY	MCCREARY	90	90	30	30	0.75	0.75	30	0.27	0.37	2
KY	MCLEAN	90	90	30	30	0.75	0.75	20	0.49	0.64	-
KY	MEADE	90	90	30	30	0.75	0.75	20	0.27	0.35	-
KY	MENIFEE	90	90	30	30	0.75	0.75	30	0.27	0.28	-
KY	MERCER	90	90	30	30	0.75	0.75	20	0.22	0.23	-
KY	METCALFE	90	90	30	30	0.75	0.75	20	0.24	0.25	-
KY	MONROE	90	90	30	30	0.75	0.75	20	0.24	0.26	-
KY	MONTGOMERY	90	90	30	30	0.75	0.75	30	0.27	0.28	-

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KY	MORGAN	90	90	30	30	0.75	0.75	30	0.25	0.27	2
KY	MUHLENBERG	90	90	30	30	0.75	0.75	20	0.41	0.60	-
KY	NELSON	90	90	30	30	0.75	0.75	20	0.22	0.25	-
KY	NICHOLAS	90	90	30	30	0.75	0.75	20	0.26	0.28	-
KY	OHIO	90	90	30	30	0.75	0.75	20	0.37	0.53	-
KY	OLDHAM	90	90	30	30	0.75	0.75	20	0.21	0.23	-
KY	OWEN	90	90	30	30	0.75	0.75	20	0.20	0.23	-
KY	OWSLEY	90	90	30	30	0.75	0.75	30	0.27	0.29	2
KY	PENDLETON	90	90	30	30	0.75	0.75	20	0.20	0.25	-
KY	PERRY	90	90	30	30	0.50	0.75	30	0.28	0.37	2
KY	PIKE	90	90	30	30	0.50	0.50	40	0.26	0.33	2
KY	POWELL	90	90	30	30	0.75	0.75	30	0.27	0.28	-
KY	PULASKI	90	90	30	30	0.75	0.75	30	0.23	0.27	-
KY	ROBERTSON	90	90	30	30	0.75	0.75	20	0.25	0.27	-
KY	ROCKCASTLE	90	90	30	30	0.75	0.75	30	0.24	0.26	-
KY	ROWAN	90	90	30	30	0.75	0.75	30	0.26	0.28	-
KY	RUSSELL	90	90	30	30	0.75	0.75	30	0.23	0.24	-
KY	SCOTT	90	90	30	30	0.75	0.75	20	0.23	0.26	-
KY	SHELBY	90	90	30	30	0.75	0.75	20	0.21	0.23	-
KY	SIMPSON	90	90	30	30	0.75	0.75	20	0.29	0.36	-
KY	SPENCER	90	90	30	30	0.75	0.75	20	0.22	0.23	-
KY	TAYLOR	90	90	30	30	0.75	0.75	20	0.22	0.24	-
KY	TODD	90	90	30	30	0.75	0.75	20	0.42	0.54	-
KY	TRIGG	90	90	30	30	0.75	1.00	20	0.65	1.08	-
KY	TRIMBLE	90	90	30	30	0.75	0.75	20	0.19	0.21	-
KY	UNION	90	90	30	30	0.75	1.00	20	0.82	1.03	-
KY	WARREN	90	90	30	30	0.75	0.75	20	0.27	0.37	-
KY	WASHINGTON	90	90	30	30	0.75	0.75	20	0.22	0.23	-
KY	WAYNE	90	90	30	30	0.75	0.75	30	0.24	0.27	-
KY	WEBSTER	90	90	30	30	0.75	0.75	20	0.60	0.94	-
KY	WHITLEY	90	90	30	30	0.50	0.75	30	0.28	0.42	2
KY	WOLFE	90	90	30	30	0.75	0.75	30	0.27	0.27	-
KY	WOODFORD	90	90	30	30	0.75	0.75	20	0.23	0.24	-
LA	ACADIA	100	110	30	30	0.50	0.50	5	0.12	0.13	-
LA	ALLEN	95	105	30	30	0.50	0.50	5	0.12	0.13	-
LA	ASCENSION	105	110	30	30	0.25	0.25	5	0.14	0.14	-
LA	ASSUMPTION	110	120	30	30	0.25	0.25	5	0.12	0.14	-
LA	AVOYELLES	90	100	30	30	0.50	0.50	5	0.13	0.14	-
LA	BEAUREGARD	95	105	30	30	0.50	0.50	5	0.13	0.15	-
LA	BIENVILLE	90	90	30	30	0.75	0.75	10	0.16	0.18	-
LA	BOSSIER	90	90	30	30	0.75	0.75	10	0.16	0.18	-
LA	CADDO	90	90	30	30	0.75	0.75	10	0.16	0.18	-
LA	CALCASIEU	105	115	30	30	0.50	0.50	5	0.12	0.13	-
LA	CALDWELL	90	90	30	30	0.50	0.75	5	0.16	0.18	-
LA	CAMERON	110	130	30	30	0.50	0.50	5	0.10	0.12	-
LA	CATAHOULA	90	95	30	30	0.50	0.75	5	0.14	0.17	-
LA	CLAIBORNE	90	90	30	30	0.75	0.75	10	0.18	0.21	-

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LA	CONCORDIA	90	95	30	30	0.50	0.50	5	0.14	0.16	-
LA	DE SOTO	90	90	30	30	0.75	0.75	10	0.16	0.16	-
LA	EAST BATON ROUGE	100	110	30	30	0.25	0.25	5	0.14	0.15	-
LA	EAST CARROLL	90	90	30	30	0.75	0.75	10	0.19	0.25	-
LA	EAST FELICIANA	100	105	30	30	0.25	0.50	5	0.14	0.15	-
LA	EVANGELINE	95	100	30	30	0.50	0.50	5	0.12	0.13	-
LA	FRANKLIN	90	90	30	30	0.50	0.75	5	0.16	0.19	-
LA	GRANT	90	90	30	30	0.50	0.75	5	0.14	0.16	-
LA	IBERIA	110	120	30	30	0.25	0.50	5	0.10	0.14	-
LA	IBERVILLE	105	110	30	30	0.25	0.50	5	0.13	0.14	-
LA	JACKSON	90	90	30	30	0.75	0.75	10	0.17	0.18	-
LA	JEFFERSON	120	140	30	30	0.00	0.25	5	0.10	0.14	-
LA	JEFFERSON DAVIS	100	110	30	30	0.50	0.50	5	0.12	0.13	-
LA	LA SALLE	90	90	30	30	0.50	0.75	5	0.14	0.16	-
LA	LAFAYETTE	105	110	30	30	0.25	0.50	5	0.12	0.13	-
LA	LAFOURCHE	115	145	30	30	0.00	0.25	5	0.09	0.13	-
LA	LINCOLN	90	90	30	30	0.75	0.75	10	0.18	0.19	-
LA	LIVINGSTON	105	110	30	30	0.25	0.25	5	0.14	0.15	-
LA	MADISON	90	90	30	30	0.50	0.75	10	0.18	0.21	-
LA	MOREHOUSE	90	90	30	30	0.75	0.75	10	0.19	0.25	-
LA	NATCHITOCHES	90	90	30	30	0.50	0.75	5	0.15	0.17	-
LA	ORLEANS	120	130	30	30	0.00	0.25	5	0.13	0.14	-
LA	OUACHITA	90	90	30	30	0.75	0.75	10	0.18	0.20	-
LA	PLAQUEMINES	125	150	30	30	0.00	0.00	5	0.09	0.13	-
LA	POINTE COUPEE	95	105	30	30	0.25	0.50	5	0.13	0.14	-
LA	RAPIDES	90	95	30	30	0.50	0.50	5	0.13	0.15	-
LA	RED RIVER	90	90	30	30	0.75	0.75	10	0.16	0.17	-
LA	RICHLAND	90	90	30	30	0.75	0.75	10	0.17	0.20	-
LA	SABINE	90	90	30	30	0.50	0.75	5	0.15	0.17	-
LA	SAINT BERNARD	125	145	30	30	0.00	0.00	5	0.11	0.14	-
LA	SAINT CHARLES	115	125	30	30	0.00	0.25	5	0.12	0.14	-
LA	SAINT HELENA	100	105	30	30	0.25	0.25	5	0.14	0.15	-
LA	SAINT JAMES	110	115	30	30	0.25	0.25	5	0.13	0.14	-
LA	SAINT LANDRY	95	105	30	30	0.50	0.50	5	0.12	0.13	-
LA	SAINT MARTIN	105	120	30	30	0.25	0.50	5	0.12	0.14	-
LA	SAINT MARY	110	125	30	30	0.25	0.25	5	0.11	0.13	-
LA	SAINT TAMMANY	110	130	30	30	0.00	0.25	5	0.14	0.15	-
LA	ST JOHN THE BAPTIST	110	120	30	30	0.00	0.25	5	0.13	0.14	-
LA	TANGIPAHOA	100	115	30	30	0.25	0.25	5	0.14	0.15	-
LA	TENSAS	90	90	30	30	0.50	0.75	5	0.16	0.18	-
LA	TERREBONNE	120	145	30	30	0.00	0.25	5	0.09	0.13	-
LA	UNION	90	90	30	30	0.75	0.75	10	0.19	0.23	-
LA	VERMILION	110	125	30	30	0.25	0.50	5	0.10	0.12	-
LA	VERNON	90	95	30	30	0.50	0.50	5	0.13	0.16	-
LA	WASHINGTON	105	115	30	30	0.25	0.25	5	0.15	0.16	-
LA	WEBSTER	90	90	30	30	0.75	0.75	10	0.17	0.19	-
LA	WEST BATON ROUGE	100	105	30	30	0.25	0.50	5	0.14	0.14	-

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State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
LA	WEST CARROLL	90	90	30	30	0.75	0.75	10	0.20	0.25	-
LA	WEST FELICIANA	95	100	30	30	0.25	0.50	5	0.14	0.14	-
LA	WINN	90	90	30	30	0.50	0.75	5	0.16	0.17	-
MA	BARNSTABLE	115	115	40	40	0.75	0.75	60	0.19	0.27	-
MA	BERKSHIRE	90	90	40	40	0.75	0.75	60	0.25	0.26	1, 2
MA	BRISTOL	105	115	40	40	0.75	0.75	60	0.25	0.28	-
MA	DUKES	120	120	40	40	0.75	0.75	50	0.19	0.24	-
MA	ESSEX	100	110	40	40	0.75	1.00	60	0.35	0.40	-
MA	FRANKLIN	90	95	40	40	0.75	1.00	60	0.25	0.27	1, 2
MA	HAMPDEN	90	100	40	40	0.75	1.00	60	0.25	0.26	1
MA	HAMPSHIRE	90	95	40	40	0.75	1.00	60	0.25	0.26	1, 2
MA	MIDDLESEX	95	105	40	40	0.75	1.00	60	0.27	0.38	-
MA	NANTUCKET	120	120	40	40	0.75	0.75	50	0.16	0.18	-
MA	NORFOLK	105	110	40	40	0.75	1.00	60	0.27	0.32	-
MA	PLYMOUTH	110	115	40	40	0.75	0.75	60	0.26	0.33	-
MA	SUFFOLK	105	110	40	40	0.75	1.00	60	0.30	0.35	-
MA	WORCESTER	90	105	40	40	0.75	1.00	60	0.26	0.32	-
MD	ALLEGANY	90	90	30	40	0.75	0.75	40	0.17	0.19	2
MD	ANNE ARUNDEL	90	90	40	40	0.50	0.50	30	0.17	0.19	-
MD	BALTIMORE	90	90	40	40	0.50	0.75	30	0.19	0.24	-
MD	BALTIMORE CITY	90	90	40	40	0.50	0.75	30	0.19	0.21	-
MD	CALVERT	90	90	40	40	0.50	0.50	30	0.16	0.17	-
MD	CAROLINE	90	100	40	40	0.50	0.50	20	0.16	0.20	-
MD	CARROLL	90	90	40	40	0.75	0.75	30	0.19	0.22	-
MD	CECIL	90	90	40	40	0.75	0.75	30	0.24	0.30	-
MD	CHARLES	90	90	40	40	0.50	0.50	20	0.17	0.19	-
MD	DORCHESTER	90	100	40	40	0.50	0.50	20	0.14	0.16	-
MD	FREDERICK	90	90	40	40	0.75	0.75	30	0.18	0.19	-
MD	GARRETT	90	90	30	30	0.75	0.75	40	0.15	0.17	2
MD	HARFORD	90	90	40	40	0.50	0.75	30	0.21	0.27	-
MD	HOWARD	90	90	40	40	0.50	0.75	30	0.18	0.19	-
MD	KENT	90	90	40	40	0.50	0.75	30	0.18	0.25	-
MD	MONTGOMERY	90	90	40	40	0.50	0.75	30	0.18	0.19	-
MD	PRINCE GEORGES	90	90	40	40	0.50	0.50	20	0.17	0.18	-
MD	QUEEN ANNES	90	90	40	40	0.50	0.75	30	0.17	0.23	-
MD	SAINT MARYS	90	95	40	40	0.50	0.50	20	0.15	0.17	-
MD	SOMERSET	105	115	40	40	0.50	0.50	20	0.12	0.14	-
MD	TALBOT	90	95	40	40	0.50	0.50	20	0.16	0.18	-
MD	WASHINGTON	90	90	30	40	0.75	0.75	30	0.19	0.19	2
MD	WICOMICO	100	115	40	40	0.50	0.50	20	0.13	0.15	-
MD	WORCESTER	110	120	40	40	0.50	0.50	20	0.12	0.13	-
ME	ANDROSCOGGIN	90	95	40	40	0.75	1.00	70	0.34	0.39	-
ME	AROOSTOOK	90	90	40	40	0.75	0.75	100	0.27	0.73	-
ME	CUMBERLAND	90	100	40	40	1.00	1.00	70	0.32	0.41	-
ME	FRANKLIN	90	90	40	40	0.75	1.00	80	0.27	0.35	2
ME	HANCOCK	90	100	40	40	1.00	1.00	80	0.21	0.32	-
ME	KENNEBEC	90	95	40	40	1.00	1.00	80	0.28	0.36	-

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ME	KNOX	95	100	40	40	1.00	1.00	70	0.20	0.28	-
ME	LINCOLN	90	100	40	40	1.00	1.00	70	0.25	0.32	-
ME	OXFORD	90	90	40	40	0.75	1.00	80	0.28	0.42	2
ME	PENOBSCOT	90	90	40	40	0.75	1.00	80	0.27	0.31	-
ME	PISCATAQUIS	90	90	40	40	0.75	0.75	90	0.28	0.42	2
ME	SAGADAHOC	95	100	40	40	0.75	1.00	70	0.29	0.35	-
ME	SOMERSET	90	90	40	40	0.75	1.00	90	0.27	0.44	2
ME	WALDO	90	95	40	40	1.00	1.00	80	0.25	0.29	-
ME	WASHINGTON	90	95	40	40	0.75	1.00	80	0.25	0.38	-
ME	YORK	90	100	40	40	1.00	1.00	70	0.37	0.42	-
MI	ALCONA	90	90	40	40	0.50	0.50	50	0.07	0.07	-
MI	ALGER	90	90	40	40	0.50	0.50	60	0.06	0.06	-
MI	ALLEGAN	90	90	40	40	0.75	0.75	60	0.09	0.11	-
MI	ALPENA	90	90	40	40	0.50	0.50	50	0.07	0.08	-
MI	ANTRIM	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	ARENAC	90	90	40	40	0.50	0.50	50	0.07	0.07	-
MI	BARAGA	90	90	40	40	0.50	0.50	80	0.07	0.10	-
MI	BARRY	90	90	40	40	0.75	0.75	60	0.10	0.12	-
MI	BAY	90	90	40	40	0.50	0.75	60	0.07	0.08	-
MI	BENZIE	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	BERRIEN	90	90	40	40	0.75	0.75	60	0.11	0.13	-
MI	BRANCH	90	90	40	40	0.75	1.00	50	0.12	0.14	-
MI	CALHOUN	90	90	40	40	0.75	0.75	60	0.11	0.13	-
MI	CASS	90	90	40	40	0.75	0.75	50	0.12	0.12	-
MI	CHARLEVOIX	90	90	40	40	0.50	0.50	50	0.05	0.06	-
MI	CHEBOYGAN	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	CHIPPEWA	90	90	40	40	0.50	0.50	60	0.06	0.08	-
MI	CLARE	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	CLINTON	90	90	40	40	0.75	0.75	60	0.09	0.11	-
MI	CRAWFORD	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	DELTA	90	90	40	40	0.50	0.50	60	0.06	0.06	-
MI	DICKINSON	90	90	40	40	0.50	0.50	70	0.06	0.07	-
MI	EATON	90	90	40	40	0.75	0.75	60	0.10	0.12	-
MI	EMMET	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	GENESEE	90	90	40	40	0.75	0.75	60	0.08	0.10	-
MI	GLADWIN	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	GOGEBIC	90	90	40	40	0.50	0.50	80	0.07	0.08	-
MI	GRAND TRAVERSE	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	GRATIOT	90	90	40	40	0.75	0.75	60	0.08	0.09	-
MI	HILLSDALE	90	90	40	40	0.75	1.00	50	0.13	0.15	-
MI	HOUGHTON	90	90	40	40	0.50	0.50	80	0.08	0.11	-
MI	HURON	90	90	40	40	0.75	0.75	60	0.07	0.08	-
MI	INGHAM	90	90	40	40	0.75	0.75	60	0.10	0.12	-
MI	IONIA	90	90	40	40	0.75	0.75	60	0.08	0.11	-
MI	IOSCO	90	90	40	40	0.50	0.50	50	0.07	0.07	-
MI	IRON	90	90	40	40	0.50	0.50	80	0.06	0.08	-
MI	ISABELLA	90	90	40	40	0.75	0.75	50	0.07	0.08	-

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MI	JACKSON	90	90	40	40	0.75	1.00	60	0.12	0.13	-
MI	KALAMAZOO	90	90	40	40	0.75	0.75	60	0.11	0.12	-
MI	KALKASKA	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	KENT	90	90	40	40	0.75	0.75	60	0.08	0.10	-
MI	KEWEENAW	90	90	40	40	0.50	0.50	80	0.07	0.11	-
MI	LAKE	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	LAPEER	90	90	40	40	0.75	0.75	60	0.08	0.10	-
MI	LEELANAU	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	LENAWEE	90	90	40	40	1.00	1.00	50	0.13	0.17	-
MI	LIVINGSTON	90	90	40	40	0.75	1.00	60	0.10	0.12	-
MI	LUCE	90	90	40	40	0.50	0.50	60	0.06	0.06	-
MI	MACKINAC	90	90	40	40	0.50	0.50	60	0.05	0.07	-
MI	MACOMB	90	90	40	40	0.75	1.00	60	0.10	0.12	-
MI	MANISTEE	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	MARQUETTE	90	90	40	40	0.50	0.50	70	0.06	0.08	-
MI	MASON	90	90	40	40	0.50	0.50	60	0.06	0.07	-
MI	MECOSTA	90	90	40	40	0.75	0.75	60	0.07	0.08	-
MI	MENOMINEE	90	90	40	40	0.50	0.50	60	0.06	0.06	-
MI	MIDLAND	90	90	40	40	0.75	0.75	50	0.07	0.08	-
MI	MISSAUKEE	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	MONROE	90	90	40	40	1.00	1.00	50	0.14	0.17	-
MI	MONTCALM	90	90	40	40	0.75	0.75	60	0.08	0.09	-
MI	MONTMORENCY	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	MUSKEGON	90	90	40	40	0.75	0.75	60	0.08	0.08	-
MI	NEWAYGO	90	90	40	40	0.75	0.75	60	0.07	0.08	-
MI	OAKLAND	90	90	40	40	0.75	1.00	60	0.10	0.12	-
MI	OCEANA	90	90	40	40	0.75	0.75	60	0.07	0.08	-
MI	OGEMAW	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	ONTONAGON	90	90	40	40	0.50	0.50	80	0.07	0.10	-
MI	OSCEOLA	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	OSCODA	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	OTSEGO	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MI	OTTAWA	90	90	40	40	0.75	0.75	60	0.08	0.10	-
MI	PRESQUE ISLE	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	ROSCOMMON	90	90	40	40	0.50	0.50	50	0.06	0.07	-
MI	SAGINAW	90	90	40	40	0.75	0.75	60	0.08	0.09	-
MI	SAINT CLAIR	90	90	40	40	0.75	1.00	60	0.09	0.12	-
MI	SAINT JOSEPH	90	90	40	40	0.75	0.75	50	0.12	0.13	-
MI	SANILAC	90	90	40	40	0.75	0.75	60	0.08	0.10	-
MI	SCHOOLCRAFT	90	90	40	40	0.50	0.50	60	0.06	0.06	-
MI	SHIAWASSEE	90	90	40	40	0.75	0.75	60	0.09	0.11	-
MI	TUSCOLA	90	90	40	40	0.75	0.75	60	0.08	0.09	-
MI	VAN BUREN	90	90	40	40	0.75	0.75	60	0.11	0.12	-
MI	WASHTENAW	90	90	40	40	0.75	1.00	50	0.12	0.14	-
MI	WAYNE	90	90	40	40	1.00	1.00	50	0.12	0.15	-
MI	WEXFORD	90	90	40	40	0.50	0.50	50	0.06	0.06	-
MN	AITKIN	90	90	50	50	0.50	0.50	90	0.06	0.07	-

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MN	ANOKA	90	90	50	50	0.50	0.75	80	0.06	0.06	-
MN	BECKER	90	90	50	50	0.50	0.50	90	0.07	0.09	-
MN	BELTRAMI	90	90	50	50	0.50	0.50	100	0.05	0.07	-
MN	BENTON	90	90	50	50	0.50	0.50	80	0.07	0.08	-
MN	BIG STONE	90	90	50	50	0.50	0.50	80	0.11	0.11	-
MN	BLUE EARTH	90	90	50	50	1.00	1.00	80	0.06	0.06	-
MN	BROWN	90	90	50	50	0.75	1.00	80	0.06	0.07	-
MN	CARLTON	90	90	50	60	0.50	1.00	90	0.06	0.06	-
MN	CARVER	90	90	50	50	0.75	0.75	80	0.06	0.07	-
MN	CASS	90	90	50	50	0.50	0.50	100	0.06	0.09	-
MN	CHIPPEWA	90	90	50	50	0.50	0.50	80	0.08	0.10	-
MN	CHISAGO	90	90	50	50	0.50	0.50	80	0.05	0.06	-
MN	CLAY	90	90	50	50	0.50	0.50	90	0.07	0.08	-
MN	CLEARWATER	90	90	50	50	0.50	0.50	100	0.06	0.08	-
MN	COOK	90	90	50	60	0.50	1.25	90	0.06	0.08	-
MN	COTTONWOOD	90	90	50	50	1.00	1.00	80	0.07	0.08	-
MN	CROW WING	90	90	50	50	0.50	0.50	90	0.07	0.08	-
MN	DAKOTA	90	90	50	50	0.75	1.00	80	0.05	0.06	-
MN	DODGE	90	90	50	50	1.00	1.00	80	0.05	0.06	-
MN	DOUGLAS	90	90	50	50	0.50	0.50	80	0.10	0.11	-
MN	FARIBAULT	90	90	50	50	1.00	1.00	70	0.06	0.06	-
MN	FILLMORE	90	90	40	50	1.00	1.00	70	0.06	0.06	-
MN	FREEBORN	90	90	50	50	1.00	1.00	70	0.06	0.06	-
MN	GOODHUE	90	90	50	50	0.75	1.00	80	0.05	0.06	-
MN	GRANT	90	90	50	50	0.50	0.50	80	0.10	0.11	-
MN	HENNEPIN	90	90	50	50	0.50	0.75	80	0.06	0.06	-
MN	HOUSTON	90	90	40	40	0.75	0.75	70	0.06	0.07	-
MN	HUBBARD	90	90	50	50	0.50	0.50	100	0.07	0.08	-
MN	ISANTI	90	90	50	50	0.50	0.50	80	0.06	0.06	-
MN	ITASCA	90	90	50	50	0.50	0.50	100	0.05	0.07	-
MN	JACKSON	90	90	50	50	1.00	1.00	70	0.07	0.08	-
MN	KANABEC	90	90	50	50	0.50	0.50	80	0.06	0.06	-
MN	KANDIYOHI	90	90	50	50	0.50	0.75	80	0.08	0.10	-
MN	KITTSON	90	90	60	60	0.50	0.50	100	0.04	0.05	-
MN	KOOCHICHING	90	90	50	50	0.50	0.50	100	0.05	0.06	-
MN	LAC QUI PARLE	90	90	50	50	0.50	0.50	80	0.09	0.11	-
MN	LAKE	90	90	50	60	0.50	1.25	100	0.05	0.07	-
MN	LAKE OF THE WOODS	90	90	50	60	0.50	0.50	100	0.04	0.05	-
MN	LE SUEUR	90	90	50	50	0.75	1.00	80	0.06	0.06	-
MN	LINCOLN	90	90	50	50	0.50	0.75	80	0.09	0.10	-
MN	LYON	90	90	50	50	0.50	0.75	80	0.08	0.09	-
MN	MAHNOMEN	90	90	50	50	0.50	0.50	100	0.06	0.08	-
MN	MARSHALL	90	90	50	60	0.50	0.50	100	0.05	0.05	-
MN	MARTIN	90	90	50	50	1.00	1.00	70	0.06	0.07	-
MN	MCLEOD	90	90	50	50	0.75	0.75	80	0.06	0.07	-
MN	MEEKER	90	90	50	50	0.50	0.75	80	0.07	0.08	-
MN	MILLE LACS	90	90	50	50	0.50	0.50	90	0.06	0.07	-

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MN	MORRISON	90	90	50	50	0.50	0.50	90	0.07	0.08	-
MN	MOWER	90	90	50	50	1.00	1.00	70	0.06	0.06	-
MN	MURRAY	90	90	50	50	0.75	1.00	80	0.08	0.09	-
MN	NICOLLET	90	90	50	50	0.75	0.75	80	0.06	0.07	-
MN	NOBLES	90	90	50	50	1.00	1.00	70	0.08	0.09	-
MN	NORMAN	90	90	50	50	0.50	0.50	100	0.06	0.07	-
MN	OLMSTED	90	90	50	50	0.75	1.00	80	0.05	0.06	-
MN	OTTER TAIL	90	90	50	50	0.50	0.50	90	0.08	0.11	-
MN	PENNINGTON	90	90	50	60	0.50	0.50	100	0.05	0.06	-
MN	PINE	90	90	50	50	0.50	0.50	90	0.05	0.06	-
MN	PIPESTONE	90	90	50	50	0.75	1.00	80	0.09	0.11	-
MN	POLK	90	90	50	60	0.50	0.50	100	0.05	0.07	-
MN	POPE	90	90	50	50	0.50	0.50	80	0.09	0.11	-
MN	RAMSEY	90	90	50	50	0.50	0.75	80	0.06	0.06	-
MN	RED LAKE	90	90	50	60	0.50	0.50	100	0.05	0.06	-
MN	REDWOOD	90	90	50	50	0.75	1.00	80	0.07	0.08	-
MN	RENVILLE	90	90	50	50	0.50	0.75	80	0.07	0.09	-
MN	RICE	90	90	50	50	0.75	1.00	80	0.06	0.06	-
MN	ROCK	90	90	50	50	0.75	1.00	70	0.09	0.11	-
MN	ROSEAU	90	90	50	60	0.50	0.50	100	0.04	0.05	-
MN	SAINT LOUIS	90	90	50	60	0.50	1.25	100	0.05	0.06	-
MN	SCOTT	90	90	50	50	0.75	0.75	80	0.06	0.06	-
MN	SHERBURNE	90	90	50	50	0.50	0.50	80	0.06	0.07	-
MN	SIBLEY	90	90	50	50	0.75	1.00	80	0.06	0.07	-
MN	STEARNS	90	90	50	50	0.50	0.50	80	0.07	0.10	-
MN	STEELE	90	90	50	50	1.00	1.00	80	0.06	0.06	-
MN	STEVENS	90	90	50	50	0.50	0.50	80	0.11	0.11	-
MN	SWIFT	90	90	50	50	0.50	0.50	80	0.09	0.11	-
MN	TODD	90	90	50	50	0.50	0.50	90	0.08	0.10	-
MN	TRAVERSE	90	90	50	50	0.50	0.50	80	0.10	0.11	-
MN	WABASHA	90	90	50	50	0.75	1.00	80	0.05	0.06	-
MN	WADENA	90	90	50	50	0.50	0.50	90	0.08	0.10	-
MN	WASECA	90	90	50	50	1.00	1.00	80	0.06	0.06	-
MN	WASHINGTON	90	90	50	50	0.50	0.75	80	0.05	0.06	-
MN	WATONWAN	90	90	50	50	1.00	1.00	80	0.06	0.07	-
MN	WILKIN	90	90	50	50	0.50	0.50	90	0.08	0.11	-
MN	WINONA	90	90	40	50	0.75	1.00	80	0.06	0.06	-
MN	WRIGHT	90	90	50	50	0.50	0.75	80	0.06	0.07	-
MN	YELLOW MEDICINE	90	90	50	50	0.50	0.75	80	0.08	0.10	-
MO	ADAIR	90	90	40	40	0.75	1.00	40	0.10	0.12	-
MO	ANDREW	90	90	40	40	0.75	0.75	40	0.11	0.12	-
MO	ATCHISON	90	90	40	40	0.75	0.75	40	0.11	0.13	-
MO	AUDRAIN	90	90	40	40	1.00	1.00	30	0.16	0.24	-
MO	BARRY	90	90	30	30	1.00	1.00	20	0.17	0.22	-
MO	BARTON	90	90	30	40	1.00	1.00	30	0.12	0.15	-
MO	BATES	90	90	40	40	1.00	1.00	30	0.12	0.13	-
MO	BENTON	90	90	40	40	1.00	1.00	30	0.14	0.18	-

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MO	BOLLINGER	90	90	30	30	1.00	1.00	20	0.91	1.49	-
MO	BOONE	90	90	40	40	1.00	1.00	30	0.16	0.20	-
MO	BUCHANAN	90	90	40	40	0.75	0.75	40	0.11	0.13	-
MO	BUTLER	90	90	30	30	1.00	1.00	20	0.91	1.59	-
MO	CALDWELL	90	90	40	40	0.75	0.75	40	0.11	0.11	-
MO	CALLAWAY	90	90	40	40	1.00	1.00	30	0.18	0.26	-
MO	CAMDEN	90	90	40	40	1.00	1.00	30	0.17	0.25	-
MO	CAPE GIRARDEAU	90	90	30	30	1.00	1.00	20	1.04	2.17	-
MO	CARROLL	90	90	40	40	0.75	1.00	30	0.11	0.12	-
MO	CARTER	90	90	30	30	1.00	1.00	20	0.59	0.95	-
MO	CASS	90	90	40	40	1.00	1.00	30	0.12	0.12	-
MO	CEDAR	90	90	40	40	1.00	1.00	30	0.13	0.17	-
MO	CHARITON	90	90	40	40	0.75	1.00	30	0.11	0.14	-
MO	CHRISTIAN	90	90	30	30	1.00	1.00	20	0.19	0.26	-
MO	CLARK	90	90	40	40	0.75	1.00	40	0.12	0.15	-
MO	CLAY	90	90	40	40	0.75	1.00	30	0.12	0.12	-
MO	CLINTON	90	90	40	40	0.75	0.75	40	0.11	0.12	-
MO	COLE	90	90	40	40	1.00	1.00	30	0.19	0.24	-
MO	COOPER	90	90	40	40	1.00	1.00	30	0.15	0.18	-
MO	CRAWFORD	90	90	30	40	1.00	1.00	20	0.33	0.52	-
MO	DADE	90	90	30	40	1.00	1.00	30	0.14	0.18	-
MO	DALLAS	90	90	30	40	1.00	1.00	20	0.18	0.23	-
MO	DAVIESS	90	90	40	40	0.75	0.75	40	0.10	0.11	-
MO	DEKALB	90	90	40	40	0.75	0.75	40	0.10	0.11	-
MO	DENT	90	90	30	40	1.00	1.00	20	0.33	0.55	-
MO	DOUGLAS	90	90	30	30	1.00	1.00	20	0.25	0.38	-
MO	DUNKLIN	90	90	30	30	1.00	1.00	20	1.42	3.33	-
MO	FRANKLIN	90	90	40	40	1.00	1.00	30	0.29	0.54	-
MO	GASCONADE	90	90	40	40	1.00	1.00	30	0.26	0.37	-
MO	GENTRY	90	90	40	40	0.75	0.75	40	0.09	0.11	-
MO	GREENE	90	90	30	30	1.00	1.00	20	0.17	0.24	-
MO	GRUNDY	90	90	40	40	0.75	0.75	40	0.09	0.10	-
MO	HARRISON	90	90	40	40	0.75	0.75	40	0.08	0.10	-
MO	HENRY	90	90	40	40	1.00	1.00	30	0.12	0.15	-
MO	HICKORY	90	90	40	40	1.00	1.00	30	0.16	0.18	-
MO	HOLT	90	90	40	40	0.75	0.75	40	0.12	0.13	-
MO	HOWARD	90	90	40	40	1.00	1.00	30	0.14	0.17	-
MO	HOWELL	90	90	30	30	1.00	1.00	20	0.35	0.55	-
MO	IRON	90	90	30	40	1.00	1.00	20	0.51	0.86	-
MO	JACKSON	90	90	40	40	0.75	1.00	30	0.12	0.12	-
MO	JASPER	90	90	30	40	1.00	1.00	20	0.13	0.16	-
MO	JEFFERSON	90	90	40	40	1.00	1.00	20	0.50	0.72	-
MO	JOHNSON	90	90	40	40	1.00	1.00	30	0.12	0.14	-
MO	KNOX	90	90	40	40	0.75	1.00	40	0.11	0.14	-
MO	LACLEDE	90	90	30	40	1.00	1.00	20	0.20	0.28	-
MO	LAFAYETTE	90	90	40	40	1.00	1.00	30	0.12	0.13	-
MO	LAWRENCE	90	90	30	30	1.00	1.00	20	0.16	0.19	-

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MO	LEWIS	90	90	40	40	0.75	1.00	40	0.12	0.17	-
MO	LINCOLN	90	90	40	40	1.00	1.00	30	0.25	0.39	-
MO	LINN	90	90	40	40	0.75	1.00	40	0.10	0.12	-
MO	LIVINGSTON	90	90	40	40	0.75	1.00	40	0.10	0.12	-
MO	MACON	90	90	40	40	0.75	1.00	40	0.11	0.15	-
MO	MADISON	90	90	30	30	1.00	1.00	20	0.72	1.04	-
MO	MARIES	90	90	40	40	1.00	1.00	30	0.24	0.33	-
MO	MARION	90	90	40	40	1.00	1.00	40	0.15	0.19	-
MO	MCDONALD	90	90	30	30	1.00	1.00	20	0.15	0.18	-
MO	MERCER	90	90	40	40	0.75	0.75	40	0.08	0.10	-
MO	MILLER	90	90	40	40	1.00	1.00	30	0.19	0.26	-
MO	MISSISSIPPI	90	90	30	30	1.00	1.00	20	2.44	3.59	-
MO	MONITEAU	90	90	40	40	1.00	1.00	30	0.17	0.20	-
MO	MONROE	90	90	40	40	1.00	1.00	30	0.14	0.19	-
MO	MONTGOMERY	90	90	40	40	1.00	1.00	30	0.21	0.28	-
MO	MORGAN	90	90	40	40	1.00	1.00	30	0.16	0.19	-
MO	NEW MADRID	90	90	30	30	1.00	1.00	20	2.23	3.69	-
MO	NEWTON	90	90	30	30	1.00	1.00	20	0.13	0.17	-
MO	NODAWAY	90	90	40	40	0.75	0.75	40	0.10	0.12	-
MO	OREGON	90	90	30	30	1.00	1.00	20	0.46	0.77	-
MO	OSAGE	90	90	40	40	1.00	1.00	30	0.23	0.30	-
MO	OZARK	90	90	30	30	1.00	1.00	20	0.27	0.41	-
MO	PEMISCOT	90	90	30	30	1.00	1.00	20	2.31	3.43	-
MO	PERRY	90	90	30	40	1.00	1.00	20	0.90	1.25	-
MO	PETTIS	90	90	40	40	1.00	1.00	30	0.13	0.16	-
MO	PHELPS	90	90	40	40	1.00	1.00	20	0.27	0.39	-
MO	PIKE	90	90	40	40	1.00	1.00	30	0.20	0.29	-
MO	PLATTE	90	90	40	40	0.75	0.75	40	0.12	0.13	-
MO	POLK	90	90	30	40	1.00	1.00	30	0.16	0.20	-
MO	PULASKI	90	90	40	40	1.00	1.00	20	0.24	0.30	-
MO	PUTNAM	90	90	40	40	0.75	0.75	40	0.09	0.11	-
MO	RALLS	90	90	40	40	1.00	1.00	30	0.17	0.21	-
MO	RANDOLPH	90	90	40	40	1.00	1.00	30	0.13	0.17	-
MO	RAY	90	90	40	40	0.75	1.00	30	0.11	0.12	-
MO	REYNOLDS	90	90	30	30	1.00	1.00	20	0.48	0.82	-
MO	RIPLEY	90	90	30	30	1.00	1.00	20	0.64	1.09	-
MO	SAINT CHARLES	90	90	40	40	1.00	1.00	30	0.34	0.54	-
MO	SAINT CLAIR	90	90	40	40	1.00	1.00	30	0.13	0.16	-
MO	SAINT FRANCOIS	90	90	30	40	1.00	1.00	20	0.60	0.91	-
MO	SAINT LOUIS	90	90	40	40	1.00	1.00	30	0.44	0.62	-
MO	SAINT LOUIS CITY	90	90	40	40	1.00	1.00	30	0.54	0.60	-
MO	SAINTE GENEVIEVE	90	90	30	40	1.00	1.00	20	0.66	0.91	-
MO	SALINE	90	90	40	40	1.00	1.00	30	0.12	0.15	-
MO	SCHUYLER	90	90	40	40	0.75	0.75	40	0.10	0.11	-
MO	SCOTLAND	90	90	40	40	0.75	0.75	40	0.11	0.12	-
MO	SCOTT	90	90	30	30	1.00	1.00	20	1.70	3.37	-
MO	SHANNON	90	90	30	30	1.00	1.00	20	0.40	0.64	-

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MO	SHELBY	90	90	40	40	1.00	1.00	40	0.13	0.17	-
MO	STODDARD	90	90	30	30	1.00	1.00	20	1.20	3.18	-
MO	STONE	90	90	30	30	1.00	1.00	20	0.19	0.24	-
MO	SULLIVAN	90	90	40	40	0.75	0.75	40	0.09	0.11	-
MO	TANEY	90	90	30	30	1.00	1.00	20	0.23	0.29	-
MO	TEXAS	90	90	30	40	1.00	1.00	20	0.28	0.44	-
MO	VERNON	90	90	40	40	1.00	1.00	30	0.12	0.14	-
MO	WARREN	90	90	40	40	1.00	1.00	30	0.27	0.41	-
MO	WASHINGTON	90	90	30	40	1.00	1.00	20	0.43	0.65	-
MO	WAYNE	90	90	30	30	1.00	1.00	20	0.76	1.24	-
MO	WEBSTER	90	90	30	30	1.00	1.00	20	0.21	0.27	-
MO	WORTH	90	90	40	40	0.75	0.75	40	0.09	0.10	-
MO	WRIGHT	90	90	30	30	1.00	1.00	20	0.24	0.31	-
MS	ADAMS	90	95	30	30	0.50	0.50	5	0.14	0.16	-
MS	ALCORN	90	90	30	30	0.75	0.75	20	0.39	0.55	-
MS	AMITE	95	105	30	30	0.25	0.50	5	0.14	0.15	-
MS	ATTALA	90	90	30	30	0.50	0.50	10	0.21	0.26	-
MS	BENTON	90	90	30	30	0.75	1.00	20	0.46	0.72	-
MS	BOLIVAR	90	90	30	30	0.75	0.75	10	0.33	0.50	-
MS	CALHOUN	90	90	30	30	0.75	0.75	10	0.29	0.42	-
MS	CARROLL	90	90	30	30	0.50	0.75	10	0.25	0.36	-
MS	CHICKASAW	90	90	30	30	0.50	0.75	10	0.27	0.36	-
MS	CHOCTAW	90	90	30	30	0.50	0.50	10	0.22	0.27	-
MS	CLAIBORNE	90	95	30	30	0.50	0.50	5	0.17	0.19	-
MS	CLARKE	100	105	30	30	0.25	0.25	5	0.18	0.19	-
MS	CLAY	90	90	30	30	0.50	0.75	10	0.25	0.28	-
MS	COAHOMA	90	90	30	30	0.75	1.00	10	0.44	0.68	-
MS	COPIAH	90	95	30	30	0.25	0.50	5	0.16	0.18	-
MS	COVINGTON	100	105	30	30	0.25	0.25	5	0.17	0.18	-
MS	DE SOTO	90	90	30	30	1.00	1.00	20	0.72	1.28	-
MS	FORREST	105	115	30	30	0.25	0.25	5	0.16	0.17	-
MS	FRANKLIN	95	100	30	30	0.25	0.50	5	0.15	0.16	-
MS	GEORGE	115	130	30	30	0.25	0.25	5	0.13	0.16	-
MS	GREENE	110	120	30	30	0.25	0.25	5	0.14	0.17	-
MS	GRENADA	90	90	30	30	0.75	0.75	10	0.31	0.40	-
MS	HANCOCK	120	135	30	30	0.25	0.25	5	0.14	0.16	-
MS	HARRISON	120	140	30	30	0.25	0.25	5	0.13	0.16	-
MS	HINDS	90	95	30	30	0.50	0.50	10	0.18	0.21	-
MS	HOLMES	90	90	30	30	0.50	0.75	10	0.23	0.29	-
MS	HUMPHREYS	90	90	30	30	0.75	0.75	10	0.24	0.29	-
MS	ISSAQUENA	90	90	30	30	0.50	0.75	10	0.19	0.26	-
MS	ITAWAMBA	90	90	30	30	0.50	0.75	10	0.27	0.35	-
MS	JACKSON	125	150	30	30	0.25	0.25	5	0.12	0.15	-
MS	JASPER	95	105	30	30	0.25	0.25	5	0.18	0.19	-
MS	JEFFERSON	90	95	30	30	0.50	0.50	5	0.16	0.17	-
MS	JEFFERSON DAVIS	100	105	30	30	0.25	0.25	5	0.16	0.17	-
MS	JONES	100	110	30	30	0.25	0.25	5	0.17	0.18	-

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MS	KEMPER	95	95	30	30	0.25	0.50	10	0.19	0.21	-
MS	LAFAYETTE	90	90	30	30	0.75	0.75	10	0.39	0.59	-
MS	LAMAR	105	110	30	30	0.25	0.25	5	0.16	0.17	-
MS	LAUDERDALE	95	100	30	30	0.25	0.25	10	0.19	0.19	-
MS	LAWRENCE	95	100	30	30	0.25	0.25	5	0.16	0.17	-
MS	LEAKE	90	95	30	30	0.50	0.50	10	0.19	0.22	-
MS	LEE	90	90	30	30	0.75	0.75	10	0.29	0.39	-
MS	LEFLORE	90	90	30	30	0.75	0.75	10	0.28	0.40	-
MS	LINCOLN	95	100	30	30	0.25	0.50	5	0.15	0.17	-
MS	LOWNDES	90	90	30	30	0.50	0.50	10	0.23	0.26	-
MS	MADISON	90	90	30	30	0.50	0.50	10	0.19	0.23	-
MS	MARION	100	110	30	30	0.25	0.25	5	0.16	0.17	-
MS	MARSHALL	90	90	30	30	0.75	1.00	20	0.46	0.95	-
MS	MONROE	90	90	30	30	0.50	0.75	10	0.25	0.31	-
MS	MONTGOMERY	90	90	30	30	0.50	0.75	10	0.25	0.33	-
MS	NESHOBA	90	95	30	30	0.25	0.50	10	0.19	0.21	-
MS	NEWTON	95	100	30	30	0.25	0.25	10	0.18	0.19	-
MS	NOXUBEE	90	95	30	30	0.25	0.50	10	0.20	0.24	-
MS	OKTIBBEHA	90	90	30	30	0.50	0.50	10	0.23	0.27	-
MS	PANOLA	90	90	30	30	0.75	1.00	10	0.44	0.70	-
MS	PEARL RIVER	110	120	30	30	0.25	0.25	5	0.15	0.16	-
MS	PERRY	105	120	30	30	0.25	0.25	5	0.15	0.17	-
MS	PIKE	100	105	30	30	0.25	0.25	5	0.15	0.16	-
MS	PONTOTOC	90	90	30	30	0.75	0.75	10	0.32	0.42	-
MS	PRENTISS	90	90	30	30	0.75	0.75	10	0.33	0.43	-
MS	QUITMAN	90	90	30	30	0.75	1.00	10	0.46	0.66	-
MS	RANKIN	90	95	30	30	0.25	0.50	10	0.18	0.20	-
MS	SCOTT	90	95	30	30	0.25	0.50	10	0.18	0.20	-
MS	SHARKEY	90	90	30	30	0.75	0.75	10	0.22	0.27	-
MS	SIMPSON	95	100	30	30	0.25	0.50	5	0.17	0.18	-
MS	SMITH	95	100	30	30	0.25	0.25	5	0.17	0.18	-
MS	STONE	115	125	30	30	0.25	0.25	5	0.15	0.16	-
MS	SUNFLOWER	90	90	30	30	0.75	0.75	10	0.28	0.44	-
MS	TALLAHATCHIE	90	90	30	30	0.75	0.75	10	0.37	0.49	-
MS	TATE	90	90	30	30	0.75	1.00	20	0.58	0.93	-
MS	TIPPAH	90	90	30	30	0.75	0.75	20	0.40	0.59	-
MS	TISHOMINGO	90	90	30	30	0.75	0.75	10	0.31	0.43	-
MS	TUNICA	90	90	30	30	0.75	1.00	20	0.61	1.16	-
MS	UNION	90	90	30	30	0.75	0.75	10	0.37	0.50	-
MS	WALTHALL	100	110	30	30	0.25	0.25	5	0.15	0.16	-
MS	WARREN	90	90	30	30	0.50	0.75	10	0.18	0.22	-
MS	WASHINGTON	90	90	30	30	0.75	0.75	10	0.25	0.34	-
MS	WAYNE	105	110	30	30	0.25	0.25	5	0.17	0.19	-
MS	WEBSTER	90	90	30	30	0.50	0.75	10	0.26	0.32	-
MS	WILKINSON	95	100	30	30	0.25	0.50	5	0.14	0.15	-
MS	WINSTON	90	95	30	30	0.50	0.50	10	0.20	0.24	-
MS	YALOBUSHA	90	90	30	30	0.75	0.75	10	0.35	0.47	-

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MS	YAZOO	90	90	30	30	0.50	0.75	10	0.21	0.25	-
MT	BEAVERHEAD	90	90	50	50	0.00	0.00	60	0.34	1.76	1, 2
MT	BIG HORN	90	90	50	50	0.00	0.25	70	0.12	0.26	2
MT	BLAINE	90	90	50	50	0.25	0.25	70	0.10	0.12	-
MT	BROADWATER	90	90	50	50	0.00	0.25	60	0.69	1.13	2
MT	CARBON	90	90	50	50	0.25	0.25	70	0.16	0.58	2
MT	CARTER	90	90	50	50	0.25	0.25	70	0.08	0.17	-
MT	CASCADE	90	90	50	50	0.25	0.25	60	0.18	0.62	1, 2
MT	CHOUTEAU	90	90	50	50	0.25	0.25	70	0.12	0.24	1, 2
MT	CUSTER	90	90	50	50	0.25	0.25	70	0.09	0.14	-
MT	DANIELS	90	90	50	50	0.25	0.25	80	0.17	0.25	-
MT	DAWSON	90	90	50	50	0.25	0.25	80	0.09	0.18	-
MT	DEER LODGE	90	90	50	50	0.00	0.00	60	0.35	0.58	2
MT	FALLON	90	90	50	50	0.25	0.25	80	0.08	0.09	-
MT	FERGUS	90	90	50	50	0.25	0.25	70	0.11	0.18	2
MT	FLATHEAD	90	90	40	40	0.25	0.25	50	0.43	1.28	1, 2
MT	GALLATIN	90	90	50	50	0.00	0.25	60	0.75	1.72	2
MT	GARFIELD	90	90	50	50	0.25	0.25	70	0.11	0.24	-
MT	GLACIER	90	90	50	50	0.25	0.25	60	0.34	0.70	1, 2
MT	GOLDEN VALLEY	90	90	50	50	0.25	0.25	70	0.12	0.20	2
MT	GRANITE	90	90	50	50	0.00	0.25	50	0.33	0.80	2
MT	HILL	90	90	50	50	0.25	0.25	70	0.11	0.18	-
MT	JEFFERSON	90	90	50	50	0.00	0.25	60	0.56	1.11	-
MT	JUDITH BASIN	90	90	50	50	0.25	0.25	70	0.15	0.40	2
MT	LAKE	90	90	40	50	0.25	0.25	50	0.75	1.37	1, 2
MT	LEWIS AND CLARK	90	90	50	50	0.25	0.25	60	0.40	1.01	2
MT	LIBERTY	90	90	50	50	0.25	0.25	60	0.16	0.26	1
MT	LINCOLN	90	90	40	50	0.25	0.25	50	0.29	0.93	1, 2
MT	MADISON	90	90	50	50	0.00	0.00	60	0.62	1.59	1, 2
MT	MCCONE	90	90	50	50	0.25	0.25	80	0.12	0.24	-
MT	MEAGHER	90	90	50	50	0.25	0.25	60	0.28	1.03	2
MT	MINERAL	90	90	40	40	0.25	0.25	50	0.34	0.53	1, 2
MT	MISSOULA	90	90	40	50	0.25	0.25	50	0.35	1.23	1, 2
MT	MUSSELSHELL	90	90	50	50	0.25	0.25	70	0.11	0.13	2
MT	PARK	90	90	50	50	0.00	0.25	60	0.40	1.26	2
MT	PETROLEUM	90	90	50	50	0.25	0.25	70	0.11	0.13	-
MT	PHILLIPS	90	90	50	50	0.25	0.25	70	0.10	0.17	-
MT	PONDERA	90	90	50	50	0.25	0.25	60	0.22	0.69	1, 2
MT	POWDER RIVER	90	90	50	50	0.25	0.25	70	0.11	0.26	-
MT	POWELL	90	90	50	50	0.00	0.25	60	0.44	1.04	2
MT	PRAIRIE	90	90	50	50	0.25	0.25	80	0.09	0.15	-
MT	RAVALLI	90	90	40	50	0.00	0.25	50	0.29	0.51	1, 2
MT	RICHLAND	90	90	50	60	0.25	0.50	80	0.10	0.18	-
MT	ROOSEVELT	90	90	50	60	0.25	0.50	80	0.14	0.22	-
MT	ROSEBUD	90	90	50	50	0.25	0.25	70	0.11	0.23	-
MT	SANDERS	90	90	40	40	0.25	0.25	50	0.37	1.13	1, 2
MT	SHERIDAN	90	90	50	60	0.25	0.50	80	0.19	0.25	-

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MT	SILVER BOW	90	90	50	50	0.00	0.00	60	0.41	0.93	2
MT	STILLWATER	90	90	50	50	0.00	0.25	70	0.13	0.65	2
MT	SWEET GRASS	90	90	50	50	0.00	0.25	70	0.18	0.83	2
MT	TETON	90	90	50	50	0.25	0.25	60	0.22	0.70	1, 2
MT	TOOLE	90	90	50	50	0.25	0.25	60	0.21	0.39	1
MT	TREASURE	90	90	50	50	0.25	0.25	70	0.11	0.15	-
MT	VALLEY	90	90	50	50	0.25	0.25	70	0.12	0.24	-
MT	WHEATLAND	90	90	50	50	0.25	0.25	70	0.14	0.39	2
MT	WIBAUX	90	90	50	50	0.25	0.50	80	0.08	0.11	-
MT	YELLOWSTONE	90	90	50	50	0.25	0.25	70	0.11	0.17	2
NC	ALAMANCE	90	90	30	30	0.75	0.75	20	0.22	0.25	-
NC	ALEXANDER	90	90	30	30	0.75	0.75	20	0.35	0.38	-
NC	ALLEGHANY	90	90	30	30	0.75	0.75	20	0.37	0.40	1, 2
NC	ANSON	90	95	30	30	0.75	0.75	10	0.34	0.42	-
NC	ASHE	90	90	30	30	0.75	0.75	30	0.39	0.42	1, 2
NC	AVERY	90	90	30	30	0.75	0.75	20	0.41	0.43	1, 2
NC	BEAUFORT	105	120	30	30	0.25	0.50	10	0.14	0.17	-
NC	BERTIE	95	105	30	30	0.50	0.75	10	0.15	0.17	-
NC	BLADEN	100	120	30	30	0.50	0.75	10	0.29	0.42	-
NC	BRUNSWICK	120	140	30	30	0.25	0.25	5	0.32	0.55	-
NC	BUNCOMBE	90	90	30	30	0.75	0.75	20	0.41	0.49	1, 2
NC	BURKE	90	90	30	30	0.75	0.75	20	0.37	0.42	1, 2
NC	CABARRUS	90	90	30	30	0.75	0.75	10	0.30	0.35	-
NC	CALDWELL	90	90	30	30	0.75	0.75	20	0.37	0.42	1, 2
NC	CAMDEN	100	115	30	30	0.25	0.50	10	0.12	0.14	-
NC	CARTERET	125	135	30	30	0.25	0.25	5	0.12	0.19	-
NC	CASWELL	90	90	30	30	0.75	0.75	20	0.21	0.23	-
NC	CATAWBA	90	90	30	30	0.75	0.75	20	0.33	0.37	-
NC	CHATHAM	90	95	30	30	0.75	0.75	10	0.22	0.27	-
NC	CHEROKEE	90	90	30	30	0.75	0.75	20	0.47	0.57	1, 2
NC	CHOWAN	100	110	30	30	0.50	0.50	10	0.13	0.15	-
NC	CLAY	90	90	30	30	0.75	0.75	20	0.43	0.51	2
NC	CLEVELAND	90	90	30	30	0.75	0.75	20	0.36	0.38	-
NC	COLUMBUS	105	125	30	30	0.25	0.50	5	0.34	0.57	-
NC	CRAVEN	105	120	30	30	0.25	0.50	10	0.16	0.19	-
NC	CUMBERLAND	95	105	30	30	0.75	0.75	10	0.26	0.34	-
NC	CURRITUCK	110	120	30	30	0.25	0.50	10	0.11	0.13	-
NC	DARE	120	135	30	30	0.25	0.25	10	0.10	0.12	-
NC	DAVIDSON	90	90	30	30	0.75	0.75	20	0.26	0.29	-
NC	DAVIE	90	90	30	30	0.75	0.75	20	0.28	0.32	-
NC	DUPLIN	100	120	30	30	0.50	0.75	10	0.21	0.28	-
NC	DURHAM	90	90	30	30	0.75	0.75	10	0.20	0.22	-
NC	EDGECOMBE	95	100	30	30	0.75	0.75	10	0.17	0.18	-
NC	FORSYTH	90	90	30	30	0.75	0.75	20	0.26	0.30	-
NC	FRANKLIN	90	95	30	30	0.75	0.75	10	0.18	0.19	-
NC	GASTON	90	90	30	30	0.75	0.75	10	0.34	0.37	-
NC	GATES	95	105	30	30	0.75	0.75	10	0.14	0.16	-

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NC	GRAHAM	90	90	30	30	0.75	0.75	20	0.52	0.58	1, 2
NC	GRANVILLE	90	90	30	30	0.75	0.75	10	0.19	0.20	-
NC	GREENE	100	105	30	30	0.50	0.75	10	0.18	0.20	-
NC	GUILFORD	90	90	30	30	0.75	0.75	20	0.23	0.27	-
NC	HALIFAX	90	100	30	30	0.75	0.75	10	0.16	0.18	-
NC	HARNETT	90	100	30	30	0.75	0.75	10	0.24	0.29	-
NC	HAYWOOD	90	90	30	30	0.75	0.75	20	0.45	0.55	1, 2
NC	HENDERSON	90	90	30	30	0.75	0.75	20	0.41	0.45	2
NC	HERTFORD	90	100	30	30	0.50	0.75	10	0.15	0.17	-
NC	HOKE	95	100	30	30	0.75	0.75	10	0.29	0.38	-
NC	HYDE	110	135	30	30	0.25	0.25	10	0.11	0.15	-
NC	IREDELL	90	90	30	30	0.75	0.75	20	0.31	0.36	-
NC	JACKSON	90	90	30	30	0.75	0.75	20	0.43	0.53	1, 2
NC	JOHNSTON	95	100	30	30	0.75	0.75	10	0.19	0.25	-
NC	JONES	105	125	30	30	0.25	0.50	10	0.18	0.22	-
NC	LEE	90	95	30	30	0.75	0.75	10	0.25	0.28	-
NC	LENOIR	100	110	30	30	0.50	0.75	10	0.18	0.22	-
NC	LINCOLN	90	90	30	30	0.75	0.75	20	0.33	0.37	-
NC	MACON	90	90	30	30	0.75	0.75	20	0.43	0.53	1, 2
NC	MADISON	90	90	30	30	0.75	0.75	10	0.45	0.51	1, 2
NC	MARTIN	95	105	30	30	0.50	0.75	10	0.15	0.17	-
NC	MCDOWELL	90	90	30	30	0.75	0.75	20	0.39	0.43	2
NC	MECKLENBURG	90	90	30	30	0.75	0.75	10	0.33	0.38	-
NC	MITCHELL	90	90	30	30	0.75	0.75	20	0.42	0.46	1, 2
NC	MONTGOMERY	90	95	30	30	0.75	0.75	10	0.28	0.35	-
NC	MOORE	90	95	30	30	0.75	0.75	10	0.26	0.35	-
NC	NASH	90	95	30	30	0.75	0.75	10	0.17	0.19	-
NC	NEW HANOVER	125	135	30	30	0.25	0.25	5	0.28	0.34	-
NC	NORTHAMPTON	90	95	30	30	0.50	0.75	10	0.16	0.18	-
NC	ONSLOW	110	130	30	30	0.25	0.50	10	0.19	0.25	-
NC	ORANGE	90	90	30	30	0.75	0.75	10	0.20	0.23	-
NC	PAMLICO	115	125	30	30	0.25	0.25	10	0.14	0.17	-
NC	PASQUOTANK	110	120	30	30	0.25	0.50	10	0.12	0.14	-
NC	PENDER	110	130	30	30	0.25	0.50	5	0.24	0.35	-
NC	PERQUIMANS	105	110	30	30	0.25	0.50	10	0.13	0.14	-
NC	PERSON	90	90	30	30	0.75	0.75	20	0.19	0.21	-
NC	PITT	100	110	30	30	0.50	0.75	10	0.17	0.18	-
NC	POLK	90	90	30	30	0.75	0.75	20	0.39	0.41	2
NC	RANDOLPH	90	90	30	30	0.75	0.75	10	0.24	0.29	-
NC	RICHMOND	90	95	30	30	0.75	0.75	10	0.33	0.41	-
NC	ROBESON	100	110	30	30	0.50	0.75	10	0.33	0.56	-
NC	ROCKINGHAM	90	90	30	30	0.75	0.75	20	0.23	0.27	-
NC	ROWAN	90	90	30	30	0.75	0.75	20	0.28	0.32	-
NC	RUTHERFORD	90	90	30	30	0.75	0.75	20	0.38	0.42	2
NC	SAMPSON	95	110	30	30	0.50	0.75	10	0.24	0.32	-
NC	SCOTLAND	95	100	30	30	0.75	0.75	10	0.35	0.46	-
NC	STANLY	90	90	30	30	0.75	0.75	10	0.29	0.35	-

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NC	STOKES	90	90	30	30	0.75	0.75	20	0.26	0.32	-
NC	SURRY	90	90	30	30	0.75	0.75	20	0.30	0.38	2
NC	SWAIN	90	90	30	30	0.75	0.75	20	0.50	0.58	1, 2
NC	TRANSYLVANIA	90	90	30	30	0.75	0.75	20	0.42	0.46	2
NC	TYRRELL	110	120	30	30	0.25	0.25	10	0.12	0.14	-
NC	UNION	90	90	30	30	0.75	0.75	10	0.34	0.41	-
NC	VANCE	90	90	30	30	0.75	0.75	10	0.19	0.19	-
NC	WAKE	90	95	30	30	0.75	0.75	10	0.19	0.24	-
NC	WARREN	90	90	30	30	0.75	0.75	10	0.18	0.19	-
NC	WASHINGTON	105	110	30	30	0.25	0.50	10	0.13	0.15	-
NC	WATAUGA	90	90	30	30	0.75	0.75	20	0.40	0.43	1, 2
NC	WAYNE	95	105	30	30	0.50	0.75	10	0.19	0.24	-
NC	WILKES	90	90	30	30	0.75	0.75	20	0.34	0.40	1, 2
NC	WILSON	95	100	30	30	0.75	0.75	10	0.18	0.20	-
NC	YADKIN	90	90	30	30	0.75	0.75	20	0.29	0.36	-
NC	YANCEY	90	90	30	30	0.75	0.75	20	0.42	0.47	1, 2
ND	ADAMS	90	90	60	60	0.50	0.50	70	0.07	0.08	-
ND	BARNES	90	90	50	60	0.50	0.50	80	0.06	0.07	-
ND	BENSON	90	90	60	60	0.50	0.50	80	0.05	0.05	-
ND	BILLINGS	90	90	60	60	0.50	0.50	70	0.07	0.09	-
ND	BOTTINEAU	90	90	60	60	0.50	0.50	80	0.05	0.07	-
ND	BOWMAN	90	90	60	60	0.25	0.50	70	0.07	0.08	-
ND	BURKE	90	90	60	60	0.50	0.50	80	0.08	0.13	-
ND	BURLEIGH	90	90	60	60	0.50	0.50	80	0.06	0.07	-
ND	CASS	90	90	50	60	0.50	0.50	80	0.06	0.08	-
ND	CAVALIER	90	90	60	60	0.50	0.50	90	0.04	0.05	-
ND	DICKEY	90	90	50	60	0.50	0.50	70	0.07	0.08	-
ND	DIVIDE	90	90	60	60	0.50	0.50	70	0.12	0.24	-
ND	DUNN	90	90	60	60	0.50	0.50	70	0.07	0.09	-
ND	EDDY	90	90	60	60	0.50	0.50	80	0.05	0.05	-
ND	EMMONS	90	90	60	60	0.50	0.50	70	0.07	0.08	-
ND	FOSTER	90	90	60	60	0.50	0.50	80	0.05	0.06	-
ND	GOLDEN VALLEY	90	90	60	60	0.50	0.50	70	0.08	0.10	-
ND	GRAND FORKS	90	90	60	60	0.50	0.50	90	0.05	0.06	-
ND	GRANT	90	90	60	60	0.50	0.50	70	0.07	0.07	-
ND	GRIGGS	90	90	60	60	0.50	0.50	80	0.05	0.06	-
ND	HETTINGER	90	90	60	60	0.50	0.50	70	0.07	0.07	-
ND	KIDDER	90	90	60	60	0.50	0.50	80	0.06	0.07	-
ND	LAMOURE	90	90	50	60	0.50	0.50	70	0.06	0.08	-
ND	LOGAN	90	90	60	60	0.50	0.50	70	0.06	0.07	-
ND	MCHENRY	90	90	60	60	0.50	0.50	80	0.05	0.06	-
ND	MCINTOSH	90	90	60	60	0.50	0.50	70	0.07	0.08	-
ND	MCKENZIE	90	90	60	60	0.50	0.50	70	0.08	0.14	-
ND	MCLEAN	90	90	60	60	0.50	0.50	80	0.06	0.08	-
ND	MERCER	90	90	60	60	0.50	0.50	70	0.06	0.07	-
ND	MORTON	90	90	60	60	0.50	0.50	70	0.06	0.07	-
ND	MOUNTRAIL	90	90	60	60	0.50	0.50	70	0.07	0.12	-

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ND	NELSON	90	90	60	60	0.50	0.50	90	0.05	0.05	-
ND	OLIVER	90	90	60	60	0.50	0.50	70	0.06	0.07	-
ND	PEMBINA	90	90	60	60	0.50	0.50	90	0.04	0.05	-
ND	PIERCE	90	90	60	60	0.50	0.50	80	0.05	0.05	-
ND	RAMSEY	90	90	60	60	0.50	0.50	90	0.05	0.05	-
ND	RANSOM	90	90	50	60	0.50	0.50	80	0.07	0.08	-
ND	RENVILLE	90	90	60	60	0.50	0.50	80	0.06	0.08	-
ND	RICHLAND	90	90	50	50	0.50	0.50	80	0.07	0.10	-
ND	ROLETTE	90	90	60	60	0.50	0.50	90	0.05	0.05	-
ND	SARGENT	90	90	50	50	0.50	0.50	70	0.08	0.09	-
ND	SHERIDAN	90	90	60	60	0.50	0.50	80	0.05	0.06	-
ND	SIOUX	90	90	60	60	0.50	0.50	70	0.07	0.08	-
ND	SLOPE	90	90	60	60	0.25	0.50	70	0.07	0.08	-
ND	STARK	90	90	60	60	0.50	0.50	70	0.07	0.08	-
ND	STEELE	90	90	60	60	0.50	0.50	80	0.05	0.06	-
ND	STUTSMAN	90	90	60	60	0.50	0.50	80	0.06	0.07	-
ND	TOWNER	90	90	60	60	0.50	0.50	90	0.05	0.05	-
ND	TRAILL	90	90	50	60	0.50	0.50	80	0.05	0.06	-
ND	WALSH	90	90	60	60	0.50	0.50	90	0.05	0.05	-
ND	WARD	90	90	60	60	0.50	0.50	80	0.06	0.09	-
ND	WELLS	90	90	60	60	0.50	0.50	80	0.05	0.06	-
ND	WILLIAMS	90	90	60	60	0.50	0.50	70	0.10	0.22	-
NE	ADAMS	90	90	50	50	0.75	0.75	50	0.11	0.12	-
NE	ANTELOPE	90	90	50	50	0.75	0.75	60	0.13	0.14	-
NE	ARTHUR	90	90	60	60	0.50	0.50	60	0.09	0.10	-
NE	BANNER	90	90	50	60	0.25	0.25	60	0.11	0.15	-
NE	BLAINE	90	90	50	60	0.50	0.50	60	0.10	0.12	-
NE	BOONE	90	90	50	50	0.75	0.75	60	0.13	0.14	-
NE	BOX BUTTE	90	90	60	60	0.25	0.25	60	0.12	0.16	-
NE	BOYD	90	90	50	50	0.50	0.50	70	0.15	0.17	-
NE	BROWN	90	90	50	60	0.50	0.50	60	0.12	0.14	-
NE	BUFFALO	90	90	50	50	0.75	0.75	50	0.10	0.12	-
NE	BURT	90	90	50	50	0.75	0.75	60	0.10	0.12	-
NE	BUTLER	90	90	50	50	0.75	0.75	50	0.15	0.18	-
NE	CASS	90	90	40	40	0.75	0.75	40	0.12	0.17	-
NE	CEDAR	90	90	50	50	0.75	0.75	70	0.12	0.15	-
NE	CHASE	90	90	60	60	0.50	0.50	50	0.08	0.08	-
NE	CHERRY	90	90	60	60	0.50	0.50	70	0.11	0.17	-
NE	CHEYENNE	90	90	60	60	0.25	0.25	60	0.09	0.11	-
NE	CLAY	90	90	40	50	0.75	0.75	40	0.11	0.14	-
NE	COLFAX	90	90	50	50	0.75	0.75	50	0.13	0.16	-
NE	CUMING	90	90	50	50	0.75	0.75	60	0.11	0.13	-
NE	CUSTER	90	90	50	60	0.50	0.50	50	0.09	0.12	-
NE	DAKOTA	90	90	50	50	0.75	0.75	60	0.10	0.11	-
NE	DAWES	90	90	60	60	0.25	0.25	60	0.14	0.18	-
NE	DAWSON	90	90	50	50	0.50	0.75	50	0.09	0.11	-
NE	DEUEL	90	90	50	60	0.25	0.50	50	0.08	0.09	-

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NE	DIXON	90	90	50	50	0.75	0.75	70	0.11	0.12	-
NE	DODGE	90	90	50	50	0.75	0.75	50	0.12	0.15	-
NE	DOUGLAS	90	90	40	50	0.75	0.75	50	0.11	0.15	-
NE	DUNDY	90	90	50	50	0.50	0.50	50	0.08	0.08	-
NE	FILLMORE	90	90	40	50	0.75	0.75	40	0.13	0.17	-
NE	FRANKLIN	90	90	50	50	0.75	0.75	40	0.10	0.10	-
NE	FRONTIER	90	90	50	50	0.50	0.50	50	0.08	0.10	-
NE	FURNAS	90	90	50	50	0.50	0.75	50	0.10	0.11	-
NE	GAGE	90	90	40	40	0.75	0.75	40	0.16	0.17	-
NE	GARDEN	90	90	60	60	0.25	0.50	60	0.09	0.12	-
NE	GARFIELD	90	90	50	50	0.50	0.75	60	0.12	0.13	-
NE	GOSPER	90	90	50	50	0.50	0.75	50	0.10	0.10	-
NE	GRANT	90	90	60	60	0.50	0.50	60	0.10	0.12	-
NE	GREELEY	90	90	50	50	0.75	0.75	50	0.13	0.14	-
NE	HALL	90	90	50	50	0.75	0.75	50	0.11	0.13	-
NE	HAMILTON	90	90	50	50	0.75	0.75	50	0.12	0.15	-
NE	HARLAN	90	90	50	50	0.75	0.75	40	0.10	0.11	-
NE	HAYES	90	90	50	60	0.50	0.50	50	0.08	0.08	-
NE	HITCHCOCK	90	90	50	50	0.50	0.50	50	0.08	0.09	-
NE	HOLT	90	90	50	50	0.50	0.75	70	0.12	0.16	-
NE	HOOKER	90	90	60	60	0.50	0.50	60	0.10	0.12	-
NE	HOWARD	90	90	50	50	0.75	0.75	50	0.12	0.14	-
NE	JEFFERSON	90	90	40	40	0.75	0.75	40	0.14	0.17	-
NE	JOHNSON	90	90	40	40	0.75	0.75	40	0.15	0.17	-
NE	KEARNEY	90	90	50	50	0.75	0.75	50	0.10	0.11	-
NE	KEITH	90	90	60	60	0.50	0.50	50	0.08	0.09	-
NE	KEYA PAHA	90	90	50	60	0.50	0.50	70	0.14	0.16	-
NE	KIMBALL	90	90	50	60	0.25	0.25	60	0.11	0.14	-
NE	KNOX	90	90	50	50	0.50	0.75	70	0.13	0.16	-
NE	LANCASTER	90	90	40	40	0.75	0.75	50	0.16	0.18	-
NE	LINCOLN	90	90	50	60	0.50	0.50	50	0.08	0.10	-
NE	LOGAN	90	90	60	60	0.50	0.50	50	0.09	0.10	-
NE	LOUP	90	90	50	50	0.50	0.50	60	0.11	0.12	-
NE	MADISON	90	90	50	50	0.75	0.75	60	0.12	0.13	-
NE	MCPHERSON	90	90	50	50	0.50	0.50	60	0.09	0.10	-
NE	MERRICK	90	90	50	50	0.75	0.75	50	0.13	0.15	-
NE	MORRILL	90	90	60	60	0.25	0.25	60	0.10	0.13	-
NE	NANCE	90	90	50	50	0.75	0.75	50	0.14	0.15	-
NE	NEMAHA	90	90	40	40	0.75	0.75	40	0.13	0.16	-
NE	NUCKOLLS	90	90	40	40	0.75	0.75	40	0.11	0.13	-
NE	OTOE	90	90	40	40	0.75	0.75	40	0.13	0.17	-
NE	PAWNEE	90	90	40	40	0.75	0.75	40	0.16	0.17	-
NE	PERKINS	90	90	60	60	0.50	0.50	50	0.08	0.08	-
NE	PHELPS	90	90	50	50	0.75	0.75	50	0.10	0.10	-
NE	PIERCE	90	90	50	50	0.75	0.75	60	0.12	0.14	-
NE	PLATTE	90	90	50	50	0.75	0.75	50	0.13	0.16	-
NE	POLK	90	90	50	50	0.75	0.75	50	0.15	0.17	-

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NE	RED WILLOW	90	90	50	50	0.50	0.50	50	0.08	0.10	-
NE	RICHARDSON	90	90	40	40	0.75	0.75	40	0.13	0.17	-
NE	ROCK	90	90	50	50	0.50	0.50	70	0.12	0.15	-
NE	SALINE	90	90	40	40	0.75	0.75	40	0.15	0.18	-
NE	SARPY	90	90	40	40	0.75	0.75	50	0.12	0.15	-
NE	SAUNDERS	90	90	40	50	0.75	0.75	50	0.14	0.18	-
NE	SCOTTS BLUFF	90	90	50	60	0.25	0.25	60	0.12	0.17	-
NE	SEWARD	90	90	40	50	0.75	0.75	50	0.17	0.18	-
NE	SHERIDAN	90	90	60	60	0.25	0.50	60	0.12	0.17	-
NE	SHERMAN	90	90	50	50	0.75	0.75	50	0.11	0.14	-
NE	SIOUX	90	90	60	60	0.25	0.25	060	0.13	0.19	-
NE	STANTON	90	90	50	50	0.75	0.75	60	0.12	0.13	-
NE	THAYER	90	90	40	40	0.75	0.75	40	0.12	0.15	-
NE	THOMAS	90	90	60	60	0.50	0.50	60	0.10	0.12	-
NE	THURSTON	90	90	50	50	0.75	0.75	60	0.10	0.12	-
NE	VALLEY	90	90	50	50	0.50	0.75	50	0.12	0.14	-
NE	WASHINGTON	90	90	50	50	0.75	0.75	50	0.11	0.13	-
NE	WAYNE	90	90	50	50	0.75	0.75	60	0.11	0.13	-
NE	WEBSTER	90	90	40	50	0.75	0.75	40	0.10	0.11	-
NE	WHEELER	90	90	50	50	0.50	0.75	60	0.13	0.14	-
NE	YORK	90	90	40	50	0.75	0.75	50	0.14	0.17	-
NH	BELKNAP	90	95	40	40	0.75	1.00	70	0.43	0.46	-
NH	CARROLL	90	95	40	40	0.75	1.00	70	0.38	0.45	2
NH	CHESHIRE	90	95	40	40	0.75	1.00	70	0.27	0.35	1, 2
NH	COOS	90	90	40	40	0.75	0.75	80	0.28	0.41	1, 2
NH	GRAFTON	90	90	40	40	0.75	1.00	70	0.35	0.44	1, 2
NH	HILLSBOROUGH	90	100	40	40	0.75	1.00	70	0.30	0.41	-
NH	MERRIMACK	90	95	40	40	0.75	1.00	70	0.36	0.44	1, 2
NH	ROCKINGHAM	95	100	40	40	1.00	1.00	70	0.38	0.43	-
NH	STRAFFORD	90	100	40	40	1.00	1.00	70	0.41	0.44	-
NH	SULLIVAN	90	90	40	40	0.75	0.75	70	0.29	0.40	1, 2
NJ	ATLANTIC	100	115	40	40	0.75	0.75	30	0.19	0.27	-
NJ	BERGEN	90	110	40	50	0.75	0.75	50	0.40	0.43	-
NJ	BURLINGTON	90	115	40	40	0.75	1.00	40	0.22	0.35	-
NJ	CAMDEN	90	100	40	40	0.75	1.00	30	0.26	0.33	-
NJ	CAPE MAY	105	115	40	40	0.75	0.75	30	0.16	0.21	-
NJ	CUMBERLAND	90	105	40	40	0.75	0.75	30	0.19	0.28	-
NJ	ESSEX	90	100	50	50	0.75	0.75	40	0.41	0.43	-
NJ	GLOUCESTER	90	100	40	40	0.75	1.00	30	0.26	0.32	-
NJ	HUDSON	100	105	50	50	0.75	0.75	40	0.42	0.43	-
NJ	HUNTERDON	90	90	40	40	1.00	1.00	40	0.32	0.38	-
NJ	MERCER	90	100	40	40	0.75	1.00	40	0.34	0.38	-
NJ	MIDDLESEX	95	105	40	50	0.75	1.00	40	0.37	0.42	-
NJ	MONMOUTH	100	115	40	50	0.75	0.75	40	0.31	0.40	-
NJ	MORRIS	90	95	40	50	0.75	1.00	50	0.35	0.42	-
NJ	OCEAN	100	115	40	40	0.75	0.75	40	0.20	0.35	-
NJ	PASSAIC	90	100	40	50	0.75	0.75	50	0.37	0.43	-

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NJ	SALEM	90	100	40	40	0.75	0.75	30	0.25	0.32	-
NJ	SOMERSET	90	95	40	40	0.75	1.00	40	0.37	0.41	-
NJ	SUSSEX	90	90	40	40	0.75	1.00	40	0.29	0.38	-
NJ	UNION	95	105	50	50	0.75	0.75	40	0.40	0.42	-
NJ	WARREN	90	90	40	40	0.75	1.00	50	0.29	0.35	-
NM	BERNALILLO	90	90	30	30	0.00	0.00	20	0.45	0.63	1, 2
NM	CATRON	90	90	30	30	0.00	0.00	20	0.28	0.39	2
NM	CHAVES	90	90	30	30	0.00	0.25	20	0.10	0.28	1, 2
NM	CIBOLA	90	90	30	30	0.00	0.00	20	0.23	0.62	2
NM	COLFAX	90	90	40	50	0.00	0.25	30	0.15	0.37	2
NM	CURRY	90	90	30	40	0.25	0.25	20	0.11	0.16	2
NM	DE BACA	90	90	30	30	0.00	0.25	20	0.10	0.15	1, 2
NM	DONA ANA	90	90	30	30	0.00	0.00	20	0.28	0.40	-
NM	EDDY	90	90	30	30	0.00	0.25	20	0.13	0.29	2
NM	GRANT	90	90	30	30	0.00	0.00	10	0.28	0.38	-
NM	GUADALUPE	90	90	30	30	0.00	0.25	20	0.13	0.30	1, 2
NM	HARDING	90	90	40	40	0.00	0.25	30	0.15	0.19	2
NM	HIDALGO	90	90	30	30	0.00	0.00	10	0.28	0.41	-
NM	LEA	90	90	30	30	0.25	0.25	20	0.11	0.27	2
NM	LINCOLN	90	90	30	30	0.00	0.00	20	0.12	0.34	1, 2
NM	LOS ALAMOS	90	90	30	40	0.00	0.00	30	0.55	0.63	1, 2
NM	LUNA	90	90	30	30	0.00	0.00	10	0.28	0.29	-
NM	MCKINLEY	90	90	30	30	0.00	0.00	20	0.24	0.43	2
NM	MORA	90	90	40	40	0.00	0.00	30	0.16	0.41	1, 2
NM	OTERO	90	90	30	30	0.00	0.00	20	0.20	0.40	1, 2
NM	QUAY	90	90	30	40	0.25	0.25	30	0.12	0.19	2
NM	RIO ARRIBA	90	90	30	40	0.00	0.00	30	0.26	0.65	1, 2
NM	ROOSEVELT	90	90	30	30	0.25	0.25	20	0.10	0.12	2
NM	SAN JUAN	90	90	30	40	0.00	0.25	30	0.19	0.28	2
NM	SAN MIGUEL	90	90	30	40	0.00	0.25	30	0.16	0.42	1, 2
NM	SANDOVAL	90	90	30	40	0.00	0.00	30	0.26	0.64	1, 2
NM	SANTA FE	90	90	30	40	0.00	0.00	30	0.38	0.62	1, 2
NM	SIERRA	90	90	30	30	0.00	0.00	20	0.28	0.35	2
NM	SOCORRO	90	90	30	30	0.00	0.00	20	0.29	0.84	2
NM	TAOS	90	90	40	40	0.00	0.00	30	0.34	0.52	2
NM	TORRANCE	90	90	30	30	0.00	0.00	20	0.18	0.59	1, 2
NM	UNION	90	90	40	50	0.00	0.25	30	0.13	0.18	2
NM	VALENCIA	90	90	30	30	0.00	0.00	20	0.54	0.70	2
NV	CARSON CITY	90	90	30	30	0.00	0.00	40	1.32	1.77	1, 2
NV	CHURCHILL	90	90	30	30	0.00	0.25	30	0.68	1.26	-
NV	CLARK	90	90	30	30	0.00	0.00	20	0.27	0.90	1
NV	DOUGLAS	90	90	30	30	0.00	0.00	20	1.33	2.09	1, 2
NV	ELKO	90	90	30	40	0.25	0.25	40	0.28	1.17	-
NV	ESMERALDA	90	90	30	30	0.00	0.00	20	0.75	2.07	1
NV	EUREKA	90	90	30	40	0.00	0.25	30	0.56	1.07	-
NV	HUMBOLDT	90	90	30	30	0.25	0.25	30	0.35	1.19	-
NV	LANDER	90	90	30	30	0.00	0.25	30	0.63	1.24	-

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NV	LINCOLN	90	90	30	30	0.00	0.00	30	0.37	1.09	-
NV	LYON	90	90	30	30	0.00	0.00	20	0.97	1.50	2
NV	MINERAL	90	90	30	30	0.00	0.00	20	1.16	1.66	2
NV	NYE	90	90	30	30	0.00	0.00	30	0.46	1.42	1
NV	PERSHING	90	90	30	30	0.25	0.25	30	0.59	1.15	-
NV	STOREY	90	90	30	30	0.00	0.00	20	1.23	1.50	-
NV	WASHOE	90	90	30	40	0.00	0.25	20	0.49	1.52	1, 2
NV	WHITE PINE	90	90	30	30	0.00	0.25	30	0.34	0.71	-
NY	ALBANY	90	90	40	40	0.75	0.75	60	0.25	0.28	2
NY	ALLEGANY	90	90	40	40	0.75	0.75	60	0.18	0.27	2
NY	BRONX	95	105	50	50	0.75	0.75	50	0.42	0.43	1
NY	BROOME	90	90	40	40	0.75	0.75	50	0.18	0.20	2
NY	CATTARAUGUS	90	90	40	40	0.75	0.75	60	0.17	0.27	2
NY	CAYUGA	90	90	40	40	0.75	1.00	60	0.18	0.19	2
NY	CHAUTAUQUA	90	90	40	40	0.75	0.75	60	0.16	0.25	2
NY	CHEMUNG	90	90	40	40	0.75	0.75	50	0.17	0.18	2
NY	CHENANGO	90	90	40	40	0.75	0.75	60	0.18	0.22	2
NY	CLINTON	90	90	40	40	0.75	1.00	80	0.50	0.77	2
NY	COLUMBIA	90	90	40	40	0.75	0.75	60	0.26	0.27	1, 2
NY	CORTLAND	90	90	40	40	0.75	0.75	60	0.18	0.19	2
NY	DELAWARE	90	90	40	40	0.75	0.75	50	0.19	0.25	2
NY	DUTCHESS	90	95	40	40	0.75	0.75	50	0.26	0.36	1
NY	ERIE	90	90	40	40	0.75	1.00	60	0.24	0.33	2
NY	ESSEX	90	90	40	40	0.75	1.00	70	0.37	0.58	2
NY	FRANKLIN	90	90	40	40	0.75	1.25	80	0.49	0.80	2
NY	FULTON	90	90	40	40	0.75	0.75	60	0.27	0.34	2
NY	GENESEE	90	90	40	40	1.00	1.00	60	0.27	0.33	-
NY	GREENE	90	90	40	40	0.75	0.75	50	0.24	0.26	2
NY	HAMILTON	90	90	40	40	0.75	0.75	70	0.30	0.51	2
NY	HERKIMER	90	90	40	40	0.75	1.00	70	0.23	0.43	2
NY	JEFFERSON	90	90	40	40	1.00	1.00	70	0.22	0.37	-
NY	KINGS	100	110	50	50	0.75	0.75	40	0.41	0.42	-
NY	LEWIS	90	90	40	40	0.75	1.00	70	0.24	0.39	-
NY	LIVINGSTON	90	90	40	40	0.75	1.00	60	0.22	0.29	2
NY	MADISON	90	90	40	40	0.75	1.00	60	0.19	0.23	2
NY	MONROE	90	90	40	40	1.00	1.00	60	0.21	0.28	-
NY	MONTGOMERY	90	90	40	40	0.75	0.75	60	0.26	0.29	2
NY	NASSAU	105	115	50	50	0.75	0.75	50	0.34	0.42	-
NY	NEW YORK	95	110	50	50	0.75	0.75	50	0.42	0.43	-
NY	NIAGARA	90	90	40	40	1.00	1.00	60	0.26	0.33	-
NY	ONEIDA	90	90	40	40	0.75	1.00	70	0.21	0.32	2
NY	ONONDAGA	90	90	40	40	0.75	1.00	60	0.19	0.21	2
NY	ONTARIO	90	90	40	40	0.75	1.00	60	0.19	0.25	2
NY	ORANGE	90	90	40	40	0.75	0.75	50	0.27	0.40	1
NY	ORLEANS	90	90	40	40	1.00	1.00	60	0.24	0.31	-
NY	OSWEGO	90	90	40	40	1.00	1.00	70	0.19	0.26	-
NY	OTSEGO	90	90	40	40	0.75	0.75	60	0.19	0.26	2

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NY	PUTNAM	90	95	40	40	0.75	0.75	50	0.33	0.38	1
NY	QUEENS	100	110	50	50	0.75	0.75	50	0.39	0.43	-
NY	RENSSELAER	90	90	40	40	0.75	0.75	60	0.26	0.28	1, 2
NY	RICHMOND	95	105	50	50	0.75	0.75	40	0.40	0.42	-
NY	ROCKLAND	90	95	40	50	0.75	0.75	50	0.38	0.42	1
NY	SAINT LAWRENCE	90	90	40	40	0.75	1.00	80	0.33	0.76	2
NY	SARATOGA	90	90	40	40	0.75	0.75	70	0.28	0.36	2
NY	SCHENECTADY	90	90	40	40	0.75	0.75	60	0.27	0.29	-
NY	SCHOHARIE	90	90	40	40	0.75	0.75	60	0.24	0.28	2
NY	SCHUYLER	90	90	40	40	0.75	0.75	60	0.18	0.19	2
NY	SENECA	90	90	40	40	0.75	1.00	60	0.18	0.20	2
NY	STEUBEN	90	90	40	40	0.75	0.75	60	0.17	0.24	2
NY	SUFFOLK	110	120	50	50	0.75	0.75	50	0.21	0.39	-
NY	SULLIVAN	90	90	40	40	0.75	0.75	50	0.22	0.29	2
NY	TIOGA	90	90	40	40	0.75	0.75	50	0.17	0.18	2
NY	TOMPKINS	90	90	40	40	0.75	0.75	60	0.18	0.18	2
NY	ULSTER	90	90	40	40	0.75	0.75	50	0.23	0.32	1, 2
NY	WARREN	90	90	40	40	0.75	0.75	70	0.33	0.41	2
NY	WASHINGTON	90	90	40	40	0.75	0.75	70	0.27	0.38	2
NY	WAYNE	90	90	40	40	1.00	1.00	60	0.19	0.23	-
NY	WESTCHESTER	90	100	40	50	0.75	0.75	50	0.36	0.43	1
NY	WYOMING	90	90	40	40	0.75	1.00	60	0.26	0.33	2
NY	YATES	90	90	40	40	0.75	1.00	60	0.18	0.22	2
OH	ADAMS	90	90	30	30	0.75	0.75	20	0.20	0.26	-
OH	ALLEN	90	90	40	40	0.75	0.75	40	0.24	0.29	-
OH	ASHLAND	90	90	40	40	0.75	0.75	40	0.15	0.17	-
OH	ASHTABULA	90	90	40	40	0.75	0.75	50	0.17	0.21	-
OH	ATHENS	90	90	30	30	0.75	0.75	30	0.16	0.18	-
OH	AUGLAIZE	90	90	40	40	0.75	0.75	40	0.27	0.32	-
OH	BELMONT	90	90	30	40	0.75	0.75	40	0.13	0.13	-
OH	BROWN	90	90	30	30	0.75	0.75	20	0.19	0.26	-
OH	BUTLER	90	90	30	30	0.75	0.75	30	0.18	0.19	-
OH	CARROLL	90	90	40	40	0.75	0.75	40	0.13	0.15	-
OH	CHAMPAIGN	90	90	40	40	0.75	0.75	40	0.20	0.29	-
OH	CLARK	90	90	40	40	0.75	0.75	40	0.19	0.26	-
OH	CLERMONT	90	90	30	40	0.75	0.75	20	0.19	0.23	-
OH	CLINTON	90	90	30	40	0.75	0.75	30	0.18	0.19	-
OH	COLUMBIANA	90	90	40	40	0.75	0.75	40	0.13	0.16	-
OH	COSHOCTON	90	90	40	40	0.75	0.75	40	0.13	0.15	-
OH	CRAWFORD	90	90	40	40	0.75	0.75	40	0.17	0.18	-
OH	CUYAHOGA	90	90	40	40	0.75	0.75	50	0.19	0.23	-
OH	DARKE	90	90	40	40	0.75	0.75	40	0.21	0.31	-
OH	DEFIANCE	90	90	40	40	1.00	1.00	40	0.15	0.19	-
OH	DELAWARE	90	90	40	40	0.75	0.75	40	0.16	0.19	-
OH	ERIE	90	90	40	40	0.75	0.75	40	0.16	0.17	-
OH	FAIRFIELD	90	90	40	40	0.75	0.75	40	0.15	0.17	-
OH	FAYETTE	90	90	30	40	0.75	0.75	30	0.17	0.19	-

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OH	FRANKLIN	90	90	40	40	0.75	0.75	40	0.16	0.18	-
OH	FULTON	90	90	40	40	1.00	1.00	50	0.15	0.17	-
OH	GALLIA	90	90	30	30	0.75	0.75	30	0.18	0.20	-
OH	GEAUGA	90	90	40	40	0.75	0.75	50	0.19	0.23	-
OH	GREENE	90	90	40	40	0.75	0.75	40	0.19	0.23	-
OH	GUERNSEY	90	90	40	40	0.75	0.75	40	0.13	0.14	-
OH	HAMILTON	90	90	30	40	0.75	0.75	30	0.18	0.19	-
OH	HANCOCK	90	90	40	40	0.75	1.00	40	0.19	0.25	-
OH	HARDIN	90	90	40	40	0.75	0.75	40	0.21	0.28	-
OH	HARRISON	90	90	40	40	0.75	0.75	40	0.13	0.13	-
OH	HENRY	90	90	40	40	0.75	1.00	40	0.16	0.19	-
OH	HIGHLAND	90	90	30	40	0.75	0.75	30	0.18	0.21	-
OH	HOCKING	90	90	30	40	0.75	0.75	30	0.16	0.17	-
OH	HOLMES	90	90	40	40	0.75	0.75	40	0.14	0.15	-
OH	HURON	90	90	40	40	0.75	0.75	40	0.17	0.17	-
OH	JACKSON	90	90	30	30	0.75	0.75	30	0.18	0.20	-
OH	JEFFERSON	90	90	40	40	0.75	0.75	40	0.13	0.13	-
OH	KNOX	90	90	40	40	0.75	0.75	40	0.14	0.16	-
OH	LAKE	90	90	40	40	0.75	0.75	50	0.20	0.23	-
OH	LAWRENCE	90	90	30	30	0.75	0.75	30	0.19	0.22	-
OH	LICKING	90	90	40	40	0.75	0.75	40	0.14	0.16	-
OH	LOGAN	90	90	40	40	0.75	0.75	40	0.23	0.31	-
OH	LORAIN	90	90	40	40	0.75	0.75	40	0.17	0.19	-
OH	LUCAS	90	90	40	40	1.00	1.00	50	0.16	0.18	-
OH	MADISON	90	90	40	40	0.75	0.75	40	0.17	0.21	-
OH	MAHONING	90	90	40	40	0.75	0.75	40	0.14	0.18	-
OH	MARION	90	90	40	40	0.75	0.75	40	0.17	0.22	-
OH	MEDINA	90	90	40	40	0.75	0.75	40	0.17	0.20	-
OH	MEIGS	90	90	30	30	0.50	0.75	30	0.17	0.18	-
OH	MERCER	90	90	40	40	0.75	1.00	40	0.23	0.31	-
OH	MIAMI	90	90	40	40	0.75	0.75	40	0.24	0.30	-
OH	MONROE	90	90	30	40	0.50	0.75	40	0.13	0.15	-
OH	MONTGOMERY	90	90	40	40	0.75	0.75	40	0.19	0.25	-
OH	MORGAN	90	90	30	40	0.75	0.75	30	0.14	0.16	-
OH	MORROW	90	90	40	40	0.75	0.75	40	0.16	0.18	-
OH	MUSKINGUM	90	90	30	40	0.75	0.75	40	0.13	0.15	-
OH	NOBLE	90	90	30	40	0.75	0.75	40	0.13	0.15	-
OH	OTTAWA	90	90	40	40	0.75	1.00	50	0.16	0.18	-
OH	PAULDING	90	90	40	40	1.00	1.00	40	0.17	0.22	-
OH	PERRY	90	90	30	40	0.75	0.75	40	0.15	0.16	-
OH	PICKAWAY	90	90	40	40	0.75	0.75	40	0.16	0.18	-
OH	PIKE	90	90	30	30	0.75	0.75	20	0.18	0.21	-
OH	PORTAGE	90	90	40	40	0.75	0.75	40	0.17	0.21	-
OH	PREBLE	90	90	40	40	0.75	0.75	40	0.18	0.24	-
OH	PUTNAM	90	90	40	40	0.75	1.00	40	0.19	0.26	-
OH	RICHLAND	90	90	40	40	0.75	0.75	40	0.15	0.17	-
OH	ROSS	90	90	30	40	0.75	0.75	30	0.17	0.19	-

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OH	SANDUSKY	90	90	40	40	0.75	1.00	40	0.17	0.19	-
OH	SCIOTO	90	90	30	30	0.75	0.75	20	0.19	0.25	-
OH	SENECA	90	90	40	40	0.75	0.75	40	0.17	0.20	-
OH	SHELBY	90	90	40	40	0.75	0.75	40	0.28	0.33	-
OH	STARK	90	90	40	40	0.75	0.75	40	0.14	0.18	-
OH	SUMMIT	90	90	40	40	0.75	0.75	40	0.17	0.21	-
OH	TRUMBULL	90	90	40	40	0.75	0.75	40	0.15	0.21	-
OH	TUSCARAWAS	90	90	40	40	0.75	0.75	40	0.13	0.15	-
OH	UNION	90	90	40	40	0.75	0.75	40	0.18	0.24	-
OH	VAN WERT	90	90	40	40	0.75	1.00	40	0.19	0.28	-
OH	VINTON	90	90	30	30	0.75	0.75	30	0.17	0.18	-
OH	WARREN	90	90	30	30	0.75	0.75	30	0.19	0.19	-
OH	WASHINGTON	90	90	30	30	0.50	0.50	30	0.14	0.17	-
OH	WAYNE	90	90	40	40	0.75	0.75	40	0.15	0.18	-
OH	WILLIAMS	90	90	40	40	1.00	1.00	50	0.14	0.17	-
OH	WOOD	90	90	40	40	0.75	1.00	40	0.17	0.19	-
OH	WYANDOT	90	90	40	40	0.75	0.75	40	0.18	0.22	-
OK	ADAIR	90	90	30	30	1.00	1.00	20	0.17	0.19	-
OK	ALFALFA	90	90	40	40	0.75	0.75	30	0.14	0.19	-
OK	ATOKA	90	90	30	30	0.75	1.00	20	0.19	0.23	-
OK	BEAVER	90	90	40	40	0.75	0.75	30	0.11	0.13	-
OK	BECKHAM	90	90	40	40	0.75	0.75	30	0.19	0.23	-
OK	BLAINE	90	90	40	40	0.75	0.75	30	0.20	0.34	-
OK	BRYAN	90	90	30	30	0.75	1.00	20	0.18	0.22	-
OK	CADDO	90	90	40	40	0.75	0.75	30	0.28	0.40	-
OK	CANADIAN	90	90	40	40	0.75	0.75	30	0.31	0.38	-
OK	CARTER	90	90	30	40	0.75	0.75	20	0.22	0.30	-
OK	CHEROKEE	90	90	30	30	1.00	1.00	20	0.17	0.19	-
OK	CHOCTAW	90	90	30	30	0.75	1.00	20	0.18	0.19	-
OK	CIMARRON	90	90	50	50	0.25	0.50	30	0.11	0.14	-
OK	CLEVELAND	90	90	40	40	0.75	0.75	20	0.29	0.38	-
OK	COAL	90	90	30	30	0.75	1.00	20	0.21	0.24	-
OK	COMANCHE	90	90	40	40	0.75	0.75	20	0.23	0.40	-
OK	COTTON	90	90	40	40	0.75	0.75	20	0.18	0.32	-
OK	CRAIG	90	90	30	40	1.00	1.00	20	0.12	0.15	-
OK	CREEK	90	90	30	40	0.75	1.00	20	0.16	0.20	-
OK	CUSTER	90	90	40	40	0.75	0.75	30	0.18	0.29	-
OK	DELAWARE	90	90	30	30	1.00	1.00	20	0.14	0.17	-
OK	DEWEY	90	90	40	40	0.75	0.75	30	0.16	0.25	-
OK	ELLIS	90	90	40	40	0.75	0.75	30	0.13	0.17	-
OK	GARFIELD	90	90	40	40	0.75	0.75	30	0.17	0.25	-
OK	GARVIN	90	90	30	40	0.75	0.75	20	0.27	0.37	-
OK	GRADY	90	90	40	40	0.75	0.75	20	0.35	0.40	-
OK	GRANT	90	90	40	40	0.75	0.75	30	0.14	0.18	-
OK	GREER	90	90	40	40	0.75	0.75	20	0.18	0.23	-
OK	HARMON	90	90	40	40	0.75	0.75	20	0.16	0.19	-
OK	HARPER	90	90	40	40	0.75	0.75	30	0.11	0.14	-

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OK	HASKELL	90	90	30	30	1.00	1.00	20	0.19	0.20	-
OK	HUGHES	90	90	30	30	0.75	1.00	20	0.19	0.24	-
OK	JACKSON	90	90	40	40	0.75	0.75	20	0.15	0.24	-
OK	JEFFERSON	90	90	40	40	0.75	0.75	20	0.18	0.26	-
OK	JOHNSTON	90	90	30	30	0.75	0.75	20	0.21	0.26	-
OK	KAY	90	90	40	40	0.75	0.75	30	0.13	0.17	-
OK	KINGFISHER	90	90	40	40	0.75	0.75	30	0.24	0.34	-
OK	KIOWA	90	90	40	40	0.75	0.75	20	0.21	0.36	-
OK	LATIMER	90	90	30	30	1.00	1.00	20	0.19	0.20	-
OK	LE FLORE	90	90	30	30	1.00	1.00	20	0.19	0.20	-
OK	LINCOLN	90	90	40	40	0.75	1.00	20	0.18	0.28	-
OK	LOGAN	90	90	40	40	0.75	0.75	30	0.21	0.33	-
OK	LOVE	90	90	30	30	0.75	0.75	20	0.18	0.23	-
OK	MAJOR	90	90	40	40	0.75	0.75	30	0.16	0.25	-
OK	MARSHALL	90	90	30	30	0.75	0.75	20	0.19	0.23	-
OK	MAYES	90	90	30	30	1.00	1.00	20	0.14	0.17	-
OK	MCCLAIN	90	90	40	40	0.75	0.75	20	0.28	0.38	-
OK	MCCURTAIN	90	90	30	30	1.00	1.00	10	0.17	0.19	-
OK	MCINTOSH	90	90	30	30	1.00	1.00	20	0.18	0.20	-
OK	MURRAY	90	90	30	40	0.75	0.75	20	0.25	0.29	-
OK	MUSKOGEE	90	90	30	30	1.00	1.00	20	0.17	0.19	-
OK	NOBLE	90	90	40	40	0.75	0.75	30	0.15	0.22	-
OK	NOWATA	90	90	30	40	1.00	1.00	20	0.12	0.14	-
OK	OKFUSKEE	90	90	30	40	0.75	1.00	20	0.18	0.23	-
OK	OKLAHOMA	90	90	40	40	0.75	0.75	20	0.26	0.38	-
OK	OKMULGEE	90	90	30	30	1.00	1.00	20	0.17	0.19	-
OK	OSAGE	90	90	30	40	0.75	1.00	30	0.12	0.16	-
OK	OTTAWA	90	90	30	30	1.00	1.00	20	0.13	0.15	-
OK	PAWNEE	90	90	40	40	0.75	1.00	30	0.14	0.17	-
OK	PAYNE	90	90	40	40	0.75	1.00	30	0.17	0.25	-
OK	PITTSBURG	90	90	30	30	1.00	1.00	20	0.19	0.21	-
OK	PONTOTOC	90	90	30	30	0.75	0.75	20	0.23	0.28	-
OK	POTTAWATOMIE	90	90	30	40	0.75	1.00	20	0.23	0.31	-
OK	PUSHMATAHA	90	90	30	30	1.00	1.00	20	0.18	0.19	-
OK	ROGER MILLS	90	90	40	40	0.75	0.75	30	0.16	0.20	-
OK	ROGERS	90	90	30	30	1.00	1.00	20	0.13	0.17	-
OK	SEMINOLE	90	90	30	30	0.75	1.00	20	0.21	0.27	-
OK	SEQUOYAH	90	90	30	30	1.00	1.00	20	0.19	0.20	-
OK	STEPHENS	90	90	40	40	0.75	0.75	20	0.26	0.37	-
OK	TEXAS	90	90	40	50	0.50	0.75	30	0.11	0.13	-
OK	TILLMAN	90	90	40	40	0.75	0.75	20	0.16	0.26	-
OK	TULSA	90	90	30	40	1.00	1.00	20	0.14	0.17	-
OK	WAGONER	90	90	30	30	1.00	1.00	20	0.16	0.18	-
OK	WASHINGTON	90	90	30	40	1.00	1.00	20	0.12	0.15	-
OK	WASHITA	90	90	40	40	0.75	0.75	30	0.21	0.35	-
OK	WOODS	90	90	40	40	0.75	0.75	30	0.12	0.18	-
OK	WOODWARD	90	90	40	40	0.75	0.75	30	0.13	0.18	-

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OR	BAKER	85	85	40	40	0.25	0.25	30	0.35	0.60	-
OR	BENTON	85	85	30	30	0.25	0.50	10	0.93	1.50	1
OR	CLACKAMAS	85	85	30	30	0.25	1.00	20	0.50	1.06	1, 2
OR	CLATSOP	85	85	30	30	0.25	0.25	10	1.15	1.50	1
OR	COLUMBIA	85	85	30	30	0.25	0.75	10	0.98	1.17	1
OR	COOS	85	85	30	30	0.00	0.25	5	1.36	1.50	1
OR	CROOK	85	85	40	40	0.25	0.25	20	0.30	0.40	1
OR	CURRY	85	85	30	30	0.00	0.25	5	1.39	1.50	1
OR	DESCHUTES	85	85	30	40	0.25	0.25	20	0.31	0.59	1, 2
OR	DOUGLAS	85	85	30	30	0.25	0.25	10	0.54	1.50	1, 2
OR	GILLIAM	85	85	40	40	0.25	0.25	20	0.33	0.46	-
OR	GRANT	85	85	40	40	0.25	0.25	30	0.30	0.39	-
OR	HARNEY	85	85	40	40	0.25	0.25	30	0.29	0.97	-
OR	HOOD RIVER	85	85	30	40	0.25	1.25	20	0.50	0.65	1, 2
OR	JACKSON	85	85	30	30	0.25	0.25	10	0.60	1.13	2
OR	JEFFERSON	85	85	30	40	0.25	0.25	20	0.34	0.50	1, 2
OR	JOSEPHINE	85	85	30	30	0.25	0.25	5	0.96	1.50	1, 2
OR	KLAMATH	85	85	30	40	0.25	0.25	20	0.47	1.75	1, 2
OR	LAKE	85	85	40	40	0.25	0.25	20	0.32	1.12	1
OR	LANE	85	85	30	30	0.25	0.50	10	0.44	1.50	1, 2
OR	LINCOLN	85	85	30	30	0.25	0.25	5	1.26	1.50	1
OR	LINN	85	85	30	30	0.25	0.50	10	0.45	1.04	2
OR	MALHEUR	85	85	40	40	0.25	0.25	30	0.28	1.19	-
OR	MARION	85	85	30	30	0.25	0.75	10	0.47	1.06	2
OR	MORROW	85	85	40	40	0.25	0.25	30	0.32	0.50	-
OR	MULTNOMAH	85	85	30	40	0.50	1.50	10	0.62	1.09	1, 2
OR	POLK	85	85	30	30	0.25	0.50	10	0.98	1.41	1
OR	SHERMAN	85	85	40	40	0.25	0.25	20	0.39	0.46	-
OR	TILLAMOOK	85	85	30	30	0.25	0.25	10	1.16	1.50	1
OR	UMATILLA	85	85	40	40	0.25	0.25	30	0.32	0.57	-
OR	UNION	85	85	40	40	0.25	0.25	30	0.34	0.50	-
OR	WALLOWA	85	85	40	40	0.25	0.25	40	0.29	0.52	-
OR	WASCO	85	85	30	40	0.25	0.75	20	0.36	0.63	1, 2
OR	WASHINGTON	85	85	30	30	0.25	1.25	10	1.03	1.22	1
OR	WHEELER	85	85	40	40	0.25	0.25	20	0.31	0.39	-
OR	YAMHILL	85	85	30	30	0.25	0.75	10	1.02	1.50	1
PA	ADAMS	90	90	40	40	0.75	0.75	30	0.19	0.21	-
PA	ALLEGHENY	90	90	40	40	0.75	0.75	40	0.13	0.14	-
PA	ARMSTRONG	90	90	40	40	0.75	0.75	40	0.13	0.13	2
PA	BEAVER	90	90	40	40	0.75	0.75	40	0.13	0.13	-
PA	BEDFORD	90	90	30	40	0.75	0.75	40	0.16	0.19	2
PA	BERKS	90	90	40	40	0.75	1.00	40	0.25	0.32	-
PA	BLAIR	90	90	40	40	0.75	0.75	40	0.16	0.17	2
PA	BRADFORD	90	90	40	40	0.75	0.75	50	0.17	0.19	2
PA	BUCKS	90	95	40	40	0.75	1.00	40	0.31	0.35	-
PA	BUTLER	90	90	40	40	0.75	0.75	40	0.13	0.13	-
PA	CAMBRIA	90	90	40	40	0.75	0.75	40	0.15	0.16	2

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PA	CAMERON	90	90	40	40	0.75	0.75	50	0.15	0.16	2
PA	CARBON	90	90	40	40	0.75	0.75	50	0.25	0.28	2
PA	CENTRE	90	90	40	40	0.75	0.75	50	0.16	0.17	2
PA	CHESTER	90	90	40	40	0.75	1.00	30	0.28	0.33	-
PA	CLARION	90	90	40	40	0.75	0.75	50	0.13	0.14	2
PA	CLEARFIELD	90	90	40	40	0.75	0.75	50	0.14	0.16	2
PA	CLINTON	90	90	40	40	0.75	0.75	50	0.15	0.17	2
PA	COLUMBIA	90	90	40	40	0.75	0.75	50	0.19	0.24	2
PA	CRAWFORD	90	90	40	40	0.75	0.75	50	0.14	0.18	2
PA	CUMBERLAND	90	90	40	40	0.75	0.75	30	0.18	0.22	-
PA	DAUPHIN	90	90	40	40	0.75	0.75	40	0.19	0.25	-
PA	DELAWARE	90	90	40	40	0.75	1.00	30	0.32	0.33	-
PA	ELK	90	90	40	40	0.75	0.75	50	0.14	0.16	2
PA	ERIE	90	90	40	40	0.75	0.75	50	0.15	0.18	2
PA	FAYETTE	90	90	30	40	0.50	0.75	40	0.14	0.16	2
PA	FOREST	90	90	40	40	0.75	0.75	50	0.13	0.15	2
PA	FRANKLIN	90	90	40	40	0.75	0.75	30	0.18	0.19	-
PA	FULTON	90	90	30	40	0.75	0.75	40	0.18	0.19	2
PA	GREENE	90	90	30	40	0.75	0.75	40	0.13	0.15	-
PA	HUNTINGDON	90	90	40	40	0.75	0.75	40	0.17	0.18	2
PA	INDIANA	90	90	40	40	0.75	0.75	40	0.13	0.15	2
PA	JEFFERSON	90	90	40	40	0.75	0.75	50	0.13	0.14	2
PA	JUNIATA	90	90	40	40	0.75	0.75	40	0.18	0.19	-
PA	LACKAWANNA	90	90	40	40	0.75	0.75	50	0.21	0.26	2
PA	LANCASTER	90	90	40	40	0.75	1.00	30	0.24	0.32	-
PA	LAWRENCE	90	90	40	40	0.75	0.75	40	0.13	0.15	-
PA	LEBANON	90	90	40	40	0.75	1.00	40	0.23	0.28	-
PA	LEHIGH	90	90	40	40	0.75	1.00	40	0.27	0.31	-
PA	LUZERNE	90	90	40	40	0.75	0.75	50	0.20	0.26	2
PA	LYCOMING	90	90	40	40	0.75	0.75	50	0.16	0.19	2
PA	MCKEAN	90	90	40	40	0.75	0.75	50	0.15	0.18	2
PA	MERCER	90	90	40	40	0.75	0.75	50	0.13	0.17	-
PA	MIFFLIN	90	90	40	40	0.75	0.75	40	0.17	0.18	2
PA	MONROE	90	90	40	40	0.75	1.00	50	0.25	0.30	2
PA	MONTGOMERY	90	90	40	40	0.75	1.00	30	0.31	0.34	-
PA	MONTOUR	90	90	40	40	0.75	0.75	50	0.18	0.21	-
PA	NORTHAMPTON	90	90	40	40	0.75	1.00	40	0.28	0.32	-
PA	NORTHUMBERLAND	90	90	40	40	0.75	0.75	50	0.18	0.23	-
PA	PERRY	90	90	40	40	0.75	0.75	40	0.18	0.21	-
PA	PHILADELPHIA	90	90	40	40	0.75	1.00	30	0.32	0.34	-
PA	PIKE	90	90	40	40	0.75	0.75	50	0.25	0.30	2
PA	POTTER	90	90	40	40	0.75	0.75	50	0.15	0.18	2
PA	SCHUYLKILL	90	90	40	40	0.75	1.00	40	0.21	0.27	2
PA	SNYDER	90	90	40	40	0.75	0.75	50	0.18	0.19	-
PA	SOMERSET	90	90	30	40	0.75	0.75	40	0.15	0.17	2
PA	SULLIVAN	90	90	40	40	0.75	0.75	50	0.17	0.20	2
PA	SUSQUEHANNA	90	90	40	40	0.75	0.75	50	0.18	0.22	2

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PA	TIOGA	90	90	40	40	0.75	0.75	50	0.16	0.17	2
PA	UNION	90	90	40	40	0.75	0.75	50	0.17	0.19	2
PA	VENANGO	90	90	40	40	0.75	0.75	50	0.13	0.14	2
PA	WARREN	90	90	40	40	0.75	0.75	50	0.14	0.17	2
PA	WASHINGTON	90	90	30	40	0.50	0.75	40	0.13	0.14	-
PA	WAYNE	90	90	40	40	0.50	0.75	50	0.20	0.26	2
PA	WESTMORELAND	90	90	40	40	0.75	0.75	40	0.13	0.15	2
PA	WYOMING	90	90	40	40	0.75	0.75	50	0.19	0.22	2
PA	YORK	90	90	40	40	0.75	0.75	30	0.19	0.27	-
RI	BRISTOL	110	115	50	50	0.75	0.75	40	0.26	0.27	-
RI	KENT	110	115	50	50	0.75	0.75	40	0.26	0.27	-
RI	NEWPORT	110	120	50	50	0.75	0.75	40	0.25	0.27	-
RI	PROVIDENCE	100	110	50	50	0.75	0.75	40	0.26	0.27	-
RI	WASHINGTON	110	120	50	50	0.75	0.75	40	0.21	0.26	-
SC	ABBEVILLE	90	90	30	30	0.75	0.75	10	0.39	0.43	-
SC	AIKEN	90	95	30	30	0.50	0.75	5	0.42	0.62	-
SC	ALLENDALE	100	100	30	30	0.25	0.50	5	0.47	0.71	-
SC	ANDERSON	90	90	30	30	0.75	0.75	10	0.38	0.42	-
SC	BAMBERG	95	105	30	30	0.25	0.50	5	0.62	1.02	-
SC	BARNWELL	95	100	30	30	0.50	0.50	5	0.43	0.63	-
SC	BEAUFORT	115	125	30	30	0.25	0.25	5	0.43	0.99	-
SC	BERKELEY	105	130	30	30	0.25	0.50	5	1.34	1.66	-
SC	CALHOUN	95	100	30	30	0.50	0.50	5	0.62	1.11	-
SC	CHARLESTON	115	130	30	30	0.25	0.25	5	1.02	1.61	-
SC	CHEROKEE	90	90	30	30	0.75	0.75	10	0.37	0.41	-
SC	CHESTER	90	90	30	30	0.75	0.75	10	0.41	0.48	-
SC	CHESTERFIELD	90	100	30	30	0.75	0.75	10	0.41	0.58	-
SC	CLARENDON	100	110	30	30	0.50	0.50	5	1.00	1.40	-
SC	COLLETON	100	130	30	30	0.25	0.50	5	0.71	1.41	-
SC	DARLINGTON	95	100	30	30	0.50	0.75	5	0.53	0.89	-
SC	DILLON	100	110	30	30	0.50	0.75	5	0.46	0.75	-
SC	DORCHESTER	105	125	30	30	0.25	0.50	5	1.02	1.61	-
SC	EDGEFIELD	90	90	30	30	0.50	0.75	10	0.42	0.52	-
SC	FAIRFIELD	90	95	30	30	0.75	0.75	10	0.45	0.56	-
SC	FLORENCE	100	115	30	30	0.50	0.50	5	0.67	1.29	-
SC	GEORGETOWN	115	130	30	30	0.25	0.50	5	1.02	1.58	-
SC	GREENVILLE	90	90	30	30	0.75	0.75	10	0.40	0.43	2
SC	GREENWOOD	90	90	30	30	0.75	0.75	10	0.42	0.47	-
SC	HAMPTON	100	110	30	30	0.25	0.50	5	0.45	0.86	-
SC	HORRY	110	130	30	30	0.25	0.50	5	0.52	1.14	-
SC	JASPER	105	125	30	30	0.25	0.25	5	0.41	0.75	-
SC	KERSHAW	95	95	30	30	0.50	0.75	10	0.47	0.64	-
SC	LANCASTER	90	95	30	30	0.75	0.75	10	0.37	0.51	-
SC	LAURENS	90	90	30	30	0.75	0.75	10	0.41	0.46	-
SC	LEE	95	100	30	30	0.50	0.75	5	0.58	1.00	-
SC	LEXINGTON	90	95	30	30	0.50	0.75	5	0.53	0.69	-
SC	MARION	100	120	30	30	0.25	0.50	5	0.60	1.21	-

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SC	MARLBORO	95	100	30	30	0.50	0.75	10	0.41	0.68	-
SC	MCCORMICK	90	90	30	30	0.75	0.75	10	0.41	0.45	-
SC	NEWBERRY	90	90	30	30	0.75	0.75	10	0.44	0.55	-
SC	OCONEE	90	90	30	30	0.75	0.75	10	0.38	0.43	2
SC	ORANGEBURG	95	110	30	30	0.25	0.50	5	0.58	1.44	-
SC	PICKENS	90	90	30	30	0.75	0.75	10	0.40	0.43	2
SC	RICHLAND	90	100	30	30	0.50	0.75	5	0.53	0.90	-
SC	SALUDA	90	90	30	30	0.50	0.75	10	0.46	0.54	-
SC	SPARTANBURG	90	90	30	30	0.75	0.75	10	0.39	0.42	-
SC	SUMTER	95	100	30	30	0.50	0.50	5	0.63	1.09	-
SC	UNION	90	90	30	30	0.75	0.75	10	0.40	0.47	-
SC	WILLIAMSBURG	105	120	30	30	0.25	0.50	5	1.18	1.62	-
SC	YORK	90	90	30	30	0.75	0.75	10	0.37	0.41	-
SD	AURORA	90	90	50	50	0.50	0.50	70	0.18	0.20	-
SD	BEADLE	90	90	50	50	0.50	0.50	80	0.13	0.19	-
SD	BENNETT	90	90	60	60	0.50	0.50	70	0.14	0.17	-
SD	BON HOMME	90	90	50	50	0.50	0.75	70	0.15	0.17	-
SD	BROOKINGS	90	90	50	50	0.50	0.50	80	0.10	0.12	-
SD	BROWN	90	90	50	60	0.50	0.50	80	0.08	0.11	-
SD	BRULE	90	90	50	50	0.50	0.50	70	0.18	0.20	-
SD	BUFFALO	90	90	50	60	0.50	0.50	70	0.17	0.20	-
SD	BUTTE	90	90	60	60	0.25	0.50	70	0.09	0.15	-
SD	CAMPBELL	90	90	60	60	0.50	0.50	80	0.08	0.09	-
SD	CHARLES MIX	90	90	50	50	0.50	0.50	70	0.16	0.19	-
SD	CLARK	90	90	50	50	0.50	0.50	80	0.11	0.14	-
SD	CLAY	90	90	50	50	0.75	0.75	70	0.11	0.13	-
SD	CODINGTON	90	90	50	50	0.50	0.50	80	0.10	0.11	-
SD	CORSON	90	90	60	60	0.50	0.50	80	0.07	0.09	-
SD	CUSTER	90	90	60	60	0.25	0.25	70	0.14	0.19	-
SD	DAVISON	90	90	50	50	0.50	0.50	70	0.17	0.19	-
SD	DAY	90	90	50	50	0.50	0.50	80	0.09	0.11	-
SD	DEUEL	90	90	50	50	0.50	0.50	80	0.10	0.11	-
SD	DEWEY	90	90	60	60	0.50	0.50	80	0.08	0.12	-
SD	DOUGLAS	90	90	50	50	0.50	0.50	70	0.17	0.19	-
SD	EDMUNDS	90	90	50	60	0.50	0.50	80	0.09	0.11	-
SD	FALL RIVER	90	90	60	60	0.25	0.25	70	0.17	0.19	-
SD	FAULK	90	90	50	60	0.50	0.50	80	0.10	0.13	-
SD	GRANT	90	90	50	50	0.50	0.50	80	0.10	0.11	-
SD	GREGORY	90	90	50	50	0.50	0.50	70	0.16	0.19	-
SD	HAAKON	90	90	60	60	0.50	0.50	70	0.10	0.12	-
SD	HAMLIN	90	90	50	50	0.50	0.50	80	0.10	0.12	-
SD	HAND	90	90	50	60	0.50	0.50	80	0.12	0.19	-
SD	HANSON	90	90	50	50	0.50	0.50	70	0.14	0.17	-
SD	HARDING	90	90	60	60	0.25	0.50	80	0.08	0.11	-
SD	HUGHES	90	90	60	60	0.50	0.50	70	0.12	0.17	-
SD	HUTCHINSON	90	90	50	50	0.50	0.75	70	0.13	0.17	-
SD	HYDE	90	90	50	60	0.50	0.50	80	0.12	0.18	-

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SD	JACKSON	90	90	60	60	0.50	0.50	70	0.12	0.16	-
SD	JERAULD	90	90	50	50	0.50	0.50	70	0.19	0.20	-
SD	JONES	90	90	60	60	0.50	0.50	70	0.12	0.14	-
SD	KINGSBURY	90	90	50	50	0.50	0.50	80	0.11	0.16	-
SD	LAKE	90	90	50	50	0.50	0.75	70	0.11	0.13	-
SD	LAWRENCE	90	90	60	60	0.25	0.25	70	0.13	0.17	-
SD	LINCOLN	90	90	50	50	0.75	0.75	70	0.10	0.12	-
SD	LYMAN	90	90	50	60	0.50	0.50	70	0.14	0.19	-
SD	MARSHALL	90	90	50	50	0.50	0.50	80	0.08	0.10	-
SD	MCCOOK	90	90	50	50	0.50	0.75	70	0.12	0.15	-
SD	MCPHERSON	90	90	60	60	0.50	0.50	80	0.08	0.09	-
SD	MEADE	90	90	60	60	0.25	0.50	70	0.08	0.16	-
SD	MELLETTE	90	90	60	60	0.50	0.50	70	0.13	0.14	-
SD	MINER	90	90	50	50	0.50	0.50	70	0.12	0.16	-
SD	MINNEHAHA	90	90	50	50	0.50	0.75	70	0.10	0.12	-
SD	MOODY	90	90	50	50	0.50	0.75	70	0.10	0.12	-
SD	PENNINGTON	90	90	60	60	0.25	0.50	70	0.10	0.18	-
SD	PERKINS	90	90	60	60	0.50	0.50	80	0.07	0.10	-
SD	POTTER	90	90	60	60	0.50	0.50	80	0.10	0.12	-
SD	ROBERTS	90	90	50	50	0.50	0.50	80	0.09	0.11	-
SD	SANBORN	90	90	50	50	0.50	0.50	70	0.16	0.19	-
SD	SHANNON	90	90	60	60	0.25	0.50	70	0.13	0.17	-
SD	SPINK	90	90	50	50	0.50	0.50	80	0.11	0.16	-
SD	STANLEY	90	90	60	60	0.50	0.50	70	0.10	0.15	-
SD	SULLY	90	90	60	60	0.50	0.50	80	0.11	0.14	-
SD	TODD	90	90	60	60	0.50	0.50	70	0.13	0.15	-
SD	TRIPP	90	90	50	60	0.50	0.50	70	0.14	0.17	-
SD	TURNER	90	90	50	50	0.50	0.75	70	0.12	0.14	-
SD	UNION	90	90	50	50	0.50	0.75	70	0.10	0.12	-
SD	WALWORTH	90	90	60	60	0.50	0.50	80	0.08	0.10	-
SD	YANKTON	90	90	50	50	0.50	0.75	70	0.13	0.16	-
SD	ZIEBACH	90	90	60	60	0.50	0.50	80	0.08	0.10	-
TN	ANDERSON	90	90	30	30	0.50	0.75	20	0.42	0.55	2
TN	BEDFORD	90	90	30	30	0.75	0.75	20	0.28	0.28	-
TN	BENTON	90	90	30	30	0.75	1.00	20	0.56	0.85	-
TN	BLEDSOE	90	90	30	30	0.75	0.75	20	0.35	0.45	2
TN	BLOUNT	90	90	30	30	0.50	0.75	20	0.57	0.60	1, 2
TN	BRADLEY	90	90	30	30	0.75	0.75	20	0.53	0.57	2
TN	CAMPBELL	90	90	30	30	0.50	0.75	30	0.36	0.50	2
TN	CANNON	90	90	30	30	0.75	0.75	20	0.27	0.28	-
TN	CARROLL	90	90	30	30	0.75	1.00	20	0.63	1.14	-
TN	CARTER	90	90	30	30	0.75	0.75	30	0.43	0.45	1, 2
TN	CHEATHAM	90	90	30	30	0.75	0.75	20	0.35	0.44	-
TN	CHESTER	90	90	30	30	0.75	1.00	20	0.56	0.80	-
TN	CLAIBORNE	90	90	30	30	0.50	0.50	30	0.41	0.54	2
TN	CLAY	90	90	30	30	0.75	0.75	20	0.25	0.26	-
TN	COCKE	90	90	30	30	0.75	0.75	30	0.51	0.56	1, 2

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TN	COFFEE	90	90	30	30	0.75	0.75	20	0.27	0.33	-
TN	CROCKETT	90	90	30	30	1.00	1.00	20	1.14	2.08	-
TN	CUMBERLAND	90	90	30	30	0.75	0.75	20	0.28	0.42	2
TN	DAVIDSON	90	90	30	30	0.75	0.75	20	0.28	0.37	-
TN	DECATUR	90	90	30	30	0.75	0.75	20	0.45	0.64	-
TN	DEKALB	90	90	30	30	0.75	0.75	20	0.26	0.28	-
TN	DICKSON	90	90	30	30	0.75	0.75	20	0.37	0.52	-
TN	DYER	90	90	30	30	1.00	1.00	20	1.92	3.33	-
TN	FAYETTE	90	90	30	30	0.75	1.00	20	0.63	1.28	-
TN	FENTRESS	90	90	30	30	0.75	0.75	20	0.26	0.33	2
TN	FRANKLIN	90	90	30	30	0.75	0.75	20	0.29	0.38	-
TN	GIBSON	90	90	30	30	1.00	1.00	20	1.03	2.20	-
TN	GILES	90	90	30	30	0.75	0.75	20	0.28	0.33	-
TN	GRAINGER	90	90	30	30	0.50	0.50	30	0.52	0.58	2
TN	GREENE	90	90	30	30	0.50	0.75	30	0.45	0.54	1, 2
TN	GRUNDY	90	90	30	30	0.75	0.75	20	0.30	0.39	2
TN	HAMBLEN	90	90	30	30	0.50	0.50	30	0.51	0.57	-
TN	HAMILTON	90	90	30	30	0.75	0.75	20	0.43	0.57	2
TN	HANCOCK	90	90	30	30	0.50	0.50	30	0.43	0.52	2
TN	HARDEMAN	90	90	30	30	0.75	1.00	20	0.54	1.03	-
TN	HARDIN	90	90	30	30	0.75	0.75	20	0.38	0.57	-
TN	HAWKINS	90	90	30	30	0.50	0.50	30	0.42	0.53	2
TN	HAYWOOD	90	90	30	30	1.00	1.00	20	0.96	2.00	-
TN	HENDERSON	90	90	30	30	0.75	1.00	20	0.54	0.96	-
TN	HENRY	90	90	30	30	0.75	1.00	20	0.76	1.15	-
TN	HICKMAN	90	90	30	30	0.75	0.75	20	0.36	0.49	-
TN	HOUSTON	90	90	30	30	0.75	0.75	20	0.50	0.75	-
TN	HUMPHREYS	90	90	30	30	0.75	0.75	20	0.43	0.66	-
TN	JACKSON	90	90	30	30	0.75	0.75	20	0.25	0.26	-
TN	JEFFERSON	90	90	30	30	0.50	0.50	30	0.55	0.59	1
TN	JOHNSON	90	90	30	30	0.75	0.75	30	0.41	0.43	1, 2
TN	KNOX	90	90	30	30	0.50	0.75	20	0.53	0.59	2
TN	LAKE	90	90	30	30	1.00	1.00	20	3.03	3.40	-
TN	LAUDERDALE	90	90	30	30	1.00	1.00	20	1.51	2.98	-
TN	LAWRENCE	90	90	30	30	0.75	0.75	20	0.29	0.38	-
TN	LEWIS	90	90	30	30	0.75	0.75	20	0.34	0.42	-
TN	LINCOLN	90	90	30	30	0.75	0.75	20	0.28	0.31	-
TN	LOUDON	90	90	30	30	0.50	0.75	20	0.52	0.59	2
TN	MACON	90	90	30	30	0.75	0.75	20	0.25	0.27	-
TN	MADISON	90	90	30	30	0.75	1.00	20	0.75	1.20	-
TN	MARION	90	90	30	30	0.75	0.75	20	0.35	0.49	2
TN	MARSHALL	90	90	30	30	0.75	0.75	20	0.28	0.30	-
TN	MAURY	90	90	30	30	0.75	0.75	20	0.29	0.37	-
TN	MCMINN	90	90	30	30	0.75	0.75	20	0.52	0.58	2
TN	MCNAIRY	90	90	30	30	0.75	0.75	20	0.43	0.63	-
TN	MEIGS	90	90	30	30	0.75	0.75	20	0.45	0.54	2
TN	MONROE	90	90	30	30	0.75	0.75	20	0.54	0.59	1, 2

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TN	MONTGOMERY	90	90	30	30	0.75	0.75	20	0.41	0.63	-
TN	MOORE	90	90	30	30	0.75	0.75	20	0.28	0.30	-
TN	MORGAN	90	90	30	30	0.50	0.75	20	0.30	0.48	2
TN	OBION	90	90	30	30	1.00	1.00	20	1.28	3.33	-
TN	OVERTON	90	90	30	30	0.75	0.75	20	0.25	0.29	-
TN	PERRY	90	90	30	30	0.75	0.75	20	0.41	0.57	-
TN	PICKETT	90	90	30	30	0.75	0.75	20	0.25	0.29	2
TN	POLK	90	90	30	30	0.75	0.75	20	0.52	0.58	-
TN	PUTNAM	90	90	30	30	0.75	0.75	20	0.26	0.30	-
TN	RHEA	90	90	30	30	0.75	0.75	20	0.41	0.50	2
TN	ROANE	90	90	30	30	0.50	0.75	20	0.42	0.54	2
TN	ROBERTSON	90	90	30	30	0.75	0.75	20	0.32	0.43	-
TN	RUTHERFORD	90	90	30	30	0.75	0.75	20	0.27	0.29	-
TN	SCOTT	90	90	30	30	0.50	0.75	20	0.27	0.42	2
TN	SEQUATCHIE	90	90	30	30	0.75	0.75	20	0.34	0.46	2
TN	SEVIER	90	90	30	30	0.50	0.75	20	0.55	0.60	1, 2
TN	SHELBY	90	90	30	30	1.00	1.00	20	0.90	2.62	-
TN	SMITH	90	90	30	30	0.75	0.75	20	0.26	0.27	-
TN	STEWART	90	90	30	30	0.75	1.00	20	0.56	0.98	-
TN	SULLIVAN	90	90	30	30	0.50	0.75	30	0.42	0.45	1, 2
TN	SUMNER	90	90	30	30	0.75	0.75	20	0.27	0.34	-
TN	TIPTON	90	90	30	30	1.00	1.00	20	1.19	2.66	-
TN	TROUSDALE	90	90	30	30	0.75	0.75	20	0.26	0.28	-
TN	UNICOI	90	90	30	30	0.50	0.75	30	0.44	0.48	1, 2
TN	UNION	90	90	30	30	0.50	0.50	30	0.47	0.57	2
TN	VAN BUREN	90	90	30	30	0.75	0.75	20	0.28	0.37	2
TN	WARREN	90	90	30	30	0.75	0.75	20	0.27	0.35	-
TN	WASHINGTON	90	90	30	30	0.50	0.75	30	0.44	0.48	1, 2
TN	WAYNE	90	90	30	30	0.75	0.75	20	0.33	0.47	-
TN	WEAKLEY	90	90	30	30	1.00	1.00	20	1.04	1.56	-
TN	WHITE	90	90	30	30	0.75	0.75	20	0.27	0.35	2
TN	WILLIAMSON	90	90	30	30	0.75	0.75	20	0.28	0.38	-
TN	WILSON	90	90	30	30	0.75	0.75	20	0.27	0.30	-
TX	ANDERSON	90	90	30	30	0.75	0.75	10	0.12	0.13	-
TX	ANDREWS	90	90	30	30	0.25	0.50	20	0.16	0.27	-
TX	ANGELINA	90	95	30	30	0.50	0.75	10	0.13	0.16	-
TX	ARANSAS	120	130	30	30	0.25	0.50	5	0.09	0.11	-
TX	ARCHER	90	90	40	40	0.75	0.75	20	0.11	0.16	-
TX	ARMSTRONG	90	90	40	40	0.75	0.75	30	0.13	0.18	-
TX	ATASCOSA	90	95	30	30	0.50	0.50	5	0.12	0.18	-
TX	AUSTIN	95	105	30	30	0.50	0.50	5	0.10	0.10	-
TX	BAILEY	90	90	30	40	0.25	0.50	20	0.10	0.11	-
TX	BANDERA	90	90	30	30	0.50	0.50	5	0.07	0.10	-
TX	BASTROP	90	95	30	30	0.50	0.50	5	0.09	0.11	-
TX	BAYLOR	90	90	40	40	0.75	0.75	20	0.10	0.13	-
TX	BEE	95	110	30	30	0.25	0.50	5	0.11	0.17	-
TX	BELL	90	90	30	30	0.75	0.75	10	0.08	0.10	-

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TX	BEXAR	90	90	30	30	0.50	0.50	5	0.10	0.16	-
TX	BLANCO	90	90	30	30	0.50	0.50	10	0.08	0.10	-
TX	BORDEN	90	90	30	40	0.75	0.75	20	0.09	0.12	-
TX	BOSQUE	90	90	30	30	0.75	0.75	10	0.08	0.09	-
TX	BOWIE	90	90	30	30	0.75	1.00	20	0.17	0.18	-
TX	BRAZORIA	110	130	30	30	0.50	0.50	5	0.09	0.10	-
TX	BRAZOS	90	95	30	30	0.50	0.75	5	0.10	0.11	-
TX	BREWSTER	90	90	30	30	0.00	0.25	10	0.18	0.38	-
TX	BRISCOE	90	90	40	40	0.75	0.75	20	0.11	0.15	-
TX	BROOKS	100	110	30	30	0.25	0.25	5	0.08	0.09	-
TX	BROWN	90	90	30	40	0.75	0.75	10	0.07	0.08	-
TX	BURLESON	90	95	30	30	0.50	0.75	5	0.10	0.11	-
TX	BURNET	90	90	30	30	0.50	0.75	10	0.08	0.08	-
TX	CALDWELL	90	95	30	30	0.50	0.50	5	0.10	0.11	-
TX	CALHOUN	115	130	30	30	0.50	0.50	5	0.09	0.11	-
TX	CALLAHAN	90	90	30	40	0.75	0.75	10	0.08	0.08	-
TX	CAMERON	110	135	30	30	0.25	0.25	5	0.05	0.07	-
TX	CAMP	90	90	30	30	0.75	0.75	10	0.16	0.16	-
TX	CARSON	90	90	40	40	0.75	0.75	30	0.16	0.19	-
TX	CASS	90	90	30	30	0.75	0.75	10	0.17	0.18	-
TX	CASTRO	90	90	40	40	0.50	0.75	20	0.11	0.13	-
TX	CHAMBERS	110	130	30	30	0.50	0.50	5	0.10	0.11	-
TX	CHEROKEE	90	90	30	30	0.75	0.75	10	0.13	0.15	-
TX	CHILDRESS	90	90	40	40	0.75	0.75	20	0.13	0.17	-
TX	CLAY	90	90	40	40	0.75	0.75	20	0.12	0.22	-
TX	COCHRAN	90	90	30	30	0.25	0.50	20	0.10	0.11	-
TX	COKE	90	90	30	30	0.75	0.75	10	0.08	0.09	-
TX	COLEMAN	90	90	30	40	0.75	0.75	10	0.07	0.08	-
TX	COLLIN	90	90	30	30	0.75	0.75	20	0.13	0.16	-
TX	COLLINGSWORTH	90	90	40	40	0.75	0.75	30	0.16	0.19	-
TX	COLORADO	95	105	30	30	0.50	0.50	5	0.10	0.11	-
TX	COMAL	90	90	30	30	0.50	0.50	5	0.09	0.12	-
TX	COMANCHE	90	90	30	30	0.75	0.75	10	0.07	0.08	-
TX	CONCHO	90	90	30	30	0.50	0.75	10	0.07	0.08	-
TX	COOKE	90	90	30	30	0.75	0.75	20	0.15	0.21	-
TX	CORYELL	90	90	30	30	0.75	0.75	10	0.08	0.09	-
TX	COTTLE	90	90	40	40	0.75	0.75	20	0.11	0.14	-
TX	CRANE	90	90	30	30	0.25	0.50	10	0.14	0.23	-
TX	CROCKETT	90	90	30	30	0.25	0.50	10	0.07	0.14	-
TX	CROSBY	90	90	40	40	0.75	0.75	20	0.09	0.10	-
TX	CULBERSON	90	90	30	30	0.00	0.25	10	0.18	0.47	-
TX	DALLAM	90	90	50	50	0.25	0.50	30	0.13	0.16	-
TX	DALLAS	90	90	30	30	0.75	0.75	10	0.11	0.13	-
TX	DAWSON	90	90	30	30	0.50	0.75	20	0.10	0.16	-
TX	DE WITT	95	105	30	30	0.50	0.50	5	0.11	0.16	-
TX	DEAF SMITH	90	90	40	40	0.25	0.50	30	0.13	0.18	-
TX	DELTA	90	90	30	30	0.75	0.75	20	0.15	0.17	-

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TX	DENTON	90	90	30	30	0.75	0.75	20	0.12	0.16	-
TX	DICKENS	90	90	40	40	0.75	0.75	20	0.09	0.11	-
TX	DIMMIT	90	90	30	30	0.25	0.50	5	0.07	0.10	-
TX	DONLEY	90	90	40	40	0.75	0.75	30	0.15	0.18	-
TX	DUVAL	95	105	30	30	0.25	0.25	5	0.09	0.12	-
TX	EASTLAND	90	90	30	40	0.75	0.75	10	0.08	0.08	-
TX	ECTOR	90	90	30	30	0.25	0.50	10	0.18	0.27	-
TX	EDWARDS	90	90	30	30	0.25	0.50	10	0.07	0.07	-
TX	EL PASO	90	90	30	30	0.00	0.00	10	0.32	0.72	1
TX	ELLIS	90	90	30	30	0.75	0.75	10	0.10	0.12	-
TX	ERATH	90	90	30	30	0.75	0.75	10	0.08	0.09	-
TX	FALLS	90	90	30	30	0.75	0.75	10	0.09	0.11	-
TX	FANNIN	90	90	30	30	0.75	0.75	20	0.16	0.18	-
TX	FAYETTE	90	95	30	30	0.50	0.50	5	0.10	0.11	-
TX	FISHER	90	90	40	40	0.75	0.75	20	0.08	0.09	-
TX	FLOYD	90	90	40	40	0.75	0.75	20	0.10	0.12	-
TX	FOARD	90	90	40	40	0.75	0.75	20	0.11	0.13	-
TX	FORT BEND	100	115	30	30	0.50	0.50	5	0.10	0.10	-
TX	FRANKLIN	90	90	30	30	0.75	0.75	10	0.15	0.17	-
TX	FREESTONE	90	90	30	30	0.75	0.75	10	0.11	0.12	-
TX	FRIO	90	90	30	30	0.25	0.50	5	0.09	0.13	-
TX	GAINES	90	90	30	30	0.25	0.50	20	0.12	0.24	-
TX	GALVESTON	115	130	30	30	0.50	0.50	5	0.09	0.11	-
TX	GARZA	90	90	30	40	0.75	0.75	20	0.09	0.10	-
TX	GILLESPIE	90	90	30	30	0.50	0.50	10	0.07	0.08	-
TX	GLASSCOCK	90	90	30	30	0.50	0.75	10	0.10	0.13	-
TX	GOLIAD	100	110	30	30	0.50	0.50	5	0.11	0.16	-
TX	GONZALES	90	100	30	30	0.50	0.50	5	0.11	0.15	-
TX	GRAY	90	90	40	40	0.75	0.75	30	0.18	0.19	-
TX	GRAYSON	90	90	30	30	0.75	0.75	20	0.16	0.21	-
TX	GREGG	90	90	30	30	0.75	0.75	10	0.15	0.16	-
TX	GRIMES	90	95	30	30	0.50	0.75	5	0.11	0.11	-
TX	GUADALUPE	90	95	30	30	0.50	0.50	5	0.10	0.14	-
TX	HALE	90	90	40	40	0.50	0.75	20	0.10	0.11	-
TX	HALL	90	90	40	40	0.75	0.75	20	0.12	0.16	-
TX	HAMILTON	90	90	30	30	0.75	0.75	10	0.08	0.08	-
TX	HANSFORD	90	90	40	50	0.75	0.75	30	0.12	0.15	-
TX	HARDEMAN	90	90	40	40	0.75	0.75	20	0.13	0.16	-
TX	HARDIN	100	110	30	30	0.50	0.50	5	0.11	0.13	-
TX	HARRIS	95	110	30	30	0.50	0.50	5	0.10	0.11	-
TX	HARRISON	90	90	30	30	0.75	0.75	10	0.16	0.17	-
TX	HARTLEY	90	90	40	50	0.25	0.50	30	0.15	0.18	-
TX	HASKELL	90	90	40	40	0.75	0.75	20	0.08	0.10	-
TX	HAYS	90	90	30	30	0.50	0.50	5	0.08	0.11	-
TX	HEMPHILL	90	90	40	40	0.75	0.75	30	0.15	0.18	-
TX	HENDERSON	90	90	30	30	0.75	0.75	10	0.12	0.14	-
TX	HIDALGO	100	110	30	30	0.25	0.25	5	0.06	0.08	-

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TX	HILL	90	90	30	30	0.75	0.75	10	0.09	0.11	-
TX	HOCKLEY	90	90	30	40	0.50	0.75	20	0.10	0.11	-
TX	HOOD	90	90	30	30	0.75	0.75	10	0.08	0.10	-
TX	HOPKINS	90	90	30	30	0.75	0.75	10	0.14	0.16	-
TX	HOUSTON	90	90	30	30	0.75	0.75	10	0.11	0.13	-
TX	HOWARD	90	90	30	30	0.50	0.75	20	0.10	0.12	-
TX	HUDSPETH	90	90	30	30	0.00	0.00	10	0.29	0.77	1
TX	HUNT	90	90	30	30	0.75	0.75	20	0.13	0.16	-
TX	HUTCHINSON	90	90	40	40	0.75	0.75	30	0.15	0.18	-
TX	IRION	90	90	30	30	0.50	0.75	10	0.08	0.10	-
TX	JACK	90	90	30	40	0.75	0.75	20	0.10	0.14	-
TX	JACKSON	105	120	30	30	0.50	0.50	5	0.10	0.11	-
TX	JASPER	90	110	30	30	0.50	0.75	5	0.12	0.16	-
TX	JEFF DAVIS	90	90	30	30	0.00	0.25	10	0.31	0.48	-
TX	JEFFERSON	110	135	30	30	0.50	0.50	5	0.10	0.12	-
TX	JIM HOGG	95	100	30	30	0.25	0.25	5	0.07	0.09	-
TX	JIM WELLS	100	110	30	30	0.25	0.25	5	0.09	0.12	-
TX	JOHNSON	90	90	30	30	0.75	0.75	10	0.09	0.11	-
TX	JONES	90	90	40	40	0.75	0.75	20	0.08	0.08	-
TX	KARNES	95	100	30	30	0.50	0.50	5	0.14	0.18	-
TX	KAUFMAN	90	90	30	30	0.75	0.75	10	0.12	0.13	-
TX	KENDALL	90	90	30	30	0.50	0.50	5	0.08	0.10	-
TX	KENEDY	110	135	30	30	0.25	0.25	5	0.07	0.09	-
TX	KENT	90	90	40	40	0.75	0.75	20	0.08	0.09	-
TX	KERR	90	90	30	30	0.50	0.50	10	0.07	0.09	-
TX	KIMBLE	90	90	30	30	0.50	0.50	10	0.07	0.07	-
TX	KING	90	90	40	40	0.75	0.75	20	0.09	0.11	-
TX	KINNEY	90	90	30	30	0.25	0.50	5	0.07	0.08	-
TX	KLEBERG	105	135	30	30	0.25	0.25	5	0.08	0.10	-
TX	KNOX	90	90	40	40	0.75	0.75	20	0.09	0.12	-
TX	LA SALLE	90	95	30	30	0.25	0.50	5	0.09	0.13	-
TX	LAMAR	90	90	30	30	0.75	1.00	20	0.16	0.18	-
TX	LAMB	90	90	30	40	0.50	0.75	20	0.10	0.11	-
TX	LAMPASAS	90	90	30	30	0.75	0.75	10	0.07	0.08	-
TX	LAVACA	95	105	30	30	0.50	0.50	5	0.10	0.12	-
TX	LEE	90	95	30	30	0.50	0.50	5	0.09	0.10	-
TX	LEON	90	90	30	30	0.75	0.75	10	0.11	0.12	-
TX	LIBERTY	100	115	30	30	0.50	0.50	5	0.11	0.12	-
TX	LIMESTONE	90	90	30	30	0.75	0.75	10	0.10	0.12	-
TX	LIPSCOMB	90	90	40	40	0.75	0.75	30	0.13	0.16	-
TX	LIVE OAK	95	105	30	30	0.25	0.50	5	0.12	0.18	-
TX	LLANO	90	90	30	30	0.50	0.75	10	0.07	0.08	-
TX	LOVING	90	90	30	30	0.25	0.25	10	0.18	0.26	-
TX	LUBBOCK	90	90	30	40	0.50	0.75	20	0.09	0.10	-
TX	LYNN	90	90	30	30	0.50	0.75	20	0.09	0.12	-
TX	MADISON	90	90	30	30	0.50	0.75	5	0.11	0.12	-
TX	MARION	90	90	30	30	0.75	0.75	10	0.16	0.17	-

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TX	MARTIN	90	90	30	30	0.50	0.75	20	0.12	0.18	-
TX	MASON	90	90	30	30	0.50	0.75	10	0.07	0.08	-
TX	MATAGORDA	115	130	30	30	0.50	0.50	5	0.08	0.10	-
TX	MAVERICK	90	90	30	30	0.25	0.50	5	0.06	0.08	-
TX	MCCULLOCH	90	90	30	30	0.50	0.75	10	0.07	0.07	-
TX	MCLENNAN	90	90	30	30	0.75	0.75	10	0.08	0.11	-
TX	MCMULLEN	90	100	30	30	0.25	0.50	5	0.11	0.16	-
TX	MEDINA	90	90	30	30	0.50	0.50	5	0.08	0.13	-
TX	MENARD	90	90	30	30	0.50	0.75	10	0.07	0.07	-
TX	MIDLAND	90	90	30	30	0.50	0.50	10	0.12	0.19	-
TX	MILAM	90	90	30	30	0.50	0.75	10	0.09	0.11	-
TX	MILLS	90	90	30	30	0.75	0.75	10	0.07	0.08	-
TX	MITCHELL	90	90	30	40	0.75	0.75	20	0.09	0.10	-
TX	MONTAGUE	90	90	30	40	0.75	0.75	20	0.13	0.20	-
TX	MONTGOMERY	90	105	30	30	0.50	0.50	5	0.11	0.11	-
TX	MOORE	90	90	40	50	0.50	0.75	30	0.14	0.17	-
TX	MORRIS	90	90	30	30	0.75	0.75	10	0.16	0.17	-
TX	MOTLEY	90	90	40	40	0.75	0.75	20	0.10	0.13	-
TX	NACOGDOCHES	90	90	30	30	0.75	0.75	10	0.14	0.16	-
TX	NAVARRO	90	90	30	30	0.75	0.75	10	0.10	0.12	-
TX	NEWTON	90	110	30	30	0.50	0.50	5	0.13	0.16	-
TX	NOLAN	90	90	30	40	0.75	0.75	20	0.08	0.09	-
TX	NUECES	110	135	30	30	0.25	0.25	5	0.09	0.11	-
TX	OCHILTREE	90	90	40	40	0.75	0.75	30	0.13	0.16	-
TX	OLDHAM	90	90	40	40	0.25	0.50	30	0.17	0.19	-
TX	ORANGE	110	120	30	30	0.50	0.50	5	0.12	0.13	-
TX	PALO PINTO	90	90	30	40	0.75	0.75	20	0.08	0.11	-
TX	PANOLA	90	90	30	30	0.75	0.75	10	0.16	0.16	-
TX	PARKER	90	90	30	30	0.75	0.75	20	0.09	0.12	-
TX	PARMER	90	90	40	40	0.25	0.50	20	0.11	0.14	-
TX	PECOS	90	90	30	30	0.25	0.50	10	0.10	0.33	-
TX	POLK	90	100	30	30	0.50	0.75	5	0.12	0.14	-
TX	POTTER	90	90	40	40	0.50	0.75	30	0.16	0.17	-
TX	PRESIDIO	90	90	30	30	0.00	0.00	10	0.31	0.49	-
TX	RAINS	90	90	30	30	0.75	0.75	10	0.13	0.15	-
TX	RANDALL	90	90	40	40	0.50	0.75	30	0.13	0.17	-
TX	REAGAN	90	90	30	30	0.50	0.50	10	0.09	0.12	-
TX	REAL	90	90	30	30	0.50	0.50	10	0.07	0.08	-
TX	RED RIVER	90	90	30	30	0.75	1.00	20	0.16	0.18	-
TX	REEVES	90	90	30	30	0.00	0.25	10	0.18	0.32	-
TX	REFUGIO	110	120	30	30	0.25	0.50	5	0.10	0.12	-
TX	ROBERTS	90	90	40	40	0.75	0.75	30	0.15	0.18	-
TX	ROBERTSON	90	90	30	30	0.50	0.75	10	0.10	0.11	-
TX	ROCKWALL	90	90	30	30	0.75	0.75	10	0.12	0.13	-
TX	RUNNELS	90	90	30	40	0.75	0.75	10	0.07	0.08	-
TX	RUSK	90	90	30	30	0.75	0.75	10	0.14	0.16	-
TX	SABINE	90	95	30	30	0.50	0.75	5	0.16	0.17	-

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TX	SAN AUGUSTINE	90	95	30	30	0.50	0.75	5	0.15	0.17	-
TX	SAN JACINTO	90	100	30	30	0.50	0.75	5	0.11	0.12	-
TX	SAN PATRICIO	105	135	30	30	0.25	0.50	5	0.10	0.12	-
TX	SAN SABA	90	90	30	30	0.50	0.75	10	0.07	0.08	-
TX	SCHLEICHER	90	90	30	30	0.50	0.50	10	0.07	0.08	-
TX	SCURRY	90	90	30	40	0.75	0.75	20	0.08	0.10	-
TX	SHACKELFORD	90	90	40	40	0.75	0.75	20	0.08	0.09	-
TX	SHELBY	90	90	30	30	0.75	0.75	10	0.16	0.17	-
TX	SHERMAN	90	90	40	50	0.50	0.75	30	0.12	0.15	-
TX	SMITH	90	90	30	30	0.75	0.75	10	0.13	0.16	-
TX	SOMERVELL	90	90	30	30	0.75	0.75	10	0.08	0.09	-
TX	STARR	95	105	30	30	0.25	0.25	5	0.06	0.08	-
TX	STEPHENS	90	90	30	40	0.75	0.75	20	0.08	0.10	-
TX	STERLING	90	90	30	30	0.50	0.75	10	0.08	0.10	-
TX	STONEWALL	90	90	40	40	0.75	0.75	20	0.08	0.09	-
TX	SUTTON	90	90	30	30	0.50	0.50	10	0.07	0.08	-
TX	SWISHER	90	90	40	40	0.75	0.75	20	0.11	0.14	-
TX	TARRANT	90	90	30	30	0.75	0.75	20	0.10	0.12	-
TX	TAYLOR	90	90	30	40	0.75	0.75	10	0.08	0.08	-
TX	TERRELL	90	90	30	30	0.25	0.25	10	0.09	0.22	-
TX	TERRY	90	90	30	30	0.50	0.75	20	0.10	0.14	-
TX	THROCKMORTON	90	90	40	40	0.75	0.75	20	0.09	0.11	-
TX	TITUS	90	90	30	30	0.75	0.75	10	0.16	0.17	-
TX	TOM GREEN	90	90	30	30	0.50	0.75	10	0.07	0.10	-
TX	TRAVIS	90	90	30	30	0.50	0.50	10	0.08	0.10	-
TX	TRINITY	90	95	30	30	0.50	0.75	5	0.12	0.13	-
TX	TYLER	95	105	30	30	0.50	0.75	5	0.12	0.15	-
TX	UPSHUR	90	90	30	30	0.75	0.75	10	0.15	0.16	-
TX	UPTON	90	90	30	30	0.25	0.50	10	0.11	0.18	-
TX	UVALDE	90	90	30	30	0.25	0.50	5	0.07	0.09	-
TX	VAL VERDE	90	90	30	30	0.25	0.50	10	0.07	0.10	-
TX	VAN ZANDT	90	90	30	30	0.75	0.75	10	0.12	0.14	-
TX	VICTORIA	100	115	30	30	0.50	0.50	5	0.10	0.12	-
TX	WALKER	90	95	30	30	0.50	0.75	5	0.11	0.12	-
TX	WALLER	95	100	30	30	0.50	0.50	5	0.10	0.11	-
TX	WARD	90	90	30	30	0.25	0.25	10	0.18	0.24	-
TX	WASHINGTON	90	95	30	30	0.50	0.50	5	0.10	0.11	-
TX	WEBB	90	100	30	30	0.25	0.25	5	0.07	0.11	-
TX	WHARTON	100	115	30	30	0.50	0.50	5	0.10	0.11	-
TX	WHEELER	90	90	40	40	0.75	0.75	30	0.18	0.19	-
TX	WICHITA	90	90	40	40	0.75	0.75	20	0.13	0.18	-
TX	WILBARGER	90	90	40	40	0.75	0.75	20	0.12	0.17	-
TX	WILLACY	110	135	30	30	0.25	0.25	5	0.06	0.08	-
TX	WILLIAMSON	90	90	30	30	0.50	0.75	10	0.08	0.10	-
TX	WILSON	90	95	30	30	0.50	0.50	5	0.13	0.18	-
TX	WINKLER	90	90	30	30	0.25	0.25	10	0.22	0.27	-
TX	WISE	90	90	30	40	0.75	0.75	20	0.11	0.15	-

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TX	WOOD	90	90	30	30	0.75	0.75	10	0.14	0.16	-
TX	YOAKUM	90	90	30	30	0.25	0.50	20	0.11	0.16	-
TX	YOUNG	90	90	40	40	0.75	0.75	20	0.09	0.12	-
TX	ZAPATA	90	95	30	30	0.25	0.25	5	0.06	0.08	-
TX	ZAVALA	90	90	30	30	0.25	0.50	5	0.08	0.10	-
UT	BEAVER	90	90	30	30	0.00	0.25	30	0.37	0.85	-
UT	BOX ELDER	90	90	40	50	0.25	0.25	40	0.38	1.74	-
UT	CACHE	90	90	40	50	0.25	0.25	50	0.88	1.58	-
UT	CARBON	90	90	40	40	0.25	0.25	40	0.27	0.68	2
UT	DAGGETT	90	90	50	50	0.25	0.25	50	0.34	0.37	2
UT	DAVIS	90	90	40	40	0.25	0.25	40	1.01	1.82	-
UT	DUCHESNE	90	90	40	50	0.25	0.25	50	0.28	1.01	2
UT	EMERY	90	90	40	40	0.25	0.25	40	0.24	1.04	2
UT	GARFIELD	90	90	30	40	0.25	0.25	30	0.24	1.03	2
UT	GRAND	90	90	40	40	0.25	0.25	40	0.23	0.30	2
UT	IRON	90	90	30	30	0.00	0.25	30	0.39	1.19	-
UT	JUAB	90	90	30	40	0.25	0.25	40	0.30	1.18	-
UT	KANE	90	90	30	40	0.00	0.25	30	0.34	0.64	2
UT	MILLARD	90	90	30	40	0.00	0.25	40	0.33	0.96	-
UT	MORGAN	90	90	40	50	0.25	0.25	50	0.63	1.62	2
UT	PIUTE	90	90	30	30	0.25	0.25	30	0.64	0.92	-
UT	RICH	90	90	50	50	0.25	0.25	50	0.63	1.29	2
UT	SALT LAKE	90	90	40	40	0.25	0.25	40	0.97	1.83	-
UT	SAN JUAN	90	90	30	40	0.25	0.25	30	0.19	0.39	2
UT	SANPETE	90	90	30	40	0.25	0.25	40	0.57	1.01	2
UT	SEVIER	90	90	30	40	0.25	0.25	40	0.56	0.97	2
UT	SUMMIT	90	90	40	50	0.25	0.25	50	0.36	1.85	2
UT	TOOELE	90	90	30	40	0.25	0.25	40	0.29	1.17	-
UT	UINTAH	90	90	40	50	0.25	0.25	50	0.26	0.37	2
UT	UTAH	90	90	40	40	0.25	0.25	40	0.45	1.78	2
UT	WASATCH	90	90	40	40	0.25	0.25	40	0.48	1.26	2
UT	WASHINGTON	90	90	30	30	0.00	0.00	30	0.43	0.77	-
UT	WAYNE	90	90	30	40	0.25	0.25	30	0.24	0.82	2
UT	WEBER	90	90	40	50	0.25	0.25	50	0.80	1.81	-
VA	ACCOMACK	110	115	30	30	0.50	0.50	20	0.12	0.14	-
VA	ALBEMARLE	90	90	30	30	0.75	0.75	20	0.26	0.34	-
VA	ALEXANDRIA CITY	90	90	30	30	0.50	0.50	30	0.18	0.18	-
VA	ALLEGHANY	90	90	30	30	0.75	0.75	30	0.24	0.30	2
VA	AMELIA	90	90	30	30	0.75	0.75	20	0.26	0.34	-
VA	AMHERST	90	90	30	30	0.75	0.75	20	0.25	0.28	2
VA	APPOMATTOX	90	90	30	30	0.75	0.75	20	0.26	0.30	-
VA	ARLINGTON	90	90	30	30	0.50	0.50	30	0.18	0.18	-
VA	AUGUSTA	90	90	30	30	0.75	0.75	30	0.20	0.27	2
VA	BATH	90	90	30	30	0.75	0.75	30	0.21	0.25	2
VA	BEDFORD	90	90	30	30	0.75	0.75	20	0.24	0.28	2
VA	BEDFORD CITY	90	90	30	30	0.75	0.75	20	0.26	0.26	-
VA	BLAND	90	90	30	30	0.75	0.75	30	0.40	0.41	1, 2

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VA	BOTETOURT	90	90	30	30	0.75	0.75	30	0.25	0.31	2
VA	BRISTOL	90	90	30	30	0.50	0.75	0	0.42	0.42	2
VA	BRUNSWICK	90	90	30	30	0.75	0.75	20	0.18	0.24	-
VA	BUCHANAN	90	90	30	30	0.50	0.75	40	0.31	0.39	2
VA	BUCKINGHAM	90	90	30	30	0.75	0.75	20	0.29	0.36	-
VA	BUENA VISTA CITY	90	90	30	30	0.75	0.75	30	0.25	0.25	2
VA	CAMPBELL	90	90	30	30	0.75	0.75	20	0.24	0.27	-
VA	CAROLINE	90	90	30	30	0.50	0.75	20	0.19	0.27	-
VA	CARROLL	90	90	30	30	0.75	0.75	20	0.34	0.40	2
VA	CHARLES CITY	90	90	30	30	0.50	0.75	20	0.18	0.24	-
VA	CHARLOTTE	90	90	30	30	0.75	0.75	20	0.20	0.27	-
VA	CHARLOTTESVILLE CITY	90	90	30	30	0.75	0.75	20	0.29	0.31	-
VA	CHESAPEAKE CITY	100	110	30	30	0.50	0.50	10	0.12	0.14	-
VA	CHESTERFIELD	90	90	30	30	0.75	0.75	20	0.24	0.31	-
VA	CLARKE	90	90	30	30	0.75	0.75	30	0.19	0.19	-
VA	CLIFTON FORGE CITY	90	90	30	30	0.50	0.50	30	0.25	0.25	2
VA	COLONIAL HEIGHTS CITY	90	90	30	30	0.75	0.75	20	0.24	0.25	-
VA	COVINGTON CITY	90	90	30	30	0.75	0.75	30	0.26	0.27	2
VA	CRAIG	90	90	30	30	0.75	0.75	30	0.28	0.37	2
VA	CULPEPER	90	90	30	30	0.75	0.75	30	0.20	0.25	-
VA	CUMBERLAND	90	90	30	30	0.75	0.75	20	0.29	0.36	-
VA	DANVILLE CITY	90	90	30	30	0.75	0.75	20	0.22	0.23	-
VA	DICKENSON	90	90	30	30	0.50	0.50	40	0.33	0.39	2
VA	DINWIDDIE	90	90	30	30	0.75	0.75	20	0.20	0.27	-
VA	EMPORIA CITY	90	90	30	30	0.75	0.75	20	0.18	0.18	-
VA	ESSEX	90	90	30	30	0.50	0.50	20	0.17	0.21	-
VA	FAIRFAX	90	90	30	30	0.50	0.75	30	0.18	0.19	-
VA	FAIRFAX CITY	90	90	30	30	0.50	0.50	30	0.18	0.18	-
VA	FALLS CHURCH CITY	90	90	30	30	0.50	0.50	30	0.18	0.18	-
VA	FAUQUIER	90	90	30	30	0.75	0.75	30	0.19	0.22	-
VA	FLOYD	90	90	30	30	0.75	0.75	20	0.31	0.39	2
VA	FLUVANNA	90	90	30	30	0.75	0.75	20	0.31	0.36	-
VA	FRANKLIN	90	90	30	30	0.75	0.75	20	0.25	0.32	2
VA	FRANKLIN CITY	90	95	30	30	0.50	0.75	10	0.16	0.16	-
VA	FREDERICK	90	90	30	30	0.75	0.75	30	0.19	0.19	2
VA	FREDERICKSBURG CITY	90	90	30	30	0.50	0.50	20	0.21	0.22	-
VA	GALAX CITY	90	90	30	30	0.75	0.75	30	0.39	0.39	2
VA	GILES	90	90	30	30	0.75	0.75	30	0.36	0.41	2
VA	GLOUCESTER	95	100	30	30	0.50	0.50	20	0.15	0.17	-
VA	GOOCHLAND	90	90	30	30	0.75	0.75	20	0.30	0.36	-
VA	GRAYSON	90	90	30	30	0.75	0.75	30	0.37	0.41	1, 2
VA	GREENE	90	90	30	30	0.75	0.75	30	0.24	0.28	-
VA	GREENSVILLE	90	90	30	30	0.75	0.75	20	0.17	0.21	-
VA	HALIFAX	90	90	30	30	0.75	0.75	20	0.20	0.24	-
VA	HAMPTON CITY	100	105	30	30	0.50	0.50	10	0.14	0.15	-
VA	HANOVER	90	90	30	30	0.75	0.75	20	0.22	0.33	-
VA	HARRISONBURG CITY	90	90	30	30	0.75	0.75	30	0.22	0.23	2

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VA	HENRICO	90	90	30	30	0.75	0.75	20	0.23	0.31	-
VA	HENRY	90	90	30	30	0.75	0.75	20	0.24	0.28	-
VA	HIGHLAND	90	90	30	30	0.75	0.75	30	0.18	0.22	2
VA	HOPEWELL CITY	90	90	30	30	0.75	0.75	30	0.23	0.24	-
VA	ISLE OF WIGHT	90	100	30	30	0.50	0.75	20	0.15	0.17	-
VA	JAMES CITY	90	95	30	30	0.50	0.50	20	0.16	0.19	-
VA	KING AND QUEEN	90	95	30	30	0.50	0.50	20	0.17	0.22	-
VA	KING GEORGE	90	90	30	30	0.50	0.50	20	0.18	0.21	-
VA	KING WILLIAM	90	90	30	30	0.50	0.50	20	0.18	0.26	-
VA	LANCASTER	95	100	30	30	0.50	0.50	20	0.14	0.17	-
VA	LEE	90	90	30	30	0.50	0.50	30	0.39	0.46	2
VA	LEXINGTON CITY	90	90	30	30	0.75	0.75	30	0.25	0.25	2
VA	LOUDOUN	90	90	30	30	0.75	0.75	30	0.18	0.19	-
VA	LOUISA	90	90	30	30	0.75	0.75	20	0.27	0.34	-
VA	LUNENBURG	90	90	30	30	0.75	0.75	20	0.20	0.26	-
VA	LYNCHBURG CITY	90	90	30	30	0.75	0.75	20	0.26	0.26	-
VA	MADISON	90	90	30	30	0.75	0.75	30	0.22	0.27	-
VA	MANASSAS CITY	90	90	30	30	0.50	0.50	30	0.18	0.19	-
VA	MANASSAS PARK CITY	90	90	30	30	0.50	0.50	30	0.18	0.18	-
VA	MARTINSVILLE CITY	90	90	30	30	0.75	0.75	10	0.26	0.26	-
VA	MATHEWS	95	105	30	30	0.50	0.50	20	0.14	0.15	-
VA	MECKLENBURG	90	90	30	30	0.75	0.75	20	0.19	0.23	-
VA	MIDDLESEX	90	100	30	30	0.50	0.50	20	0.15	0.18	-
VA	MONTGOMERY	90	90	30	30	0.75	0.75	30	0.33	0.40	2
VA	NELSON	90	90	30	30	0.75	0.75	20	0.26	0.32	-
VA	NEW KENT	90	90	30	30	0.50	0.50	20	0.18	0.24	-
VA	NEWPORT NEWS CITY	95	100	30	30	0.50	0.50	10	0.14	0.16	-
VA	NORFOLK CITY	100	110	30	30	0.50	0.50	10	0.13	0.14	-
VA	NORTHAMPTON	110	115	30	30	0.50	0.50	20	0.12	0.13	-
VA	NORTHUMBERLAND	90	100	30	30	0.50	0.50	20	0.15	0.17	-
VA	NORTON CITY	90	90	30	30	0.50	0.50	40	0.38	0.39	-
VA	NOTTOWAY	90	90	30	30	0.75	0.75	20	0.23	0.29	-
VA	ORANGE	90	90	30	30	0.75	0.75	20	0.23	0.28	-
VA	PAGE	90	90	30	30	0.75	0.75	30	0.20	0.24	-
VA	PATRICK	90	90	30	30	0.75	0.75	20	0.27	0.36	2
VA	PETERSBURG CITY	90	90	30	30	0.75	0.75	20	0.23	0.25	-
VA	PITTSYLVANIA	90	90	30	30	0.75	0.75	20	0.21	0.25	-
VA	POQUOSON CITY	100	105	30	30	0.50	0.50	10	0.14	0.15	-
VA	PORTSMOUTH CITY	100	105	30	30	0.50	0.50	10	0.13	0.14	-
VA	POWHATAN	90	90	30	30	0.75	0.75	20	0.30	0.36	-
VA	PRINCE EDWARD	90	90	30	30	0.75	0.75	20	0.25	0.31	-
VA	PRINCE GEORGE	90	90	30	30	0.50	0.75	20	0.19	0.25	-
VA	PRINCE WILLIAM	90	90	30	30	0.50	0.50	30	0.18	0.19	-
VA	PULASKI	90	90	30	30	0.75	0.75	30	0.38	0.41	2
VA	RADFORD	90	90	30	30	0.75	0.75	30	0.39	0.39	2
VA	RAPPAHANNOCK	90	90	30	30	0.75	0.75	30	0.20	0.23	-
VA	RICHMOND	90	95	30	30	0.50	0.50	20	0.16	0.18	-

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VA	RICHMOND CITY	90	90	30	30	0.75	0.75	20	0.27	0.29	-
VA	ROANOKE	90	90	30	30	0.75	0.75	20	0.28	0.35	2
VA	ROANOKE CITY	90	90	30	30	0.75	0.75	20	0.28	0.30	2
VA	ROCKBRIDGE	90	90	30	30	0.75	0.75	30	0.23	0.26	2
VA	ROCKINGHAM	90	90	30	30	0.75	0.75	30	0.19	0.26	2
VA	RUSSELL	90	90	30	30	0.50	0.75	40	0.39	0.41	2
VA	SALEM	90	90	30	30	0.75	0.75	10	0.29	0.32	2
VA	SCOTT	90	90	30	30	0.50	0.50	30	0.39	0.44	2
VA	SHENANDOAH	90	90	30	30	0.75	0.75	30	0.19	0.22	2
VA	SMYTH	90	90	30	30	0.75	0.75	30	0.40	0.41	1, 2
VA	SOUTH BOSTON CITY	90	90	30	30	0.50	0.50	30	0.20	0.25	-
VA	SOUTHAMPTON	90	95	30	30	0.50	0.75	10	0.16	0.18	-
VA	SPOTSYLVANIA	90	90	30	30	0.75	0.75	20	0.21	0.28	-
VA	STAFFORD	90	90	30	30	0.50	0.50	20	0.19	0.22	-
VA	STAUNTON CITY	90	90	30	30	0.75	0.75	30	0.24	0.25	2
VA	SUFFOLK CITY	95	100	30	30	0.50	0.75	10	0.14	0.16	-
VA	SURRY	90	95	30	30	0.50	0.75	20	0.16	0.20	-
VA	SUSSEX	90	90	30	30	0.50	0.75	20	0.17	0.21	-
VA	TAZEWELL	90	90	30	30	0.75	0.75	40	0.39	0.41	1, 2
VA	VIRGINIA BEACH CITY	105	115	30	30	0.50	0.50	10	0.12	0.13	-
VA	WARREN	90	90	30	30	0.75	0.75	30	0.19	0.21	-
VA	WASHINGTON	90	90	30	30	0.50	0.75	30	0.41	0.42	1, 2
VA	WAYNESBORO CITY	90	90	30	30	0.75	0.75	30	0.26	0.27	-
VA	WESTMORELAND	90	90	30	30	0.50	0.50	20	0.16	0.19	-
VA	WILLIAMSBURG CITY	90	95	30	30	0.50	0.50	10	0.17	0.17	-
VA	WINCHESTER CITY	90	90	30	30	0.75	0.75	30	0.19	0.19	-
VA	WISE	90	90	30	30	0.50	0.50	40	0.33	0.40	2
VA	WYTHE	90	90	30	30	0.75	0.75	30	0.39	0.41	1, 2
VA	YORK	90	100	30	30	0.50	0.50	20	0.14	0.17	-
VT	ADDISON	90	90	40	40	0.75	0.75	60	0.34	0.42	2
VT	BENNINGTON	90	90	40	40	0.75	0.75	50	0.26	0.30	1, 2
VT	CALEDONIA	90	90	40	40	0.75	0.75	60	0.31	0.37	1, 2
VT	CHITTENDEN	90	90	40	40	0.75	1.00	60	0.37	0.51	2
VT	ESSEX	90	90	40	40	0.75	0.75	70	0.29	0.36	1, 2
VT	FRANKLIN	90	90	40	40	0.75	1.00	70	0.37	0.57	-
VT	GRAND ISLE	90	90	40	40	1.00	1.00	70	0.49	0.60	-
VT	LAMOILLE	90	90	40	40	0.75	0.75	70	0.34	0.42	2
VT	ORANGE	90	90	40	40	0.75	0.75	60	0.34	0.38	1, 2
VT	ORLEANS	90	90	40	40	0.75	0.75	70	0.30	0.39	2
VT	RUTLAND	90	90	40	40	0.75	0.75	60	0.28	0.37	1, 2
VT	WASHINGTON	90	90	40	40	0.75	0.75	60	0.34	0.38	2
VT	WINDHAM	90	90	40	40	0.75	0.75	50	0.26	0.30	1, 2
VT	WINDSOR	90	90	40	40	0.75	0.75	60	0.28	0.37	1, 2
WA	ADAMS	85	85	40	40	0.25	0.25	20	0.29	0.42	-
WA	ASOTIN	85	85	40	40	0.25	0.25	30	0.29	0.35	-
WA	BENTON	85	85	40	40	0.25	0.25	20	0.42	0.59	-
WA	CHELAN	85	85	30	40	0.25	0.25	10	0.45	0.76	2

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WA	CLALLAM	85	85	30	30	0.25	0.25	5	1.21	1.50	1, 2
WA	CLARK	85	85	30	30	0.25	0.25	5	0.82	1.04	1
WA	COLUMBIA	85	85	40	40	0.25	0.25	20	0.32	0.43	-
WA	COWLITZ	85	85	30	30	0.25	0.25	5	0.89	1.08	1
WA	DOUGLAS	85	85	30	40	0.25	0.25	20	0.39	0.50	2
WA	FERRY	85	85	40	40	0.25	0.25	20	0.29	0.37	-
WA	FRANKLIN	85	85	40	40	0.25	0.25	20	0.33	0.53	-
WA	GARFIELD	85	85	40	40	0.25	0.25	30	0.29	0.37	-
WA	GRANT	85	85	40	40	0.25	0.25	20	0.39	0.44	-
WA	GRAYS HARBOR	85	85	30	30	0.25	0.25	5	1.14	1.50	1, 2
WA	ISLAND	85	85	30	30	0.25	0.25	5	1.18	1.42	-
WA	JEFFERSON	85	85	30	30	0.25	0.25	5	1.22	1.50	1, 2
WA	KING	85	85	30	30	0.25	0.25	10	0.68	1.62	2
WA	KITSAP	85	85	30	40	0.25	0.25	5	1.25	1.58	-
WA	KITTITAS	85	85	30	40	0.25	0.25	10	0.42	1.01	2
WA	KLICKITAT	85	85	30	40	0.25	0.25	10	0.42	0.59	2
WA	LEWIS	85	85	30	30	0.25	0.25	5	0.63	1.19	1, 2
WA	LINCOLN	85	85	40	40	0.25	0.25	20	0.29	0.40	-
WA	MASON	85	85	30	30	0.25	0.25	5	1.20	1.28	2
WA	OKANOGAN	85	85	30	40	0.25	0.25	20	0.30	0.53	2
WA	PACIFIC	85	85	30	30	0.25	0.25	5	1.15	1.50	1
WA	PEND OREILLE	85	85	40	40	0.25	0.25	30	0.29	0.37	-
WA	PIERCE	85	85	30	30	0.25	0.25	10	0.90	1.28	2
WA	SAN JUAN	85	85	30	30	0.25	0.25	5	1.15	1.19	-
WA	SKAGIT	85	85	30	30	0.25	0.25	10	0.51	1.18	2
WA	SKAMANIA	85	85	30	30	0.25	0.25	10	0.52	1.04	1, 2
WA	SNOHOMISH	85	85	30	30	0.25	0.25	10	0.58	1.30	2
WA	SPOKANE	85	85	40	40	0.25	0.25	30	0.29	0.37	-
WA	STEVENS	85	85	40	40	0.25	0.25	20	0.29	0.33	-
WA	THURSTON	85	85	30	30	0.25	0.25	5	1.11	1.22	-
WA	WAHKIAKUM	85	85	30	30	0.25	0.25	5	1.07	1.41	1
WA	WALLA WALLA	85	85	40	40	0.25	0.25	20	0.35	0.57	-
WA	WHATCOM	85	85	30	40	0.25	0.75	10	0.45	1.15	2
WA	WHITMAN	85	85	40	40	0.25	0.25	30	0.29	0.36	-
WA	YAKIMA	85	85	30	40	0.25	0.25	10	0.43	0.98	2
WI	ADAMS	90	90	40	40	0.50	0.75	70	0.07	0.09	-
WI	ASHLAND	90	90	40	50	0.50	0.50	80	0.06	0.08	-
WI	BARRON	90	90	50	50	0.50	0.50	80	0.05	0.05	-
WI	BAYFIELD	90	90	40	50	0.50	0.50	80	0.06	0.07	-
WI	BROWN	90	90	40	40	0.50	0.50	60	0.06	0.07	-
WI	BUFFALO	90	90	40	50	0.50	0.75	80	0.05	0.06	-
WI	BURNETT	90	90	50	50	0.50	0.50	80	0.05	0.06	-
WI	CALUMET	90	90	40	40	0.50	0.75	60	0.07	0.08	-
WI	CHIPPEWA	90	90	40	50	0.50	0.50	80	0.05	0.06	-
WI	CLARK	90	90	40	40	0.50	0.50	70	0.06	0.06	-
WI	COLUMBIA	90	90	40	40	0.75	0.75	60	0.08	0.11	-
WI	CRAWFORD	90	90	40	40	0.75	0.75	70	0.07	0.08	-

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WI	DANE	90	90	40	40	0.75	0.75	60	0.10	0.13	-
WI	DODGE	90	90	40	40	0.75	0.75	60	0.09	0.11	-
WI	DOOR	90	90	40	40	0.50	0.50	60	0.06	0.06	-
WI	DOUGLAS	90	90	50	60	0.50	1.25	80	0.05	0.06	-
WI	DUNN	90	90	50	50	0.50	0.75	80	0.05	0.05	-
WI	EAU CLAIRE	90	90	40	50	0.50	0.75	80	0.05	0.06	-
WI	FLORENCE	90	90	40	40	0.50	0.50	70	0.06	0.07	-
WI	FOND DU LAC	90	90	40	40	0.50	0.75	60	0.08	0.10	-
WI	FOREST	90	90	40	40	0.50	0.50	70	0.06	0.07	-
WI	GRANT	90	90	40	40	0.75	0.75	60	0.08	0.11	-
WI	GREEN	90	90	40	40	0.75	0.75	60	0.11	0.14	-
WI	GREEN LAKE	90	90	40	40	0.50	0.75	70	0.08	0.09	-
WI	IOWA	90	90	40	40	0.75	0.75	60	0.08	0.11	-
WI	IRON	90	90	40	40	0.50	0.50	80	0.06	0.07	-
WI	JACKSON	90	90	40	40	0.50	0.75	80	0.06	0.07	-
WI	JEFFERSON	90	90	40	40	0.75	0.75	60	0.11	0.13	-
WI	JUNEAU	90	90	40	40	0.50	0.75	70	0.07	0.08	-
WI	KENOSHA	90	90	40	40	0.75	0.75	60	0.13	0.16	-
WI	KEWAUNEE	90	90	40	40	0.50	0.50	60	0.06	0.07	-
WI	LA CROSSE	90	90	40	40	0.50	0.50	70	0.06	0.07	-
WI	LAFAYETTE	90	90	40	40	0.75	0.75	60	0.09	0.12	-
WI	LANGLADE	90	90	40	40	0.50	0.50	70	0.06	0.06	-
WI	LINCOLN	90	90	40	40	0.50	0.50	80	0.06	0.06	-
WI	MANITOWOC	90	90	40	40	0.50	0.75	60	0.07	0.08	-
WI	MARATHON	90	90	40	40	0.50	0.50	80	0.06	0.06	-
WI	MARINETTE	90	90	40	40	0.50	0.50	60	0.06	0.06	-
WI	MARQUETTE	90	90	40	40	0.50	0.75	70	0.08	0.09	-
WI	MENOMINEE	90	90	40	40	0.50	0.50	70	0.06	0.06	-
WI	MILWAUKEE	90	90	40	40	0.75	0.75	60	0.11	0.13	-
WI	MONROE	90	90	40	40	0.50	0.75	70	0.06	0.08	-
WI	OCONTO	90	90	40	40	0.50	0.50	60	0.06	0.06	-
WI	ONEIDA	90	90	40	40	0.50	0.50	80	0.06	0.06	-
WI	OUTAGAMIE	90	90	40	40	0.50	0.50	70	0.07	0.07	-
WI	OZAUKEE	90	90	40	40	0.75	0.75	60	0.09	0.11	-
WI	PEPIN	90	90	50	50	0.50	0.75	80	0.05	0.05	-
WI	PIERCE	90	90	50	50	0.50	0.75	80	0.05	0.05	-
WI	POLK	90	90	50	50	0.50	0.50	80	0.05	0.06	-
WI	PORTAGE	90	90	40	40	0.50	0.50	70	0.06	0.07	-
WI	PRICE	90	90	40	40	0.50	0.50	80	0.06	0.06	-
WI	RACINE	90	90	40	40	0.75	0.75	60	0.12	0.15	-
WI	RICHLAND	90	90	40	40	0.75	0.75	70	0.07	0.09	-
WI	ROCK	90	90	40	40	0.75	0.75	60	0.12	0.16	-
WI	RUSK	90	90	40	50	0.50	0.50	80	0.05	0.06	-
WI	SAINT CROIX	90	90	50	50	0.50	0.75	80	0.05	0.06	-
WI	SAUK	90	90	40	40	0.75	0.75	70	0.08	0.10	-
WI	SAWYER	90	90	40	50	0.50	0.50	80	0.05	0.06	-
WI	SHAWANO	90	90	40	40	0.50	0.50	70	0.06	0.07	-

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WI	SHEBOYGAN	90	90	40	40	0.50	0.75	60	0.08	0.10	-
WI	TAYLOR	90	90	40	40	0.50	0.50	80	0.05	0.06	-
WI	TREMPEALEAU	90	90	40	50	0.50	0.75	80	0.06	0.06	-
WI	VERNON	90	90	40	40	0.75	0.75	70	0.06	0.08	-
WI	VILAS	90	90	40	40	0.50	0.50	80	0.06	0.07	-
WI	WALWORTH	90	90	40	40	0.75	0.75	60	0.13	0.16	-
WI	WASHBURN	90	90	50	50	0.50	0.50	80	0.05	0.06	-
WI	WASHINGTON	90	90	40	40	0.75	0.75	60	0.09	0.11	-
WI	WAUKESHA	90	90	40	40	0.75	0.75	60	0.11	0.13	-
WI	WAUPACA	90	90	40	40	0.50	0.50	70	0.06	0.07	-
WI	WAUSHARA	90	90	40	40	0.50	0.75	70	0.07	0.08	-
WI	WINNEBAGO	90	90	40	40	0.50	0.75	70	0.07	0.08	-
WI	WOOD	90	90	40	40	0.50	0.50	70	0.06	0.07	-
WV	BARBOUR	90	90	30	30	0.50	0.50	40	0.16	0.17	2
WV	BERKELEY	90	90	30	40	0.75	0.75	30	0.19	0.19	2
WV	BOONE	90	90	30	30	0.50	0.50	40	0.22	0.29	2
WV	BRAXTON	90	90	30	30	0.50	0.50	40	0.17	0.19	2
WV	BROOKE	90	90	40	40	0.75	0.75	40	0.13	0.13	2
WV	CABELL	90	90	30	30	0.50	0.75	40	0.20	0.22	-
WV	CALHOUN	90	90	30	30	0.50	0.50	40	0.16	0.18	2
WV	CLAY	90	90	30	30	0.50	0.50	40	0.18	0.22	2
WV	DODDRIDGE	90	90	30	30	0.50	0.50	40	0.15	0.16	-
WV	FAYETTE	90	90	30	30	0.50	0.75	40	0.22	0.29	2
WV	GILMER	90	90	30	30	0.50	0.50	40	0.16	0.18	2
WV	GRANT	90	90	30	30	0.75	0.75	40	0.17	0.19	2
WV	GREENBRIER	90	90	30	30	0.50	0.75	40	0.21	0.32	2
WV	HAMPSHIRE	90	90	30	30	0.75	0.75	30	0.18	0.19	2
WV	HANCOCK	90	90	40	40	0.75	0.75	40	0.13	0.13	2
WV	HARDY	90	90	30	30	0.75	0.75	30	0.18	0.19	2
WV	HARRISON	90	90	30	30	0.50	0.50	40	0.15	0.16	-
WV	JACKSON	90	90	30	30	0.50	0.75	40	0.17	0.19	-
WV	JEFFERSON	90	90	30	40	0.75	0.75	30	0.19	0.19	2
WV	KANAWHA	90	90	30	30	0.50	0.50	40	0.19	0.26	2
WV	LEWIS	90	90	30	30	0.50	0.50	40	0.16	0.17	2
WV	LINCOLN	90	90	30	30	0.50	0.50	40	0.21	0.24	-
WV	LOGAN	90	90	30	30	0.50	0.50	40	0.24	0.30	-
WV	MARION	90	90	30	30	0.50	0.50	40	0.14	0.16	-
WV	MARSHALL	90	90	30	40	0.50	0.75	40	0.13	0.14	-
WV	MASON	90	90	30	30	0.50	0.75	30	0.18	0.20	-
WV	MCDOWELL	90	90	30	30	0.50	0.75	40	0.32	0.40	2
WV	MERCER	90	90	30	30	0.75	0.75	30	0.35	0.40	2
WV	MINERAL	90	90	30	30	0.75	0.75	40	0.17	0.18	2
WV	MINGO	90	90	30	30	0.50	0.50	40	0.24	0.32	-
WV	MONONGALIA	90	90	30	30	0.50	0.50	40	0.14	0.16	-
WV	MONROE	90	90	30	30	0.75	0.75	30	0.29	0.40	2
WV	MORGAN	90	90	30	40	0.75	0.75	30	0.19	0.19	2
WV	NICHOLAS	90	90	30	30	0.50	0.75	40	0.18	0.25	2

State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
WV	OHIO	90	90	30	40	0.50	0.75	40	0.13	0.13	2
WV	PENDLETON	90	90	30	30	0.50	0.75	30	0.18	0.20	2
WV	PLEASANTS	90	90	30	30	0.50	0.50	40	0.15	0.16	-
WV	POCAHONTAS	90	90	30	30	0.50	0.75	40	0.18	0.24	2
WV	PRESTON	90	90	30	30	0.50	0.75	40	0.15	0.17	2
WV	PUTNAM	90	90	30	30	0.50	0.50	40	0.19	0.22	-
WV	RALEIGH	90	90	30	30	0.50	0.75	40	0.25	0.37	2
WV	RANDOLPH	90	90	30	30	0.50	0.75	40	0.16	0.19	2
WV	RITCHIE	90	90	30	30	0.50	0.50	40	0.15	0.17	-
WV	ROANE	90	90	30	30	0.50	0.50	40	0.17	0.19	2
WV	SUMMERS	90	90	30	30	0.75	0.75	30	0.28	0.39	2
WV	TAYLOR	90	90	30	30	0.50	0.50	40	0.16	0.16	-
WV	TUCKER	90	90	30	30	0.50	0.75	40	0.16	0.18	2
WV	TYLER	90	90	30	30	0.50	0.50	40	0.14	0.15	-
WV	UPSHUR	90	90	30	30	0.50	0.50	40	0.16	0.18	2
WV	WAYNE	90	90	30	30	0.50	0.75	40	0.22	0.25	-
WV	WEBSTER	90	90	30	30	0.50	0.75	40	0.17	0.22	2
WV	WETZEL	90	90	30	30	0.50	0.50	40	0.14	0.15	-
WV	WIRT	90	90	30	30	0.50	0.50	30	0.16	0.17	-
WV	WOOD	90	90	30	30	0.50	0.75	30	0.16	0.17	-
WV	WYOMING	90	90	30	30	0.50	0.75	40	0.28	0.38	2
WY	ALBANY	90	90	50	50	0.00	0.25	60	0.22	0.45	2
WY	BIG HORN	90	90	30	30	0.00	0.25	60	0.18	0.36	1, 2
WY	CAMPBELL	90	90	30	30	0.25	0.25	70	0.17	0.42	2
WY	CARBON	90	90	30	30	0.00	0.00	60	0.24	0.42	2
WY	CONVERSE	90	90	30	30	0.00	0.25	60	0.25	0.45	2
WY	CROOK	90	90	30	30	0.25	0.25	70	0.12	0.27	2
WY	FREMONT	90	90	30	30	0.00	0.00	60	0.31	1.01	1, 2
WY	GOSHEN	90	90	30	30	0.25	0.25	60	0.14	0.26	2
WY	HOT SPRINGS	90	90	30	30	0.00	0.00	60	0.26	0.36	1, 2
WY	JOHNSON	90	90	30	30	0.00	0.25	60	0.27	0.42	1, 2
WY	LARAMIE	90	90	30	30	0.00	0.25	60	0.13	0.27	2
WY	LINCOLN	90	90	30	30	0.25	0.25	50	0.34	1.96	2
WY	NATRONA	90	90	30	30	0.00	0.25	60	0.31	0.42	1, 2
WY	NIOBRARA	90	90	30	30	0.25	0.25	60	0.19	0.30	-
WY	PARK	90	90	30	30	0.00	0.00	60	0.18	1.71	1, 2
WY	PLATTE	90	90	30	30	0.25	0.25	60	0.19	0.41	2
WY	SHERIDAN	90	90	30	30	0.00	0.25	70	0.18	0.34	1, 2
WY	SUBLETTE	90	90	30	30	0.00	0.25	50	0.35	1.51	1, 2
WY	SWEETWATER	90	90	30	30	0.00	0.25	50	0.27	0.42	1, 2
WY	TETON	90	90	30	30	0.00	0.25	60	0.62	1.69	2
WY	UINTA	90	90	30	30	0.25	0.25	50	0.35	1.85	2
WY	WASHAKIE	90	90	30	30	0.00	0.00	60	0.25	0.38	1, 2
WY	WESTON	90	90	30	30	0.25	0.25	70	0.17	0.28	2
DC	DISTRICT OF COLUMBIA	90	90	40	40	0.50	0.50	30	0.20	0.20	-
GUAM	GUAM	170	170	0.00	0.00	0.00	0.00	0	1.50	1.50	-
PR	PUERTO RICO	145	145	0.00	0.00	0.00	0.00	0	1.00	1.00	-

State	County	Min. Basic Wind Speed V (mph)	Max. Basic Wind Speed V (mph)	Min. Basic Wind Speed with Ice V_i (mph)	Max. Basic Wind Speed with Ice V_i (mph)	Min. Design Ice Thickness t_i (in.)	Max. Design Ice Thickness t_i (in.)	Design Frost Depth (in.)	Min. S_S	Max. S_S	Notes
TUTUILA	TUTUILA (AMERICAN SAMOA)	125	125	0.00	0.00	0.00	0.00	0	1.00	1.00	-
VI	VIRGIN ISLANDS	145	145	0.00	0.00	0.00	0.00	0	0.00	0.60	-

Notes:

For a site location not designated as a county, refer to the design criteria maps in Appendix 1 to determine the design values for the site.

The tabulated wind speeds represent the minimum and maximum basic wind speeds associated with a county when multiple basic wind speed contours traverse a county. For these counties, refer to the design criteria maps in Appendix 1 to determine the basic wind speed for a specific site location. When a site is located between two contours, the higher wind speed contour shall be used as the basic wind speed.

The tabulated design values represent the minimum and maximum design values associated with a county when multiple ice and/or wind zones traverse a county. For these counties, refer to the design criteria maps in Appendix 1 to determine the basic wind speed with ice and the design ice thickness for a specific site location.

Earthquake effects may be ignored per this Standard for site locations where S_s does not exceed 1.0 (refer to 2.7.3). Maximum and minimum values for S_s are tabulated to facilitate identifying those counties where earthquake effects may be ignored. For a specific site location where the maximum value of S_s exceeds 1.0 for the county, or for any location where earthquake effects are desired to be determined, refer to the design criteria maps in Appendix 1 to determine the values of S_s and S_1 for the specific site location. When a site is located between two contours, linear interpolation may be used. Values for S_s and S_1 shown on the design criteria maps are expressed as a percent of gravity and therefore must be divided by 100 to be used with this Standard. (The tabulated S_s values were provided by Ken Rukstales, US Geological Survey, National Seismic Hazard Mapping Program.)

For metric units, refer to Annex M for appropriate conversion factors.

The following notes correspond to the notes listed in the county listings of design criteria:

1. Special wind regions exist within the county. Refer to the design criteria maps in Appendix 1. The authority having jurisdiction may require higher basic wind speeds for a specific site location in these regions to account for local wind conditions.

2. Special ice regions exist within the county. Refer to the design criteria maps in Appendix 1. The authority having jurisdiction may require higher basic wind speeds with ice and/or higher design ice thicknesses for a specific site location in these regions to account for local wind on ice conditions.

3. The design frost depth shall be based on regional climatic data and knowledge of local conditions in accordance with 2.6.4.1.

ANNEX C: DESIGN WIND FORCE ON TYPICAL ANTENNAS (Normative)

This Annex contains wind load data for typical wireless carriers and microwave antennas.

When the azimuth orientations of antennas located on the same relative elevation on a structure are not specified, the antennas shall be assumed to radiate symmetrically about the structure.

C.1 Typical Wireless Carrier Antenna Loading

A typical wireless carrier consists of multiple antennas mounted on a platform or similar mount. The effective projected areas, (EPA), provided in this annex are intended to be used as presumptive standard values when actual antennas and mounting details are undefined (e.g. for future loading considerations). It is not practical to provide standard EPA values to cover all possible antenna and mounting arrangements. Prior to adding a wireless carrier to a structure designed using presumptive EPA values, a review of the structure considering the existing and the actual proposed antennas, mounts, and appurtenances shall be preformed in accordance with this Standard.

Carrier Type	No ice		Ice $t_i \leq 0.50"$ [$t_i \leq 13$ mm]		Ice $0.50" < t_i \leq 1.50"$ [$13 < t_i \leq 38$ mm]		Transmission Lines
	$(EPA)_A$ ft² [m²]	Wt kips [kN]	$(EPA)_A$ ft² [m²]	Wt kips [kN]	$(EPA)_A$ ft² [m²]	Wt kips [kN]	
Light (9 antennas max)	55 [6.5]	0.75 [3.3]	75 [7.9]	1.00 [3.3]	110 [10.2]	1.50 [6.7]	(9) 1 5/8 in. diameter (2.0 in. [51 mm] OD)
Heavy (12 antennas max)	80 [8.4]	1.20 [5.3]	100 [9.3]	1.20 [5.3]	135 [12.6]	2.00 [8.9]	(12) 1 5/8 in. diameter (2.0 in. [51 mm] OD)

Note: For latticed structures, all lines to a carrier elevation shall be considered to be on one face of the structure. It shall be permissible to assume lines for different carriers are placed on adjacent faces of the structure.

C.2 Typical Microwave Antennas

Wind force data presented in this annex for typical microwave antennas (including grid antennas) are described in the antenna axis system having the origin at the vertex of the reflector. The axial force, F_{AM}, acts along the axis of the antenna. The side force, F_{SM}, acts perpendicular to the antenna axis in the plane of the antenna axis and the wind vector. The twisting moment, M_M, acts in the plane containing F_{AM} and F_{SM}. (See Figure C-1).

In all cases, the magnitude of F_{AM}, F_{SM}, and M_M depend on the dynamic pressure of the wind, the projected frontal area of the antenna, and the aerodynamic characteristics of the antenna body. The aerodynamic characteristics vary with wind angle. The values of F_{AM}, F_{SM}, and M_M shall be determined from the following equations:

$F_{AM} = q_z G_h C_A A$ $F_{SM} = q_z G_h C_S A$ $M_M = q_z G_h C_M A D$

where:

q_z = velocity pressure at vertex of the antenna from 2.6.9.6

G_h = gust effect factor from 2.6.7 (depending on the type of structure supporting the antenna)

C_A, C_S, and C_M are the coefficients contained in Tables C-1 through C-4 as a function of wind angle, θ.

θ = wind angle, see Figure C-1 for positive sign conventions.

A = outside aperture area of microwave antenna.

D = outside diameter of microwave antenna.

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Table C1: Wind Force Coefficients for Typical Microwave Antenna without Radome

WIND ANGLE θ (DEG)	C_A	C_S	C_M
0	1.5508	0.0000	0.0000
10	1.5391	-0.0469	-0.0254
20	1.5469	-0.0508	-0.0379
30	1.5547	-0.0313	-0.0422
40	1.5938	0.0078	-0.0535
50	1.6641	0.0898	-0.0691
60	1.6484	0.2422	-0.0871
70	1.3672	0.4570	-0.0078
80	0.7617	0.3789	0.1000
90	-0.0117	0.3438	0.1313
100	-0.4023	0.3828	0.1320
110	-0.4609	0.4141	0.1340
120	-0.4570	0.4570	0.1430
130	-0.4688	0.4688	0.1461
140	-0.5742	0.4453	0.1320
150	-0.7734	0.3906	0.1086
160	-0.8672	0.2930	0.0836
170	-0.9453	0.1445	0.0508
180	-1.0547	0.0000	0.0000
190	-0.9453	-0.1445	-0.0508
200	-0.8672	-0.2930	-0.0836
210	-0.7734	-0.3906	0.1086
220	-0.5742	-0.4453	-0.1320
230	-0.4688	-0.4688	-0.1461
240	-0.4570	-0.4570	-0.1430
250	-0.4609	-0.4141	-0.1340
260	-0.4023	-0.3828	-0.1320
270	-0.0117	-0.3438	-0.1313
280	0.7617	-0.3789	-0.1000
290	1.3672	-0.4570	0.0078
300	1.6484	-0.2422	0.0871
310	1.6641	-0.0898	0.0691
320	1.5938	-0.0078	0.0535
330	1.5547	0.0313	0.0422
340	1.5469	0.0508	0.0379
350	1.5391	0.0469	0.0254

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Table C2: Wind Force Coefficients for Typical Microwave Antenna with Radome

WIND ANGLE θ (DEG)	C_A	C_S	C_M
0	0.8633	0.0000	0.0000
10	0.8594	0.1484	-0.0797
20	0.8203	0.2969	-0.1113
30	0.7617	0.4102	-0.1082
40	0.6641	0.4883	-0.0801
50	0.5469	0.5313	-0.0445
60	0.4180	0.5000	-0.0008
70	0.3125	0.4609	0.0508
80	0.2266	0.4375	0.1047
90	0.1328	0.4063	0.1523
100	0.0313	0.3906	0.1695
110	-0.0664	0.3711	0.1648
120	-0.1641	0.3477	0.1578
130	-0.2930	0.3203	0.1395
140	-0.4102	0.3047	0.0906
150	-0.5195	0.2734	0.0516
160	-0.6016	0.2266	0.0246
170	-0.6563	0.1484	0.0086
180	-0.6914	0.0000	0.0000
190	-0.6563	-0.1484	-0.0086
200	-0.6016	-0.2266	-0.0246
210	-0.5195	-0.2734	-0.0516
220	-0.4102	-0.3047	-0.0906
230	-0.2930	-0.3203	-0.1395
240	-0.1641	-0.3477	-0.1578
250	-0.0664	-0.3711	-0.1648
260	0.0313	-0.3906	-0.1695
270	0.1328	-0.4063	-0.1523
280	0.2266	-0.4375	-0.1047
290	0.3125	-0.4609	-0.0508
300	0.4180	-0.5000	0.0008
310	0.5469	-0.5313	0.0445
320	0.6641	-0.4883	0.0801
330	0.7617	-0.4102	0.1082
340	0.8203	-0.2969	0.1113
350	0.8594	-0.1484	0.0797

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Table C3: Wind Force Coefficients for Typical Microwave Antenna with Cylindrical Shroud

WIND ANGLE θ (DEG)	C_A	C_S	C_M
0	1.2617	0.0000	0.0000
10	1.2617	0.0977	-0.0281
20	1.2500	0.1758	-0.0453
30	1.2109	0.2344	-0.0520
40	1.1563	0.2813	-0.0488
50	1.0859	0.3047	-0.0324
60	0.9453	0.3672	-0.0086
70	0.6719	0.4766	0.0227
80	0.2734	0.5820	0.0695
90	-0.1094	0.6250	0.0980
100	-0.3438	0.6016	0.1125
110	-0.5391	0.5313	0.1141
120	-0.7109	0.4375	0.1039
130	-0.8594	0.3125	0.0926
140	-0.9336	0.2305	0.0777
150	-0.9570	0.1758	0.0617
160	-0.9727	0.1484	0.0438
170	-0.9961	0.0977	0.0230
180	-1.0156	0.0000	0.0000
190	-0.9961	-0.0977	-0.0230
200	-0.9727	-0.1484	-0.0438
210	-0.9570	-0.1758	-0.0617
220	-0.9336	-0.2305	-0.0777
230	-0.8594	-0.3125	-0.0926
240	-0.7109	-0.4375	-0.1039
250	-0.5391	-0.5313	-0.1137
260	-0.3438	-0.6016	-0.1125
270	-0.1094	-0.6250	-0.0980
280	0.2734	-0.5820	-0.0695
290	0.6719	-0.4766	-0.0227
300	0.9453	-0.3672	0.0086
310	1.0859	-0.3047	0.0324
320	1.1563	-0.2813	0.0488
330	1.2109	-0.2344	0.0520
340	1.2500	-0.1758	0.0453
350	1.2617	-0.0977	0.0281

Table C4: Wind Force Coefficients for Typical Microwave Grid Antenna without Ice

WIND ANGLE θ (DEG)	C_A	C_S	C_M
0	0.5352	0.0000	0.0000
10	0.5234	0.1016	0.0168
20	0.5078	0.1797	0.0289
30	0.4609	0.2305	0.0383
40	0.4063	0.2617	0.0449
50	0.3438	0.2734	0.0496
60	0.2344	0.2813	0.0527
70	0.1289	0.2734	0.0555
80	0.0391	0.2500	0.0492
90	-0.0508	0.2422	0.0434
100	-0.1172	0.2734	0.0469
110	-0.1875	0.2852	0.0504
120	-0.2656	0.2773	0.0512
130	-0.3359	0.2617	0.0496
140	-0.4063	0.2344	0.0445
150	-0.4766	0.2031	0.0371
160	-0.5469	0.1563	0.0273
170	-0.5859	0.0859	0.0148
180	-0.5938	0.0000	0.0000
190	-0.5859	-0.0859	-0.0148
200	-0.5469	-0.1563	-0.0273
210	-0.4766	-0.2031	-0.0371
220	-0.4063	-0.2344	-0.0445
230	-0.3359	-0.2617	-0.0496
240	-0.2656	-0.2773	-0.0512
250	-0.1875	-0.2852	-0.0504
260	-0.1172	-0.2734	-0.0469
270	-0.0508	-0.2422	-0.0434
280	0.0391	-0.2500	-0.0492
290	0.1289	-0.2734	-0.0555
300	0.2344	-0.2813	-0.0527
310	0.3438	-0.2734	-0.0496
320	0.4063	-0.2617	-0.0449
330	0.4609	-0.2305	-0.0383
340	0.5078	-0.1797	-0.0289
350	0.5234	-0.1016	-0.0168

Note: For iced conditions, in the absence of more accurate data, coefficients from Table C1 shall be used.

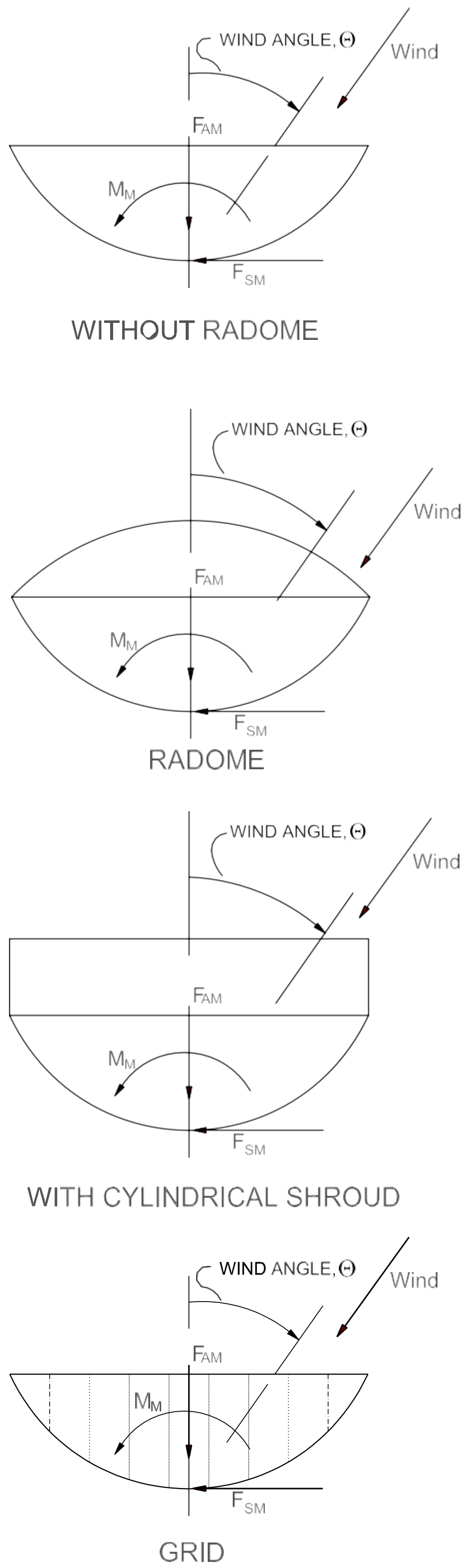

Figure C-1: Wind Forces on Typical Microwave Antennas

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ANNEX D: TWIST AND SWAY LIMITATIONS FOR MICROWAVE ANTENNAS (Normative)

This Annex provides twist and sway deformation limits for structures supporting microwave antennas under the serviceability limit state condition.

The twist and sway limits of the structure at the elevation of an antenna, θ, shall be calculated in accordance with the following:

a) For a microwave antenna with an allowable 10 dB degradation in radio frequency signal level:

$$\theta = \frac{C_{10}}{D \quad \alpha}$$

b) For a microwave antenna with an allowable 3 dB degradation in radio frequency signal level:

$$\theta = \frac{C_{3}}{D \quad \alpha}$$

where:

θ = twist or sway deformation limit, degrees
C_{10} = 53.1 GHz.ftdeg [16.2 GHz.m.deg]
C_3 = 31.0 GHz.ftdeg [9.45 GHz.m.deg]
D = Diameter of dish, ft [m]
α = Dish Frequency, GHz.

Notes:

1. It is not intended that the calculated values of θ imply an accuracy of beam width determination or structural rigidity calculation beyond known practical values and computational procedures. For most microwave antenna supporting structures, it is not practical to specify a calculated structural rigidity less than 0.25 degrees twist or sway with a 60 mph [26.8 m/s] basic wind speed.
2. Section A2.8 requires default limit state deformations to be based on an overall allowable 10 db degradation. The equation based on 3 dB is provided for reference purposes.

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ANNEX E: GUY RUPTURE (Normative)

E.1 Scope

This Annex defines a simplified equivalent static method that shall be used when it is a specified requirement to check for a guy rupture condition.

E.2 Introduction

An accurate analysis of a guyed mast for the dynamic effects caused by the sudden rupture of a guy is very complicated as it depends on the characteristics of the rupture, the damping of the structure, the vibration of the guys and the mast, etc. The following equivalent static method is provided to simulate the behavior of the structure immediately after a guy rupture.

The method presented herein utilizes the following simplifying criteria:

1. The rupture is a simple cut through the guy
2. The elastic energy stored in the broken guy before the rupture is neglected
3. Damping is not considered
4. The wind loading at the time of guy rupture is minimal and is neglected
5. For face guying or guy levels involving torsion stabilizers, the two guys in the same general direction shall be assumed to be broken. (Note: the torsional effects of a single broken guy under these guying configurations are beyond the scope of this annex.)

Guyed masts with only one guy level must have fixed bases in order to provide any resistance to guy rupture.

This method replaces the dynamic forces acting on the mast just after a guy rupture with an equivalent horizontal static force (F_{dyn}) acting on the mast at the attachment level of the ruptured guy (Figure E-1).

E.3 Analysis Method

1. The remaining guys excluding the ruptured guy (guy 1) are analyzed as a system with the mast replaced by a vertical only support under an applied horizontal force, F, acting in the direction of the broken guy. Curve 1 (Figure E-2) is generated for different values of F by plotting the sum of the horizontal components in the direction parallel to F of the non-ruptured guys at the ruptured guy level with the corresponding deflections of the guy system at the ruptured guy level from the initial tension condition. (Note that the deflection increases as the applied horizontal force, F, decreases).

2. The structure is analyzed with all guys removed at the ruptured guy level for different values of F, acting in the opposite direction of the broken guy. Curve 2 (Figure E-2) is generated for different values of F and plotted with the corresponding deflections of the mast from the initial tension condition. (Note that the deflection increases as the applied horizontal force, F, increases).

3. The area under curve 1 represents the energy that is lost in the non-ruptured guys as the mast deflects in their direction. The area under curve 2 represents the energy absorbed by the structure as it deflects due to an external horizontal force. The equivalent static force for the guy rupture condition, F_{dyn}, corresponds to the magnitude of the applied horizontal force, F, required to result in the area under curve 2 to equal the area under curve 1 (Figure E-2).

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4. F_{dyn} is applied to the structure (with a load factor equal to 1.0) with all guys removed at the same level and in the opposite direction of the ruptured guy (Figure E-1). (Note that under this condition, the structure absorbs the energy lost in the non-ruptured guy system under the movement associated with the guy rupture. This conservation of energy is required to maintain equilibrium of the structure. The resulting member forces in the structure therefore simulate the member forces that would occur under a ruptured guy condition.)

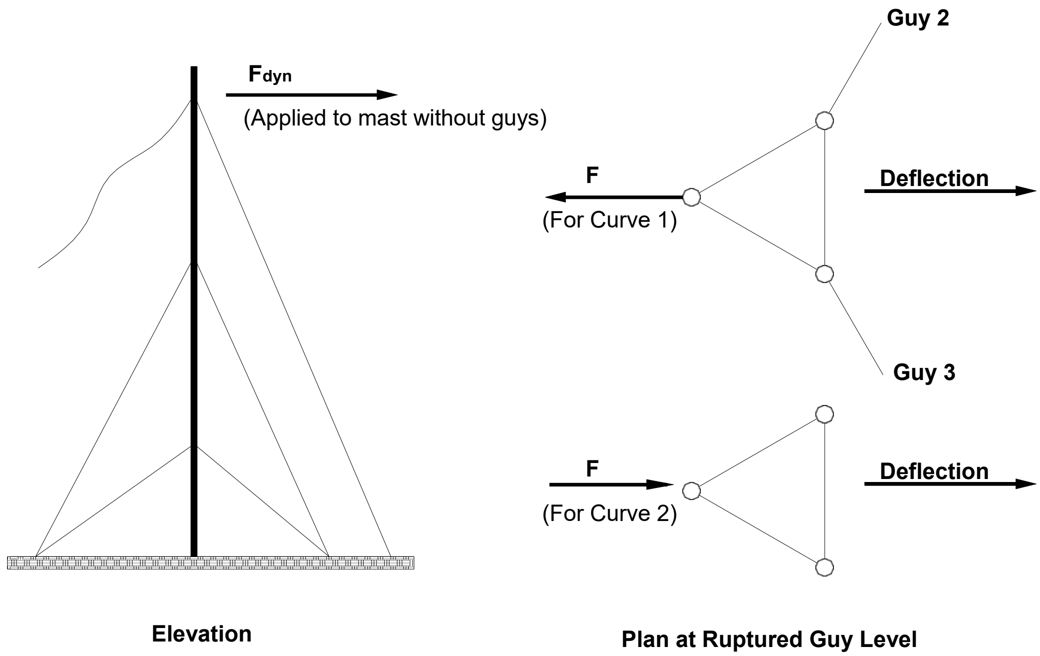
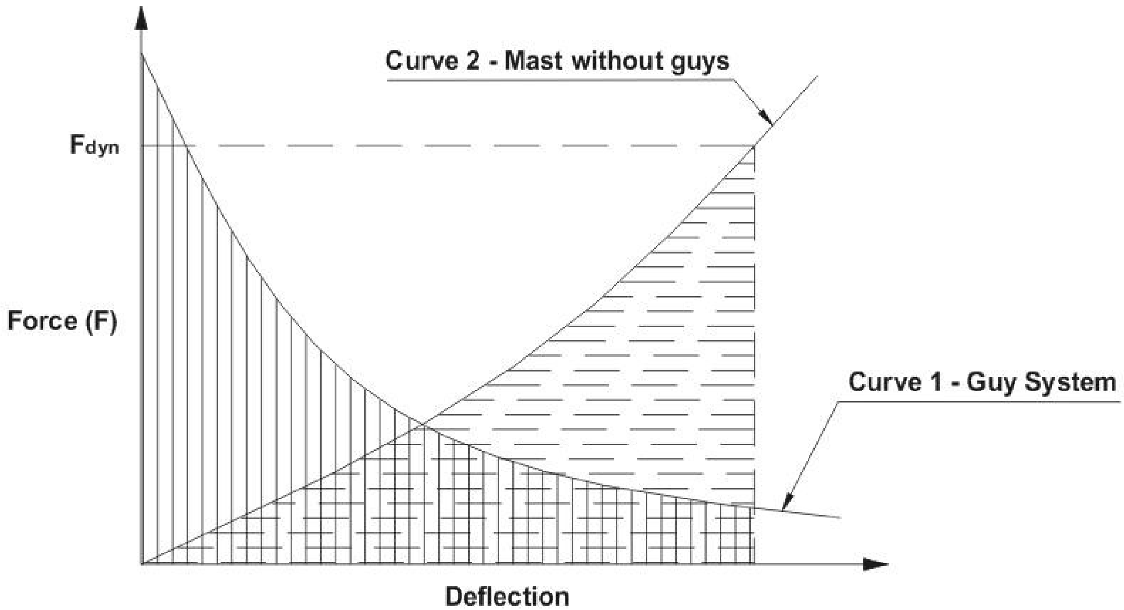


Figure E-1: Guy Rupture Condition



F_{dyn} is defined as the force associated with the point along Curve 2 where the area under Curve 2 equals the area under Curve 1.

Figure E-2: Determination of F_{dyn}

ANNEX F: PRESUMPTIVE SOIL PARAMETERS (Normative)

This Annex provides presumptive soil parameters to be used in the absence of a geotechnical report. Clay soils are assumed to be non-expansive with a plasticity index less than 24. The presumptive soil parameters in this annex assume dry conditions (non-buoyant) with a soil electrical resistivity greater than 150 ohm-m and a soil pH value between 3 and 9 (Refer to 5.6.6). When the site location is unknown, the frost depth shall be equal to 3.5 ft. [1.1 m]. Presumptive soil parameters and assumptions shall be validated for a specific site prior to installation.

Table F-1: Presumptive Soil Parameters:

Soil Type	N (blows/ ft) [blows /m]	ϕ (deg)	γ (lb/ft3) [kN/m^3]	c (psf) [kPa]	Ultimate Bearing (psf) [kPa]		S_f (psf) [kPa]	k (pci) [kN/m^3]	ε_{50}
					Shallow Fnds.	Deep Fnds.			
Clay	8 [26]	0	110 [17]	1000 [48]	5000 [240]	9000 [431]	500 [24]	150 [41,000]	.01
Sand	10 [33]	30	110 [17]	0	3000 [144]	7000 [335]	500 [24]	35 [9,500]	N/A

where:

N = standard penetration value
ϕ = angle of internal friction
γ = effective unit weight of soil
c = cohesion
S_f = ultimate skin friction
k = lateral modulus of soil reaction
ε_{50} = strain at 50% of ultimate compression
Shallow Foundations – isolated foundations such as pier and pads and mats
Deep Foundations – drilled piers, piles, and drill and bell foundations

Note: Actual soil design parameters based on a geotechnical report with similar standard penetration values may vary from the tabulated values.

ANNEX G: GEOTECHNICAL INVESTIGATIONS (Normative)

This Annex contains information that should be contained in a geotechnical investigation.

G 1. Boring logs and report shall provide:

1. Date, sampling methods, number and type of samples
2. Description of the soil strata according to the Unified Soil Classification System
3. Depths at which strata changes occur referenced to a site benchmark elevation
4. Standard Penetration Test blow counts for each soil layer
5. Soil density for each soil layer
6. Internal angle of friction for each soil layer
7. Cohesion for each soil layer
8. Ultimate bearing capacities for each soil layer or at the recommended bearing depth(s)
9. For expansive soil conditions, the active zone of influence and recommendations for design
10. Elevation of free water encountered and the ground water depth below grade to be considered for design
11. Frost depth to be considered for design
12. Soil electrical resistivity, pH values and corrosive nature of soil
13. Other pertinent soil design data and recommendations
14. Recommendations for alternate foundation types
15. Topographic information for the site
16. Note the location within 1,000 ft [300 m] of the structure of underground pipelines, buried concentric neutral power wires and electrical substations as these may effect electrolytic corrosion.

G 2. For drilled piers the following information shall also be provided:

1. Ultimate tip bearing capacity
2. Ultimate skin friction for each soil layer
3. Lateral modulus of soil reaction for each soil layer.
4. Ultimate soil strain at 50% of ultimate compression, ε_{50}, for each soil layer.

G 3. For rock anchors the following information shall also be provided:

1. Type and condition of rock
2. Rock quality designation, RQD
3. Percent rock sample recovered
4. Ultimate bond stress in the interface between the rock and grout
5. Ultimate shear strength.

ANNEX H: ADDITIONAL CORROSION CONTROL (Normative)

This annex provides additional corrosion control methods for steel guy anchorages and ground embedded poles in direct contact with soil.

Additional corrosion control methods are required for steel in direct contact with soil when the measured soil electrical resistivity is less than 50 ohm-m and/or the measured soil pH values are less than 3 or greater than 9, for Class II and III structures.

Additional corrosion control methods are also recommended for AM antenna sites and sites known to be in close proximity to underground buried pipelines, underground buried cables that utilize a concentric neutral or located within 1000 ft [300 m] of an electrical substation.

Sites with soils with a high salt or organic content, oxygen differential or transfer, significant moisture content fluctuation, or with high redox potential (microbiological corrosion potential) may be susceptible to accelerated corrosion and it is recommended that a corrosion control expert establish the control measures for the site.

Additional Corrosion Control Methods

a) Cathodic protection utilizing sacrificial anodes: The size, type and placement of anodes are to be determined by a competent corrosion control specialist or firm.

b) Cathodic protection utilizing an impressed current: A competent corrosion specialists or corrosion control firm shall determine the impressed current system to be utilized.

c) Concrete encasement: Sulfate resisting concrete mix designs should be used for all concrete below grade depending upon the concentration of soluble sulfates that exist in the soil or groundwater

   When a concrete deadman is used with an anchor, the reinforcing in the concrete encasement shall be properly developed into the concrete deadman to prevent excess cracking and the concrete encasement shall extend a minimum of 6 in. [150 mm] above grade..

d) Taping or coating of steel in direct contact with soil with special corrosion control products that remain crack free, chemically stable and ductile over the anticipated life of the structure. Special precautions are required for this method during installation and backfill operations to avoid damage to the coating. Accelerated corrosion may occur at the damaged location. Cathodic protection shall also be provided in conjunction with this method.

ANNEX I: CLIMBER ATTACHMENT ANCHORAGES (Normative)

This annex provides examples of suitable climber attachment anchors (Refer to Figs I-1 & I-2). Caution shall be used to ensure that attachments are made to sound members that do not exhibit signs of damage and/or excessive corrosion.

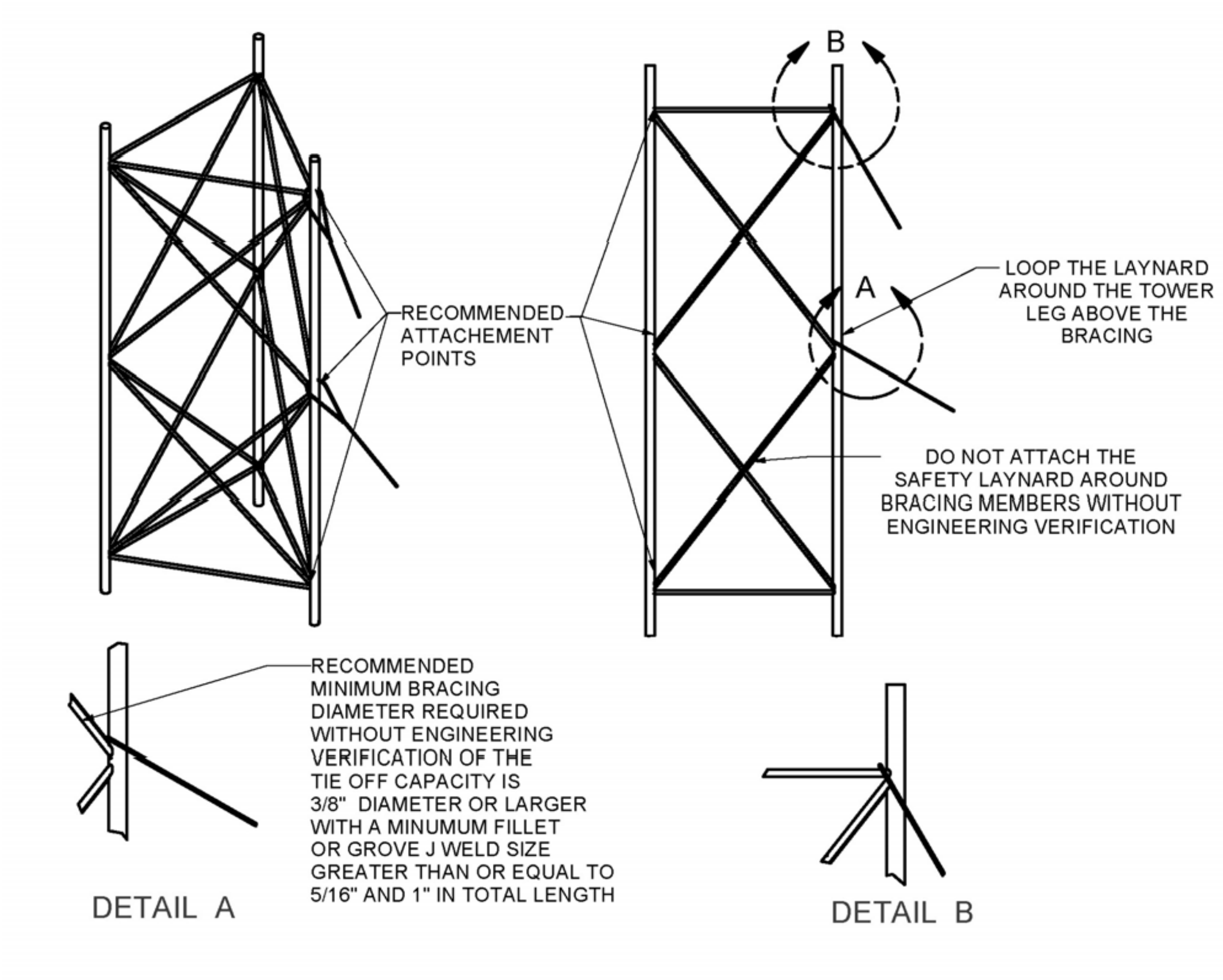


Figure I-1: Examples of Climber Attachment Anchorages (All welded Sections)

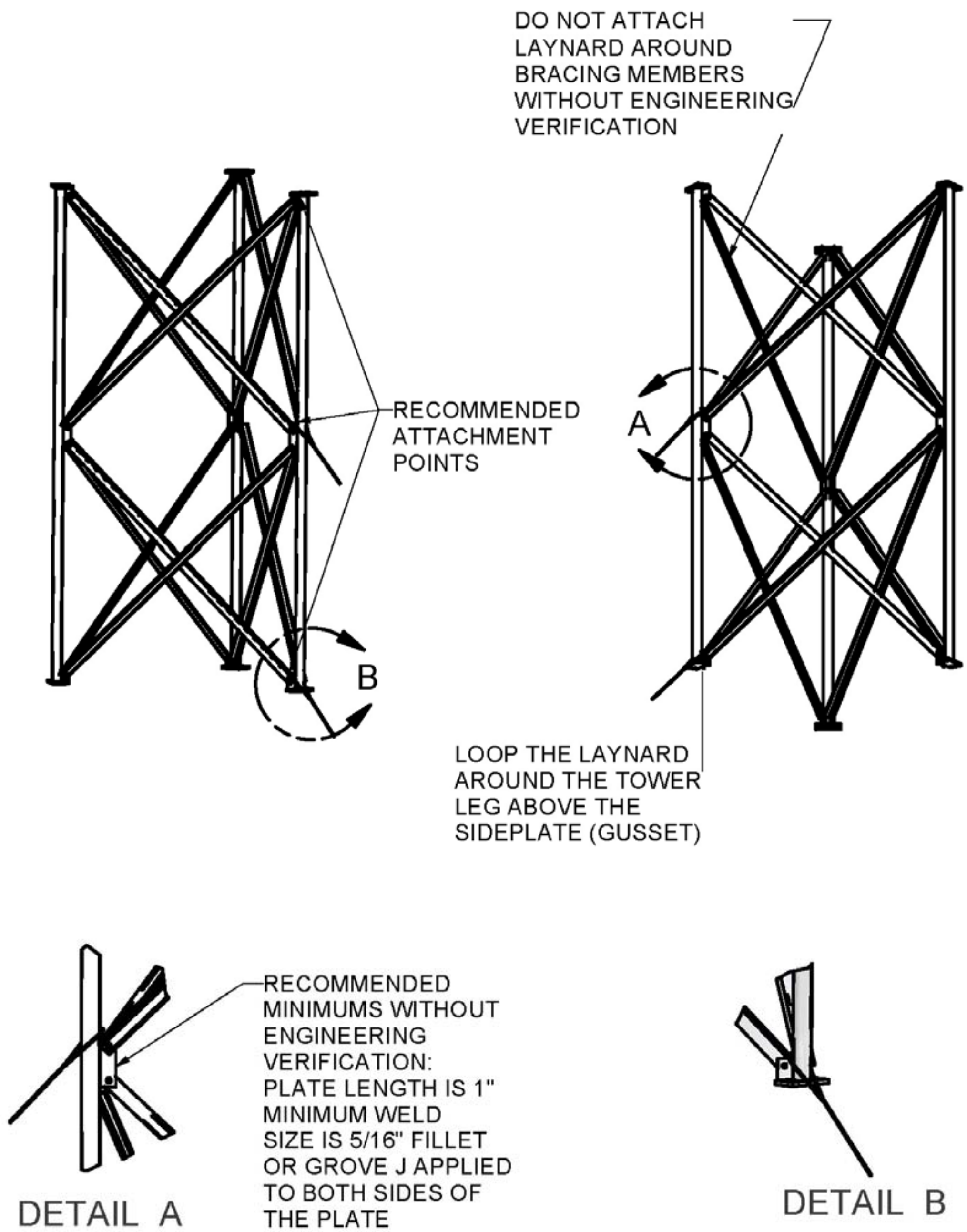


Figure I-2: Examples of Climber Attachment Anchorages (Bolted Sections)

Note: Similar climbing attachment anchorages exist at the apex of K-type bracing patterns with horizontal plan bracing connection details matching those illustrated.

ANNEX J: MAINTAINANCE AND CONDITION ASSESSMENT (Normative)

This annex provides checklists for: (a) maintenance and condition assessment, and (b) field mapping of structures and appurtenances.
Note: This annex does not provide means and methods for RF protection.

J.1 Maintenance and Condition Assessment

A) Structure Condition
1) Damaged members (legs and bracing)
2) Loose members
3) Missing members
4) Climbing facilities, platforms, catwalks – all secure
5) Loose and/or missing bolts and/or nut locking devices
6) Visible cracks in welded connections

B) Finish
1) Paint and/or galvanizing condition
2) Rust and/or corrosion condition including mounts and accessories
3) FAA or ICAO color marking conditions
4) Water collection in members (to be remedied, e.g., unplug drain holes, etc.)

C) Lighting
1) Conduit, junction boxes, and fasteners (weather tight and secure)
2) Drain and vent openings (unobstructed)
3) Wiring condition
4) Light lenses
5) Bulb condition
6) Controllers (functioning)
   a) Flasher
   b) Photo control
   c) Alarms

D) Grounding
1) Connections
2) Corrosion
3) Lightning protection (secured to structure)

E) Antennas and Lines
1) Antenna condition
2) Mount and/or ice shield condition (bent, loose, and/or missing members)
3) Feed line condition (flanges, seals, dents, jacket damage, grounding, etc.)
4) Hanger condition (snap-ins, bolt on, kellum grips, etc.)
5) Secured to structure

F) Other appurtenances (walkways, platforms, sensors, floodlights, etc.)
1) Condition
2) Secured to structure

G) Insulator Condition
   1) Cracking and chipping
   2) Cleanliness of insulators
   3) Spark gaps set properly
   4) Isolation transformer condition
   5) Bolts and connection secure

H) Guys
   1) Strand condition (corrosion, breaks, nicks, kinks, etc.)
   2) Guy Hardware Conditions
      a) Turnbuckles or equivalent (secure and safety properly applied)
      b) Cable thimbles properly in place (if required)
      c) Service sleeves properly in place (if required)
      d) Cable connectors (end fittings)
         (i) Cable clamps applied properly and bolts tight
         (ii) Wire serving properly applied
         (iii) No signs of slippage or damaged strands
         (iv) Preformed wraps – properly applied, fully wrapped, and sleeve in place
         (v) Poured sockets secure and showing no separation
         (vi) Shackles, bolts, pins and cotter pins secure and in good condition

   3) Guy Tensions
   4) Measure guy tensions (refer to Annex K)
   5) Record temperature, wind speed and wind direction

Notes:

1) Minor variations in guy tensions are to be expected due to temperature and low wind speed conditions. The cause of significant changes should be determined immediately and proper remedial action taken. Possible causes may be initial construction loosening, previously experienced extreme wind or ice, anchor movements, base settlement, or connection slippage.

2) Tension variations at a single level are to be expected because of anchor elevation differences, construction deviations, and wind effects.

I) Concrete Foundations
   1) Ground condition
      a) Settlement, movement or earth cracks
      b) Erosion
      c) Site condition (standing water, drainage, trees, etc.)
   2) Anchorage condition
      a) Nuts and/or nut locking device (tightened)
      b) Grout condition
      c) Anchorages and/or anchor rod condition
   3) Concrete condition
      a) Cracking, spalling, or splitting
      b) Chipped or broken concrete
      c) Honeycombing
      d) Low spots to collect moisture

J) Guyed Mast Anchors
   1) Settlement, movement or earth cracks
   2) Backfill heaped over concrete for water shedding
   3) Anchor rod condition below earth (Maintain required structural capacity of anchor during exploration. Attachment to temporary anchorage may be required)
   4) Corrosion control measures (galvanizing, coating, concrete encasement, cathodic protection systems, etc.)
   5) Anchor heads clear of earth

K) Tower Alignment
   1) Tower Plumb and Twist (See Figures J-1 and J-2)

J.2 Field Mapping

J.2.1 Mapping of Appurtenances
The mapping of appurtenances shall provide sufficient dimensional data in order to calculate the effective projected area, weight and location of all appurtenances.

The mapping of appurtenances shall include, as a minimum:

A) Inventory of existing antennas: Elevation, antenna type and dimensions/model number, support mount and location, spacing and orientation on cross-section, and corresponding transmission line(s).
B) Inventory of other appurtenances (such as climbing ladders, platforms, etc.): Elevation, appurtenance type and dimensions, location, spacing and orientation on cross-section.
C) A cross-section sketch locating and labeling the transmission lines (size and spacing) and showing the orientation of the lines and the structure with respect to North. For transmission lines in clusters: number of lines per row, number of rows, and separation between the lines, overall width and depth dimensions.

J.2.2 Mapping of Structural Components
In order to perform an analysis of a structure, the structural configuration and the size of all structural members must be mapped in order to calculate wind loading and member capacities.

The mapping of the structure and its main structural members shall include, as a minimum:

J.2.2.1 Self-Supporting Latticed Structures

A) Sketch of overall structure numbering all sections.
B) The Configuration of each section:
   1) Section height
   2) Panel height and number of panels
   3) Configuration of the panels (X, X with horizontal, K)
   4) Face width (Center to Center of legs) at all taper change locations.
   5) Sketch indicating the above for each typical section
C) Member sizes for each section:
   1) Leg member sizes - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), solid round diameter, or angle size & thickness (60 deg. or 90 deg.)
   2) Diagonal member sizes - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), angle size, thickness and orientation (long leg back to back, LLBB, or short leg back to back, SLBB)

3) Horizontal member sizes - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), angle size, thickness and orientation (LLBB, SLBB)
4) Subbrace member sizes (if applicable) - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), angle size, thickness and orientation (LLBB, SLBB)

J.2.2.2 Guyed Masts

A) Structure base type (fixed or pinned) and tapered or flat base
B) Guy anchor dimensions: distance from base to guy anchors and their relative elevations to base and their orientation.
C) Sketch of overall structure numbering all sections. Locate and label all guy wire levels.
   1) The configuration of each Section:
   2) Section height
   3) Panel height and number of panels
   4) Configuration of the panels (X, X with horizontals, K)
   5) Face width (center to center of legs) at all taper change locations
   6) Sketch indicating the above for each typical section
D) Member sizes for each section:
   1) Leg member sizes - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), solid round diameter, angle size & thickness (60 deg. or 90 deg.)
   2) Diagonal member sizes - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), angle size, thickness and orientation (long leg back to back, LLBB, or short leg back to back, SLBB)
   3) Horizontal member sizes - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), solid round diameter, angle size, thickness and orientation (LLBB, SLBB)
   4) Subbrace member sizes (if applicable) - i.e. pipe diameter (outside diameter & wall thickness using ultra sound device), angle size, thickness and orientation (LLBB, SLBB)
E) Guy wire elevation, size and type for each guy level

J.2.2.3 Pole Structures

A) Sketch of overall structure numbering all sections.
B) Configuration of each section:
C) Section height – For flanged type, the length from splice to splice. For telescoping poles, the length from butt to butt
D) If multi-sided, number of sides
E) Flat to flat dimension or diameter and circumference at top and bottom of each section
F) Port hole opening size, reinforcing and location
G) Size for each Section:
   1) Wall thickness of each section

J.2.2.4 Connections

In order to perform a rigorous structural analysis of a structure the details of all structural connections must be mapped in order to calculate connection capacities.

The mapping of the structure connections shall include, as a minimum, the following:

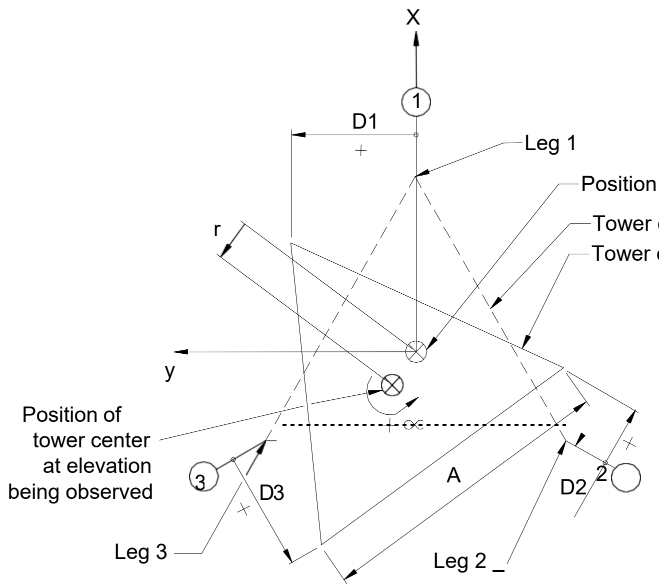
A) Member end connection details:
B) If Bolted: number, type and size of end bolts and center bolts
C) Size and thickness of gusset plate with related details (hole sizes, edge distances, weld size and length)
D) If Welded: weld size and length of end and center connections

E) Splice connection details:
F) Number, type and size of bolts
G) Size and thickness of splice plate with related details (hole sizes, edge distances, weld size and length,) and distance from panel intersection point
H) Anchor rod type, size, number, and bolt circle
I) Guy Assembly and connection details:
J) Preformed size/type, turnbuckle size, shackle size
K) Socket size, pin size, link plate dimensions with related details
L) Size and thickness of guy pull-off plate with related details (hole sizes, edge distances, weld size and length, stiffener size)
M) Guy anchor head plate size, thickness, holes size, spacing, and edge distances of holes, shaft type, size and extension length and angle from horizontal plane and weld size and length of connection between shaft and fan plate

Site Name:________________________________Date: ______________________

Wind:____________________________________Temperature: ________________

The transit is to be set up on each leg azimuth at the base of the tower. The corresponding tower leg at the base of the tower is used to set the vertical baseline. The deflection at each point of interest on the tower is measured from this vertical baseline, as shown below.



$$d = (D1 + D2 + D3) / 3$$
$$e = (d \sqrt{3}) / A$$
$$\alpha = \arcsin(e)$$
$$x = (D2 - D3) / \sqrt{3}$$
$$y = (2 \times D1 - D2 - D3) / 3$$
$$r = \sqrt{x^2 + y^2}$$

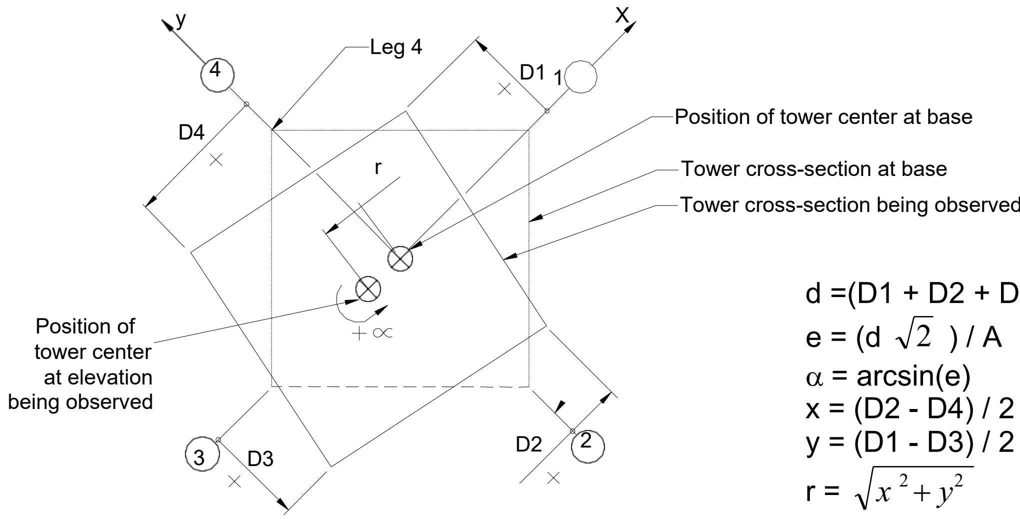
OBSERVED LEG DISPLACEMENTS					CALCULATED TWIST			CALCULATED OUT-OF-PLUMB		
SIGHTED ELEV ft [m]	A in [mm]	D1 in [mm]	D2 in [mm]	D3 in [mm]	d in [mm]	e	α deg.	x in [mm]	y in [mm]	r in [mm]

Figure J-1: Twist and Out-of Plumb Determination for Triangular Towers

Site Name:____________________________________Date: ____________________

Wind:____Temperature: _______________

The transit is to be set up on each leg azimuth at the base of the tower. The corresponding tower leg at the base of the tower is used to set the vertical baseline. The deflection at each point of interest on the tower is measured from this vertical baseline, as shown below.



$d = (D1 + D2 + D3 + D4) / 4$

$e = (d \sqrt{2}) / A$

$\alpha = \arcsin(e)$

$x = (D2 - D4) / 2$

$y = (D1 - D3) / 2$

$r = \sqrt{x^2 + y^2}$

OBSERVED LEG DISPLACEMENTS						CALCULATED TWIST			CALCULATED OUT-OF-PLUMB		
SIGHTED ELEV ft [m]	A in [mm]	D1 in [mm]	D2 in [mm]	D3 in [mm]	D4 in [mm]	d in [mm]	e	α deg.	x in [mm]	y in [mm]	r in [mm]

Figure J-2: Twist and Out-of-Plumb Determination for Square Towers

ANNEX K: MEASURING GUY TENSIONS (Normative)

This annex provides guidelines for field measuring guy tensions. There are two basic methods for measuring guy initial tensions in the field: the direct method and the indirect method.

A. The Direct Method (see Figure K1)

A dynamometer (load cell) with a length adjustment device, such as a come-along, is attached to the guy system by clamping onto the guy just above the turnbuckle and onto the anchor shaft below the turnbuckle.

The come-along is then tightened until the original turnbuckle begins to slacken. At this point the dynamometer carries all of the guy load to the anchor, and the guy tension may be read directly off the dynamometer dial.

One may use this method to set the correct tension by adjusting the come-along until the proper tension is read on the dynamometer. The control points are marked, one above the clamping point on the guy and one on the anchor shaft, and the control length is measured. The dynamometer and come-along are then removed, and the original turnbuckle is adjusted to maintain the control length previously measured.

B. The Indirect Methods

There are two common techniques for the indirect measurements of guy initial tensions; the pulse or swing method (vibration) and the tangent intercept or sag method (geometry).

1. The Pulse Method (see Figures K1 and K3)

One sharp jerk is applied to the guy cable near its connection to the anchor causing a pulse or wave to travel up and down the cable. On the first return of the pulse to the lower end of the guy cable the stopwatch is started. A number of returns of the pulse to the anchor are then timed, and the guy tension is calculated from the following equations:

$$T_M = \frac{WLN^2}{8.05P^2} \qquad T_M = \frac{WLN^2}{5.94P^2}$$

$$T_A = \sqrt{\left(T_M - \frac{WV}{2L}\right)^2 + \left(\frac{WH}{2L}\right)^2}$$

where:

T_A = guy tension at anchor, lb [N]

T_M = guy tension at mid-guy, lb [N]

W = total weight of guy, including insulators, etc., lb [N]

L = guy chord length, ft [m]

$$L = \sqrt{H^2 + V^2}$$

H = horizontal distance from guy attachment on tower to guy attachment at anchor, ft [m]

V = vertical distance from guy attachment on tower to guy attachment at anchor, ft [m]

N = number of complete pulses or swings counted in P seconds

P = period of time measured for N pulses or swings, seconds

Instead of creating a pulse that travels up and down the guy, one may achieve the same result by causing the guy cable to swing freely from side to side while timing N complete swings. The formulas given above will also apply for this approach.

2. The Tangent Intercept Method (see Figure K2)

A line if sight is established which is tangential to the guy cable near the anchor end and which intersects the tower leg a distance (tangent intercept) below the guy attachment point on the mast. This tangent intercept distance is either measured or estimated and the tension is calculated from the following equation.

$$T_A = \frac{WC\sqrt{H^2 + (V - I)^2}}{HI}$$

where:

C = distance from guy attachment on tower to the center of gravity of the weight W, ft [m]

I = tangent intercept, ft [m]

If the weight is uniformly distributed along the guy cable, C will be approximately equal to H/2. If the weight is not uniformly distributed, the guy may be subdivided into n segments and the following equation may be used:

$$T_A = \frac{S\sqrt{H^2 + (V - I)^2}}{HI}$$

where:

$$S = \sum_{i=1}^{N} W_i C_i$$

W_i = weight of segment i, lb [N]

C_i = horizontal distance from the guy attachment on the tower to the center of gravity of segment, ft [m]

N = number of segments

If the intercept is difficult to establish, one may use the guy slope at the anchor end with the following equation:

$$T_A = \frac{WC\sqrt{1+\tan^2\alpha}}{(V - H\tan\alpha)}$$

where:

α = guy angle at the anchor (see Figure K2)

$I = V - H\tan\alpha$

and

$$\frac{\sqrt{H^2 + (V-I)^2}}{H} = \sqrt{1+\tan^2\alpha}$$

WC may be replaced with S.

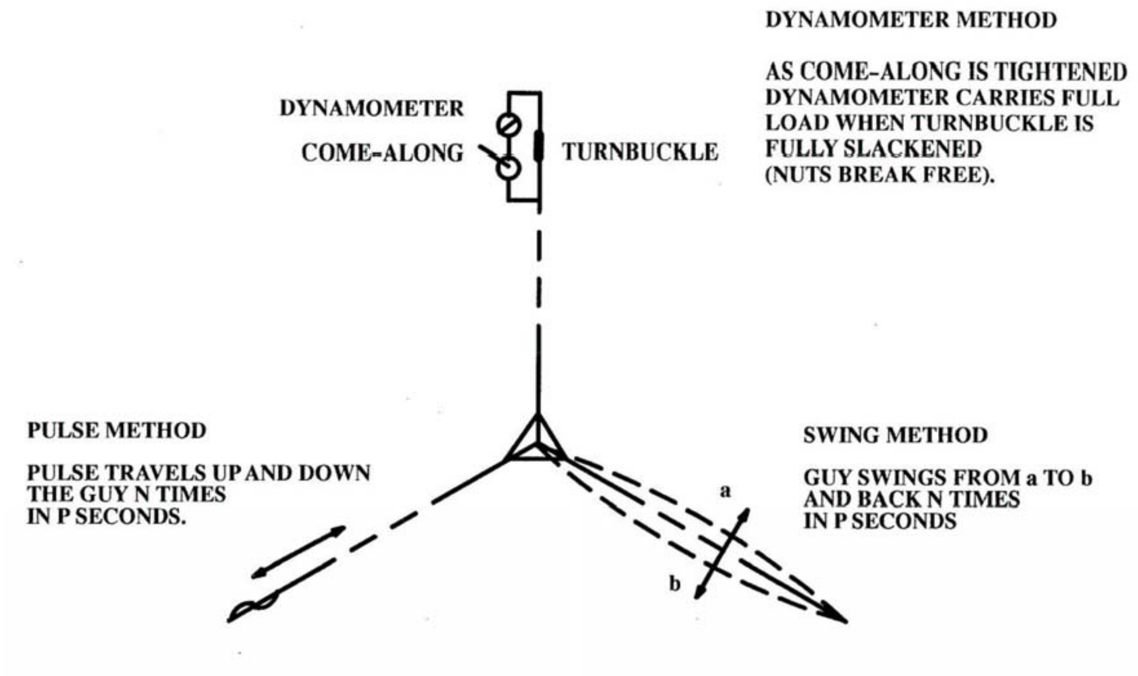


Figure K1: Method of Measuring Initial Tension

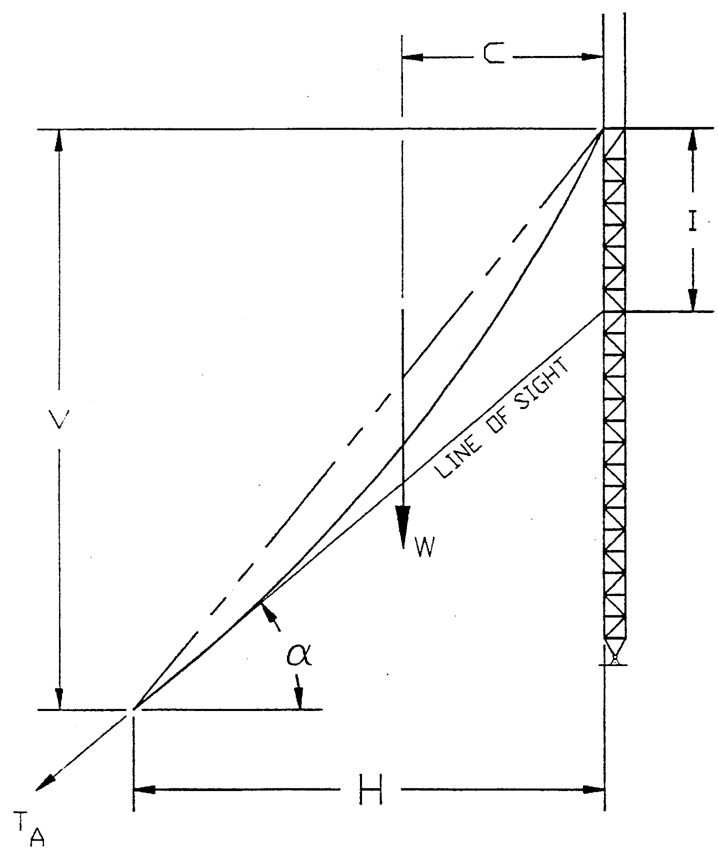


Figure K2: Tangent Intercept Method

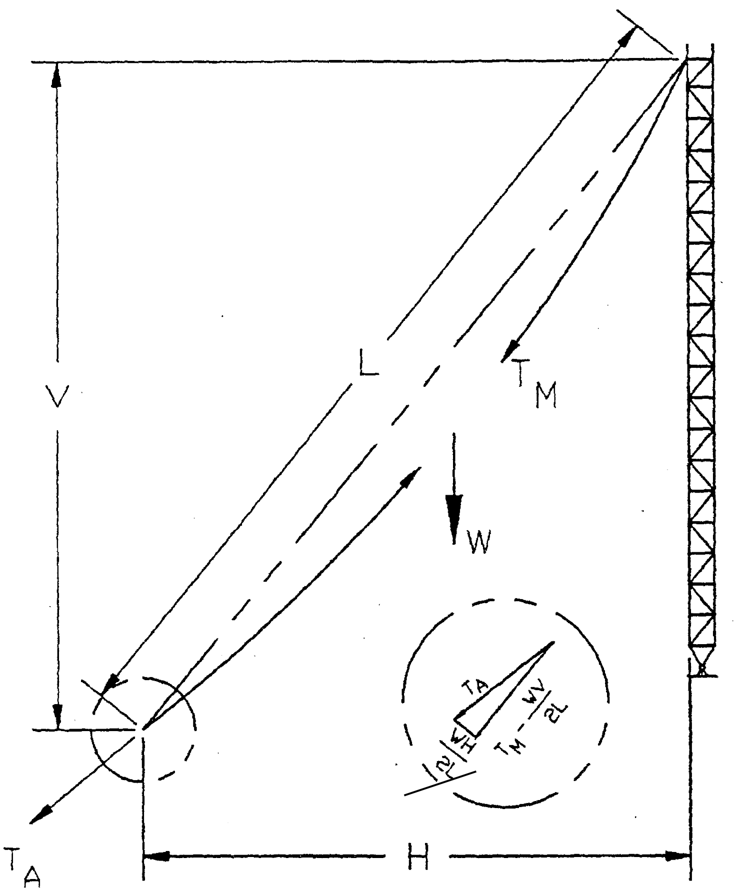


Figure K3: Relationship Between Guy Tension at Anchor and at Mid-Guy

ANNEX L: WIND SPEED CONVERSIONS (Normative)

This annex provides conversion of wind speeds based on various averaging periods to the 3-sec gust wind speed. Wind data based on other averaging periods are to be converted to a 3-sec gust wind speed for use with the Standard.

3-sec gust (mph)	Fastest-mile		10-min avg. (mph)	Hourly mean (mph)
	Wind speed (mph)	Averaging period (sec)		
60	50	72	42	40
70	58	62	49	46
80	66	55	56	53
85	70	51	59	56
90	75	48	62	60
95	78	46	66	63
100	80	45	69	66
105	85	42	73	70
110	90	40	76	73
115	95	38	80	76
120	100	36	83	79
125	105	34	87	83
130	110	33	90	86
135	115	31	94	89
140	120	30	97	93
145	125	29	101	96
150	130	28	104	99
155	135	27	108	103
160	140	26	111	106
165	145	25	115	109
170	150	24	118	113

Notes: 1. For conversion to [m/s] multiply the above values by 0.447.
2. Linear interpolation may be used between the values shown.

ANNEX M: SI CONVERSION FACTORS (Normative)

This annex provides conversions commonly required for the International System of Units (SI).

To Convert From	To	Multiply By
inches (in)	millimeters [mm]	25.40
feet (ft)	meters [m]	0.3048
square feet (ft^2)	square meters [m^2]	0.0929
cubic feet (ft^3)	cubic meters [m^3]	0.0283
gravity, g, (32.1 ft/s^2)	gravity, g, (9.81 m/s^2)	0.3048
pounds [force] (lb)	newtons [N]	4.4482
pounds [mass] (lb)	kilograms [kg]	0.4536
pounds per cubic feet (lb/ft^3)	kilonewtons per cubic meter [kN/m^3]	0.1571
pounds per square foot (lb/ft^2)	Pascals [Pa]	47.88
kips per square inch (ksi)	megapascals [MPa]	6.8948
miles per hour (mph)	meters per second [m/s]	0.4470

ANNEX N: REFERENCES (Normative)

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APPENDIX 1: DESIGN CRITERIA MAPS (Normative)

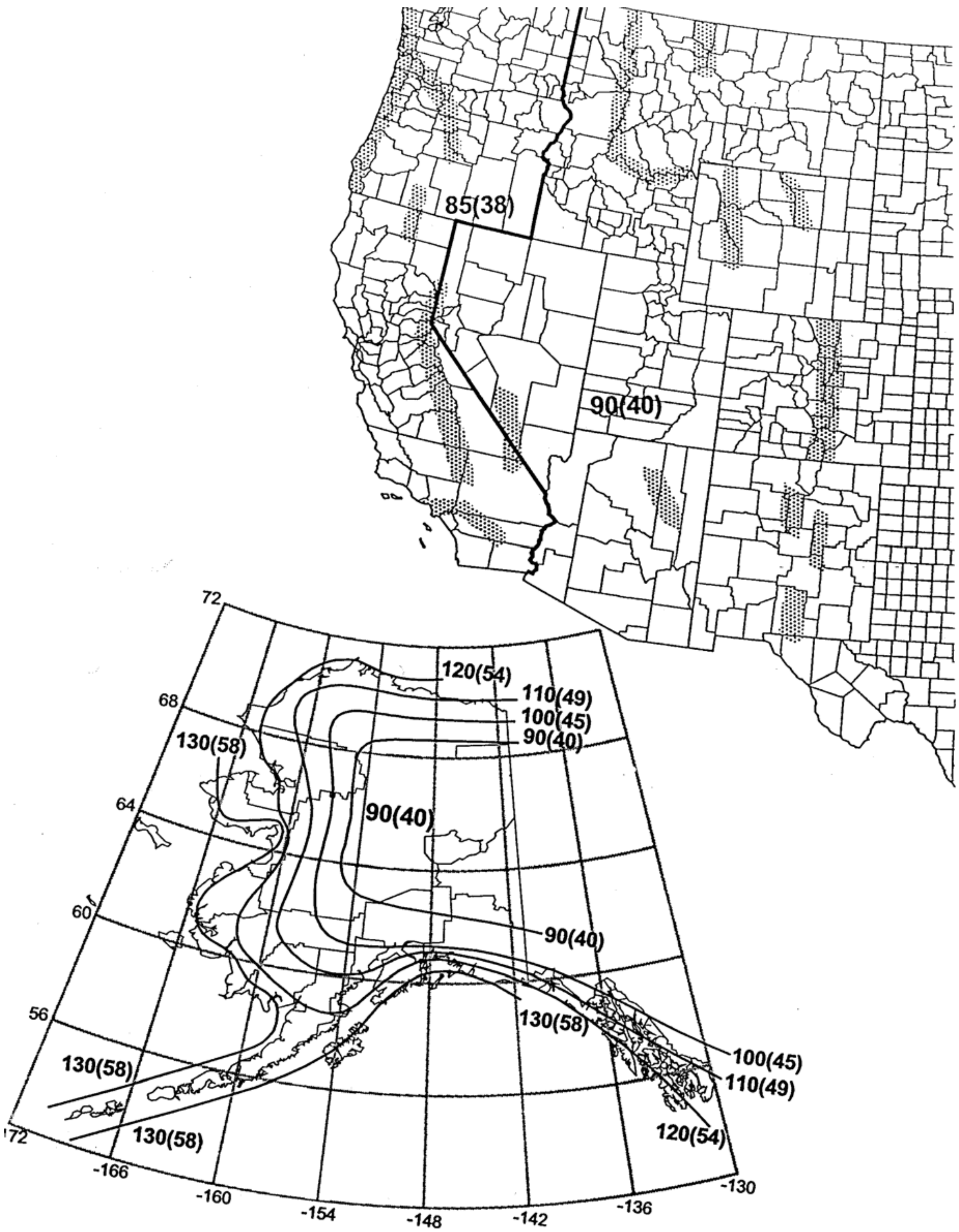
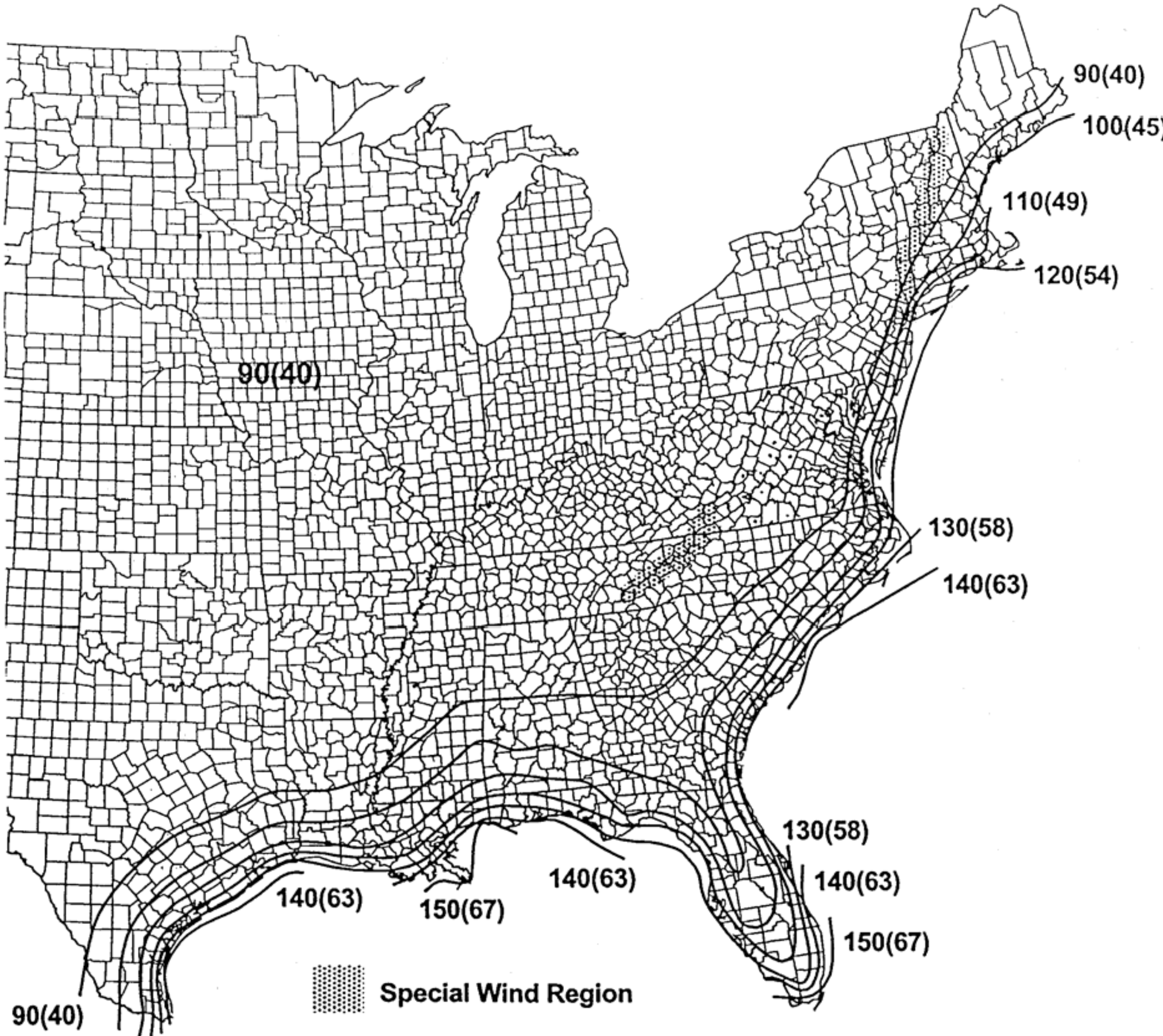


FIGURE A1-1a BASIC WIND SPEED WITHOUT ICE, V mph (m/s)



Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(65)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind 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.

FIGURE A1-1b BASIC WIND SPEED WITHOUT ICE, V mph [m/s]

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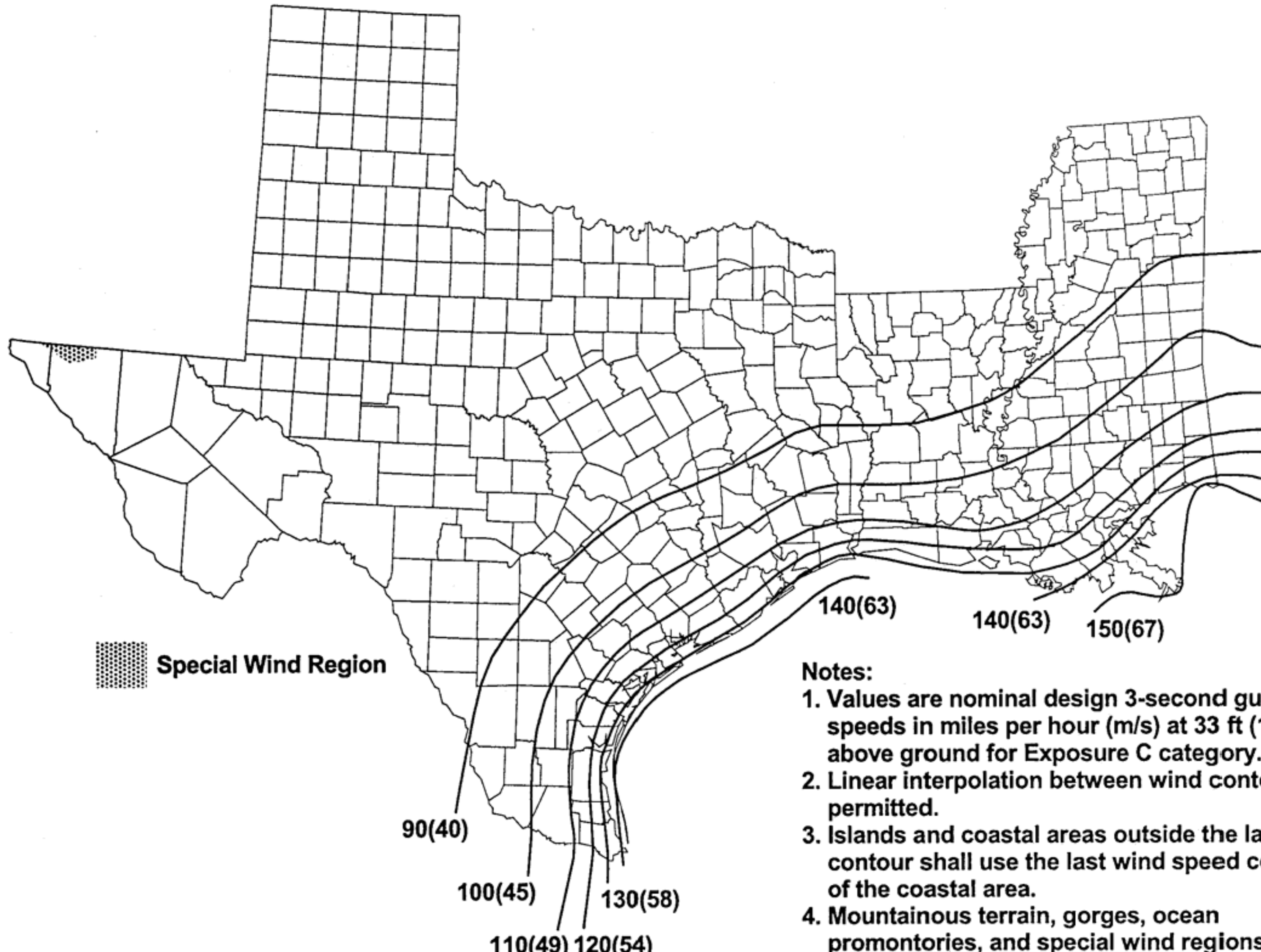

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind 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.

FIGURE A1-1c BASIC WIND SPEED WITHOUT ICE, V mph [m/s]

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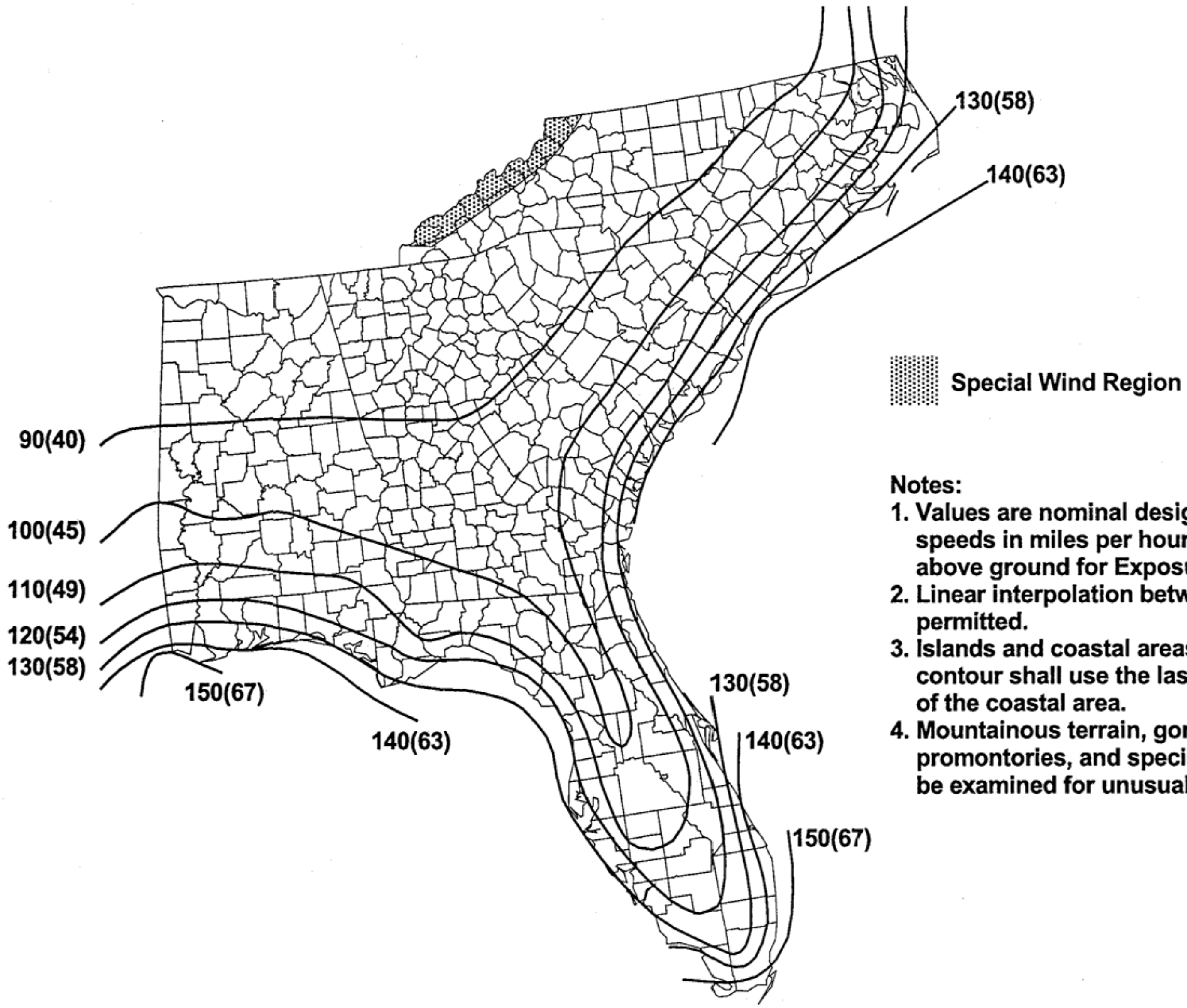
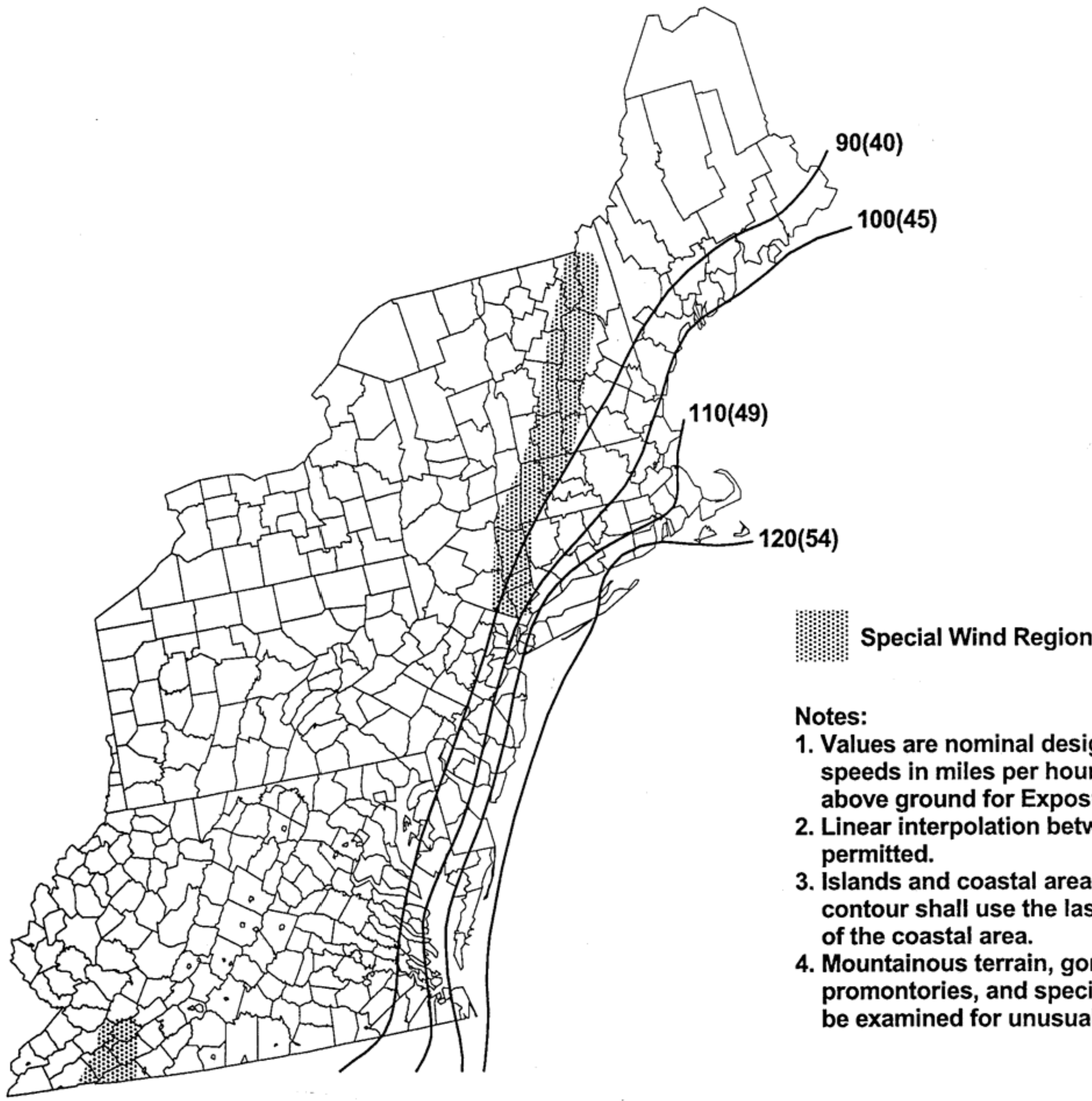


Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

FIGURE A1-1d BASIC WIND SPEED WITHOUT ICE, V mph [m/s]

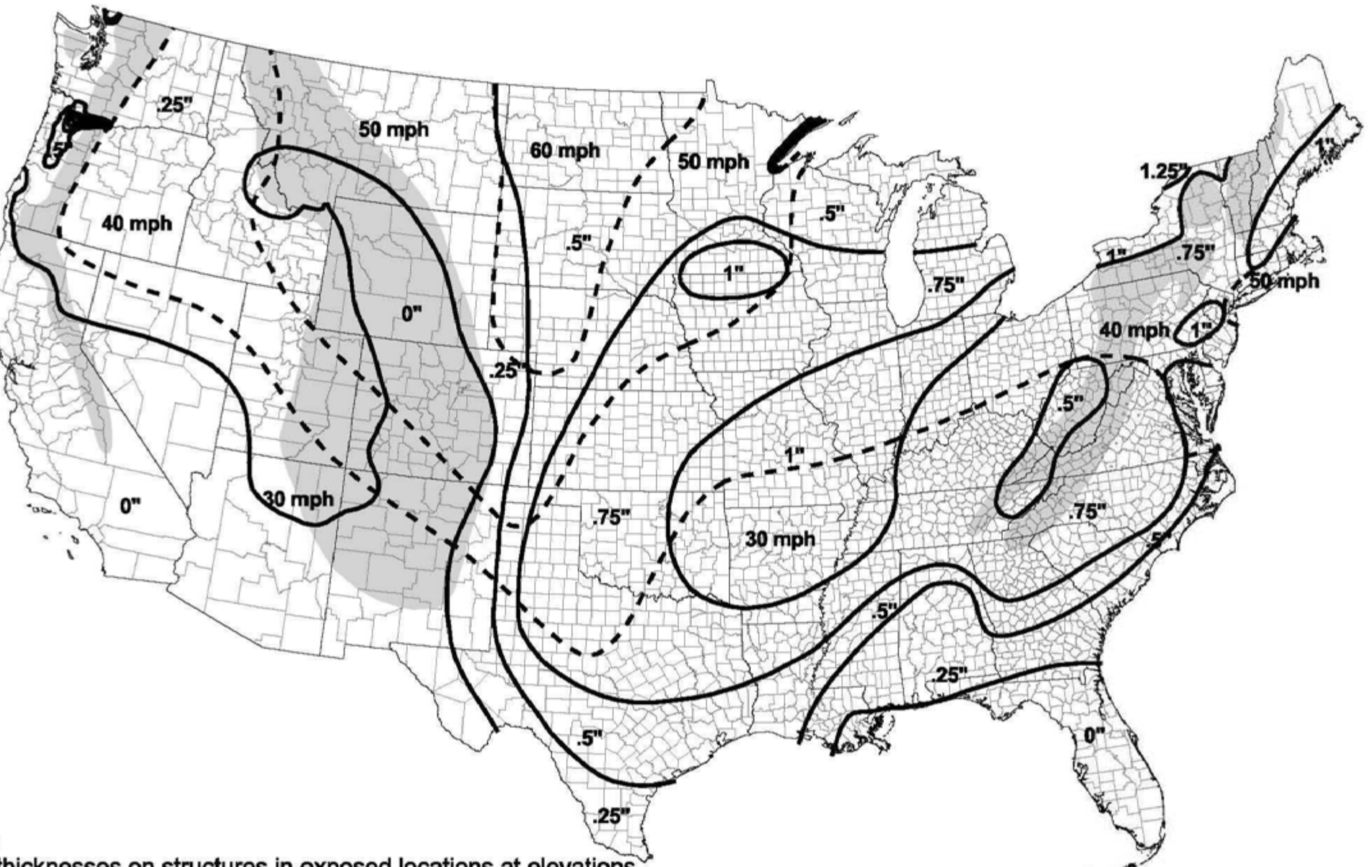


Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind 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.

FIGURE A1-1e BASIC WIND SPEED WITHOUT ICE, V mph [m/s]

Equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 50-year mean recurrence interval



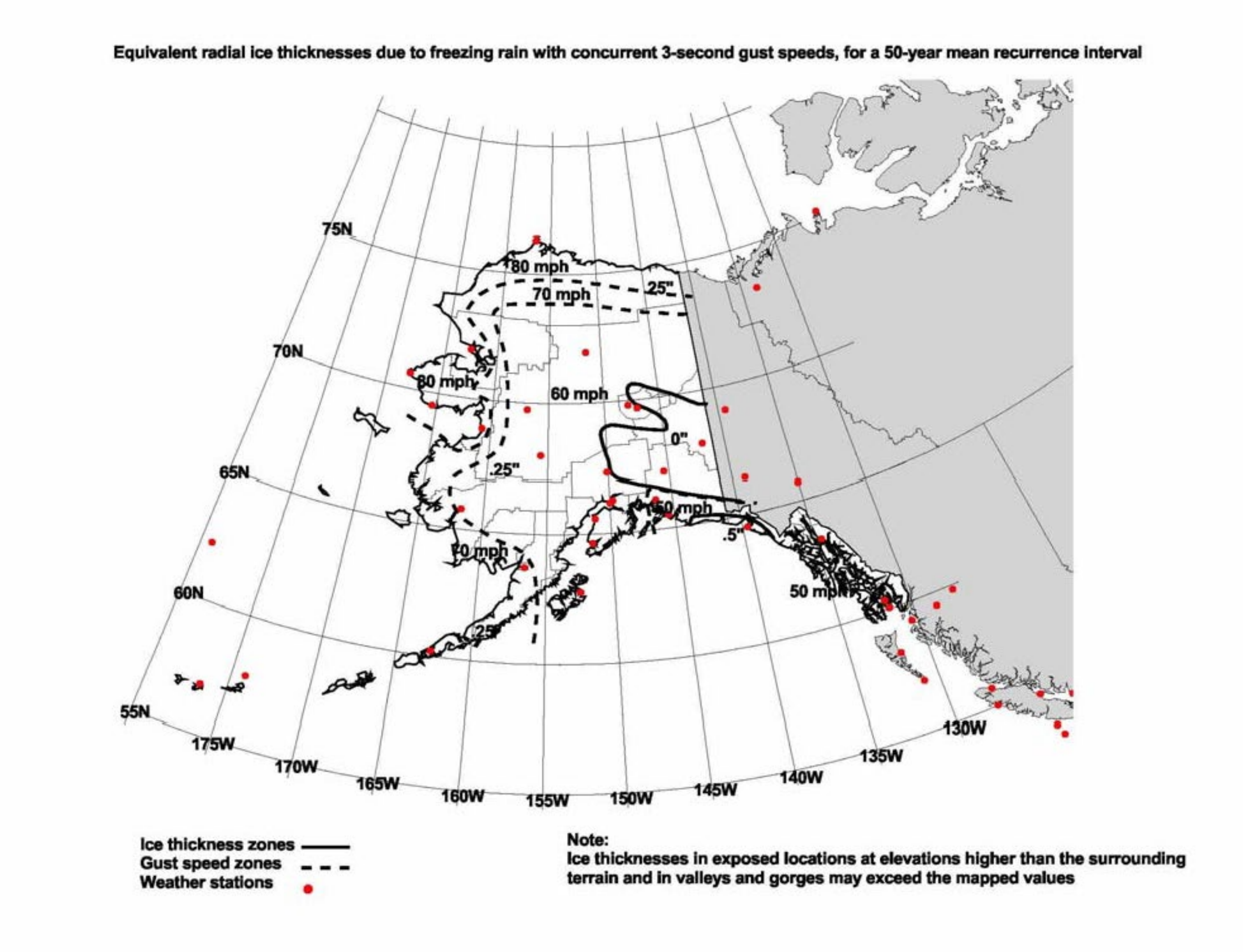
Notes:
1. Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.
2. In the mountain west, indicated by the shading, ice thicknesses may exceed the mapped values in the foothills and passes. However, at elevations above 5,000 ft, freezing rain is unlikely.
3. In the Appalachian Mountains, indicated by the shading, ice thicknesses may vary significantly over short distances.

Ice thickness zones ——
Gust speed zones - - -

t_i inch [mm]	V_i mph [m/s]
0.25 in. [6.4 mm]	30 mph [13 m/s]
0.50 in. [12.7 mm]	40 mph [18 m/s]
0.75 in. [19.0 mm]	50 mph [22 m/s]
1.00 in. [25.4 mm]	60 mph [27 m/s]
1.25 in. [31.8 mm]	70 mph [31 m/s]

Note: For purposes of this Standard, ice may be ignored in the ¼" thickness zones

FIGURE A1-2a BASIC WIND SPEED WITH ICE V_i mph [m/s] and DESIGN ICE THICKNESS t_i inch [mm]



t_i inch [mm]	V_i mph [m/s]
0.25 in. [6.4 mm]	30 mph [13 m/s]
0.50 in. [12.7 mm]	40 mph [18 m/s]
0.75 in. [19.0 mm]	50 mph [22 m/s]
1.00 in. [25.4 mm]	60 mph [27 m/s]
1.25 in. [31.8 mm]	70 mph [31 m/s]

Note: For purposes of this Standard, ice may be ignored in the ¼” thickness zones

FIGURE A1-2b BASIC WIND SPEED WITH ICE V_i mph [m/s] and DESIGN ICE THICKNESS t_i inch [mm]

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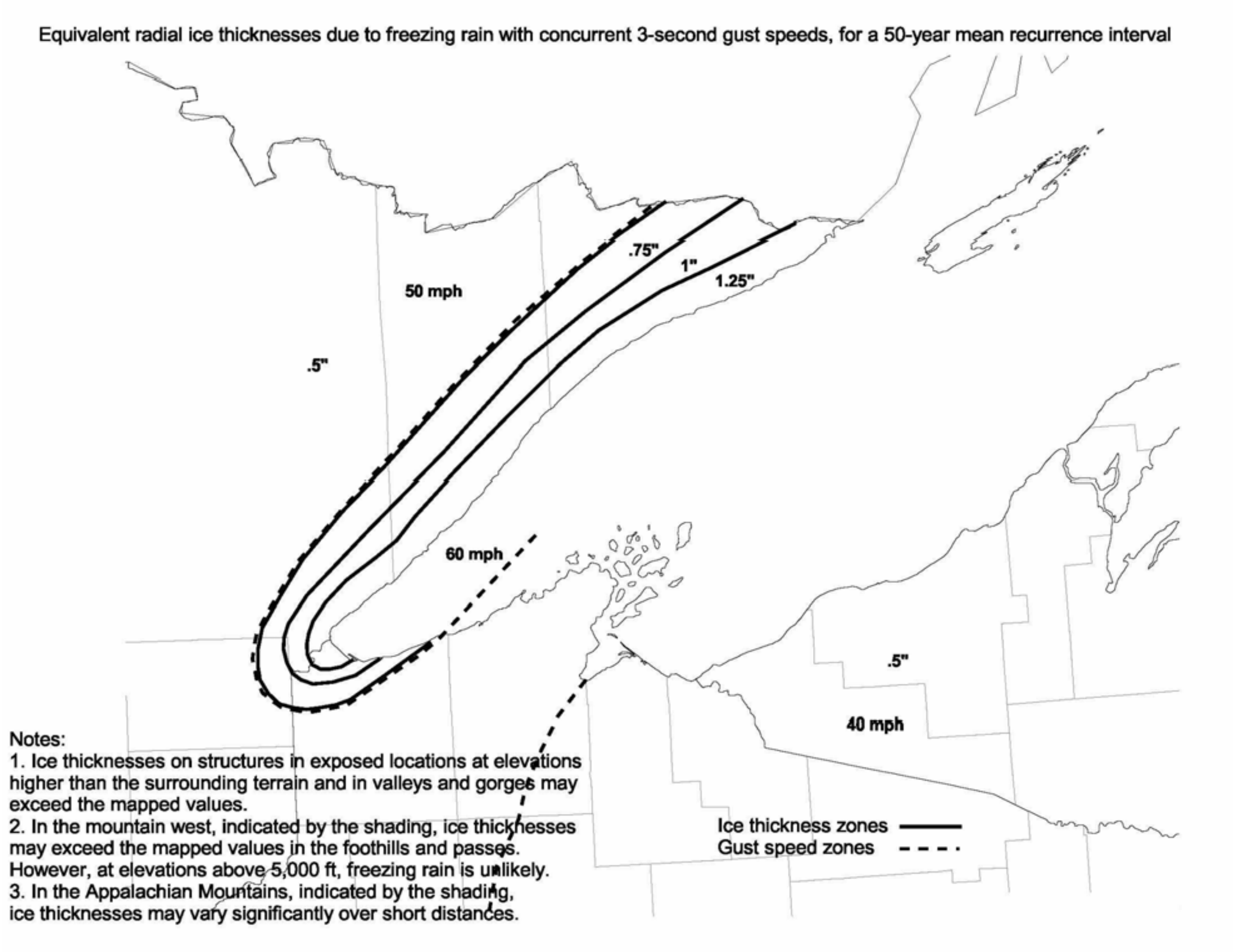
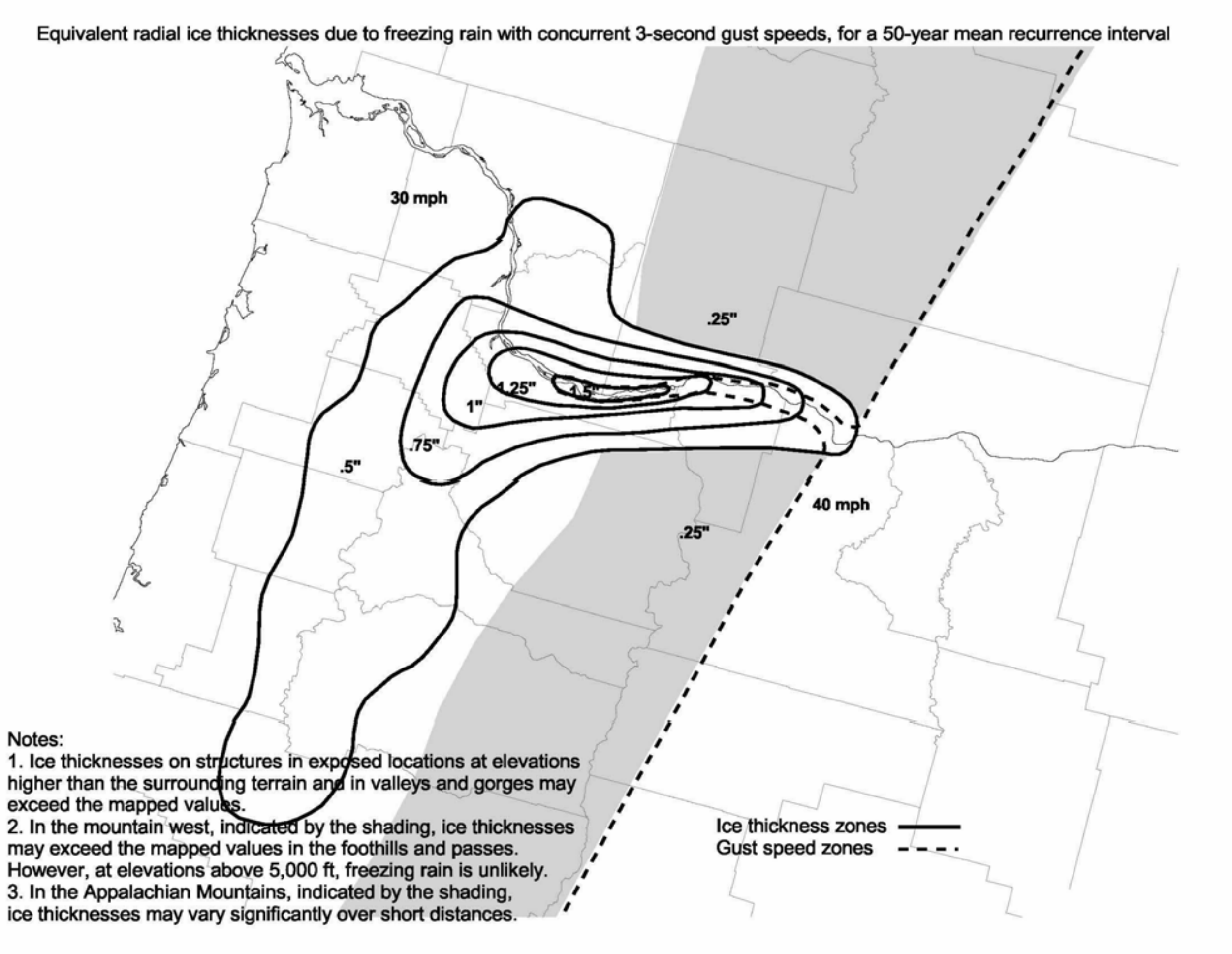


t_i inch [mm]	V_i mph [m/s]
0.25 in. [6.4 mm]	30 mph [13 m/s]
0.50 in. [12.7 mm]	40 mph [18 m/s]
0.75 in. [19.0 mm]	50 mph [22 m/s]
1.00 in. [25.4 mm]	60 mph [27 m/s]
1.25 in. [31.8 mm]	70 mph [31 m/s]

Note: For purposes of this Standard, ice may be ignored in the ¼” thickness zones

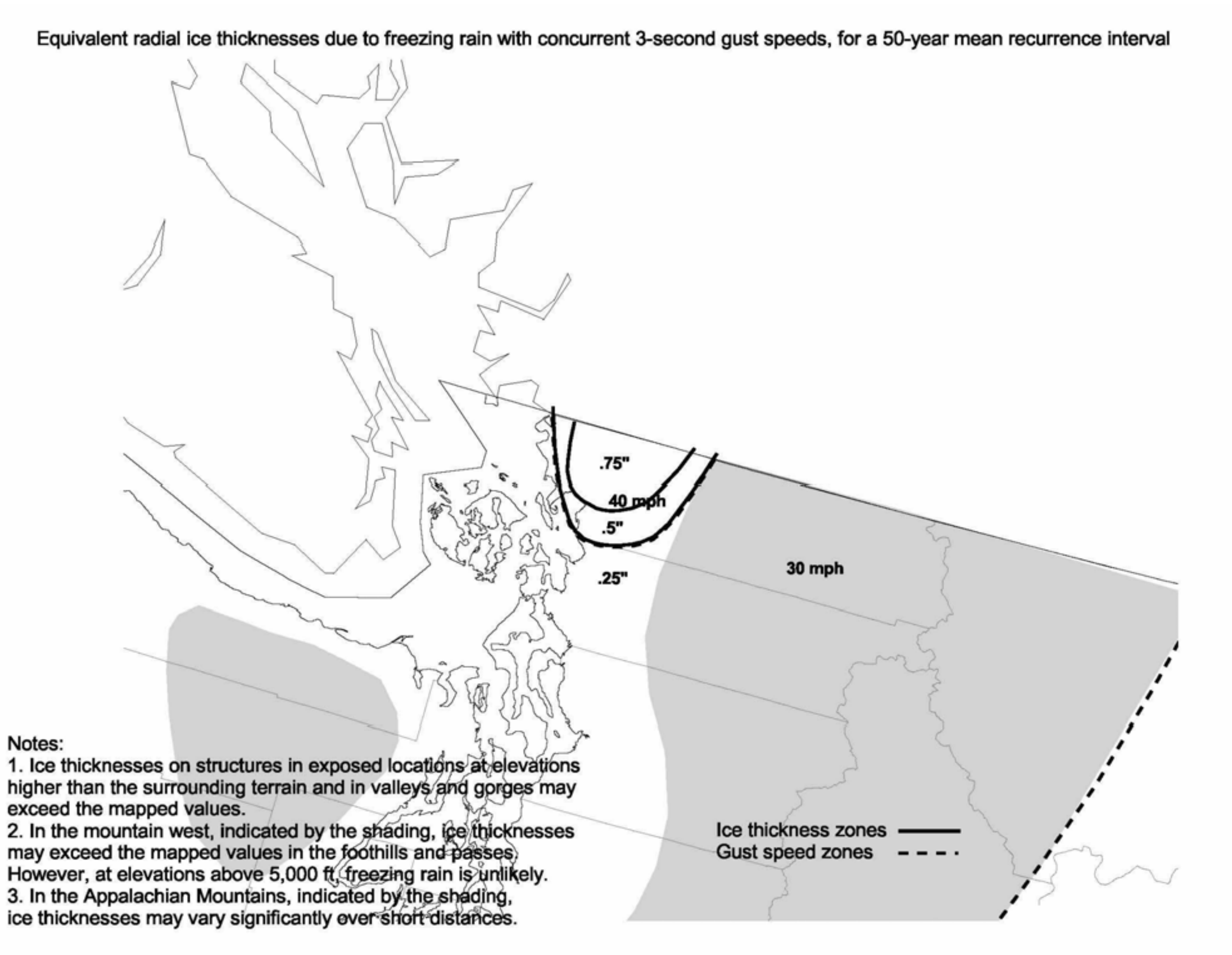
FIGURE A1-2c LAKE SUPERIOR REGION BASIC WIND SPEED WITH ICE V_i mph [m/s] and DESIGN ICE THICKNESS t_i inch [mm]



t_i inch [mm]	V_i mph [m/s]
0.25 in. [6.4 mm]	30 mph [13 m/s]
0.50 in. [12.7 mm]	40 mph [18 m/s]
0.75 in. [19.0 mm]	50 mph [22 m/s]
1.00 in. [25.4 mm]	60 mph [27 m/s]
1.25 in. [31.8 mm]	70 mph [31 m/s]

Note: For purposes of this Standard, ice may be ignored in the ¼" thickness zones

FIGURE A1-2d COLUMBIA RIVER BASIN BASIC WIND SPEED WITH ICE V_i mph [m/s] and DESIGN ICE THICKNESS t_i inch [mm]



t_i inch [mm]	V_i mph [m/s]
0.25 in. [6.4 mm]	30 mph [13 m/s]
0.50 in. [12.7 mm]	40 mph [18 m/s]
0.75 in. [19.0 mm]	50 mph [22 m/s]
1.00 in. [25.4 mm]	60 mph [27 m/s]
1.25 in. [31.8 mm]	70 mph [31 m/s]

Note: For purposes of this Standard, ice may be ignored in the ¼" thickness zones

FIGURE A1-2e NORTHWEST REGION BASIC WIND SPEED WITH ICE V_i mph [m/s] and DESIGN ICE THICKNESS t_i inch [mm]

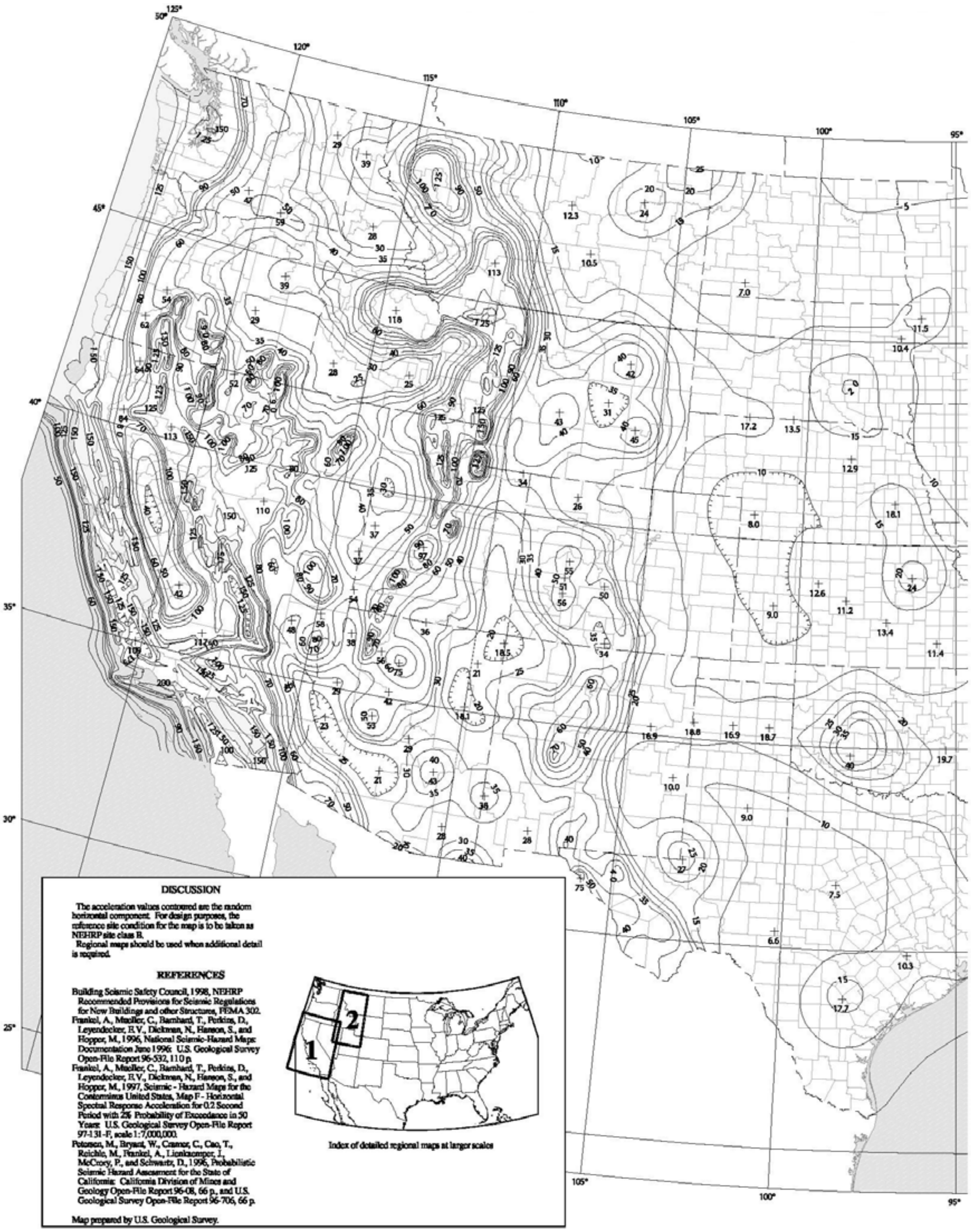


FIGURE A1-3a MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

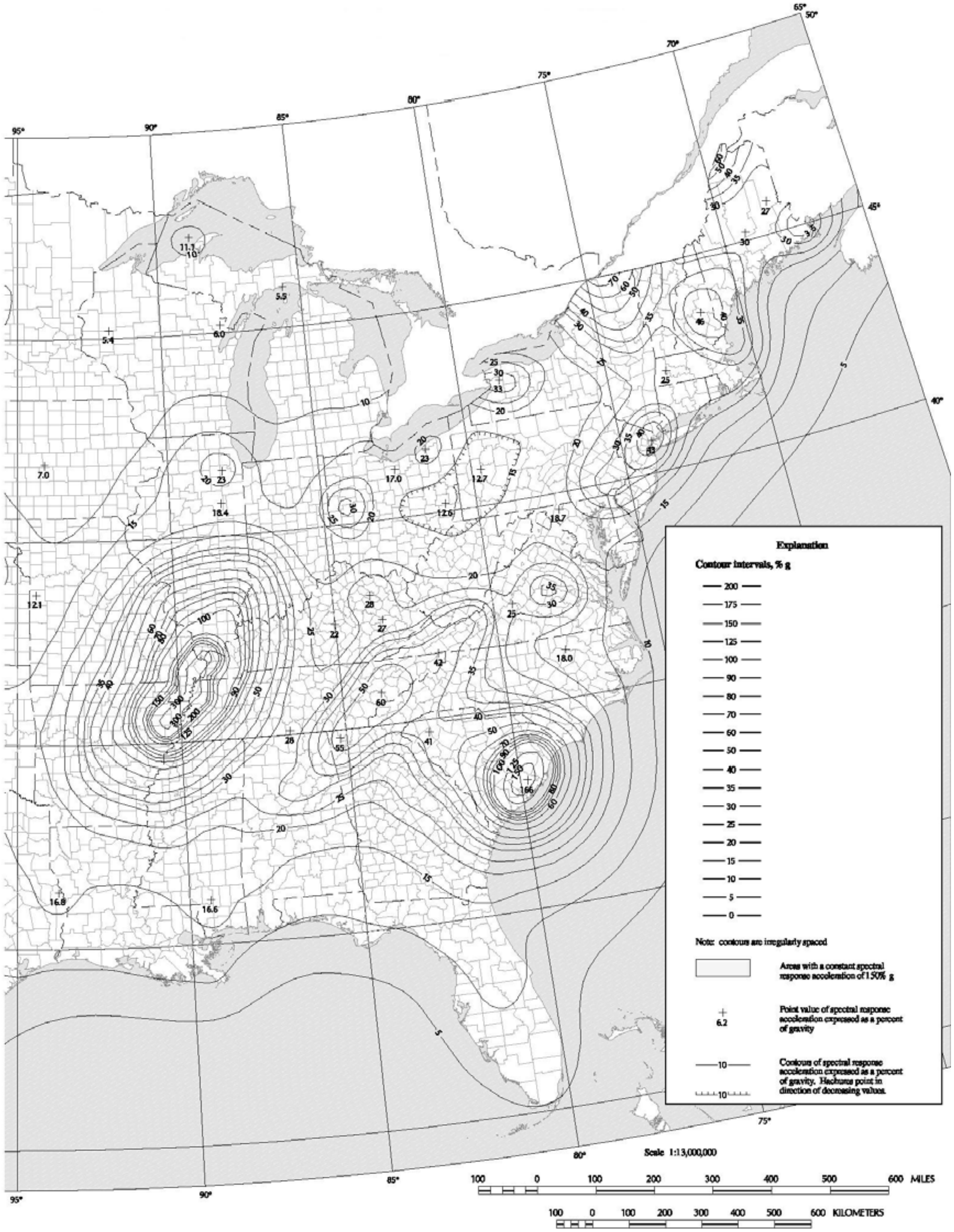


FIGURE A1-3b MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

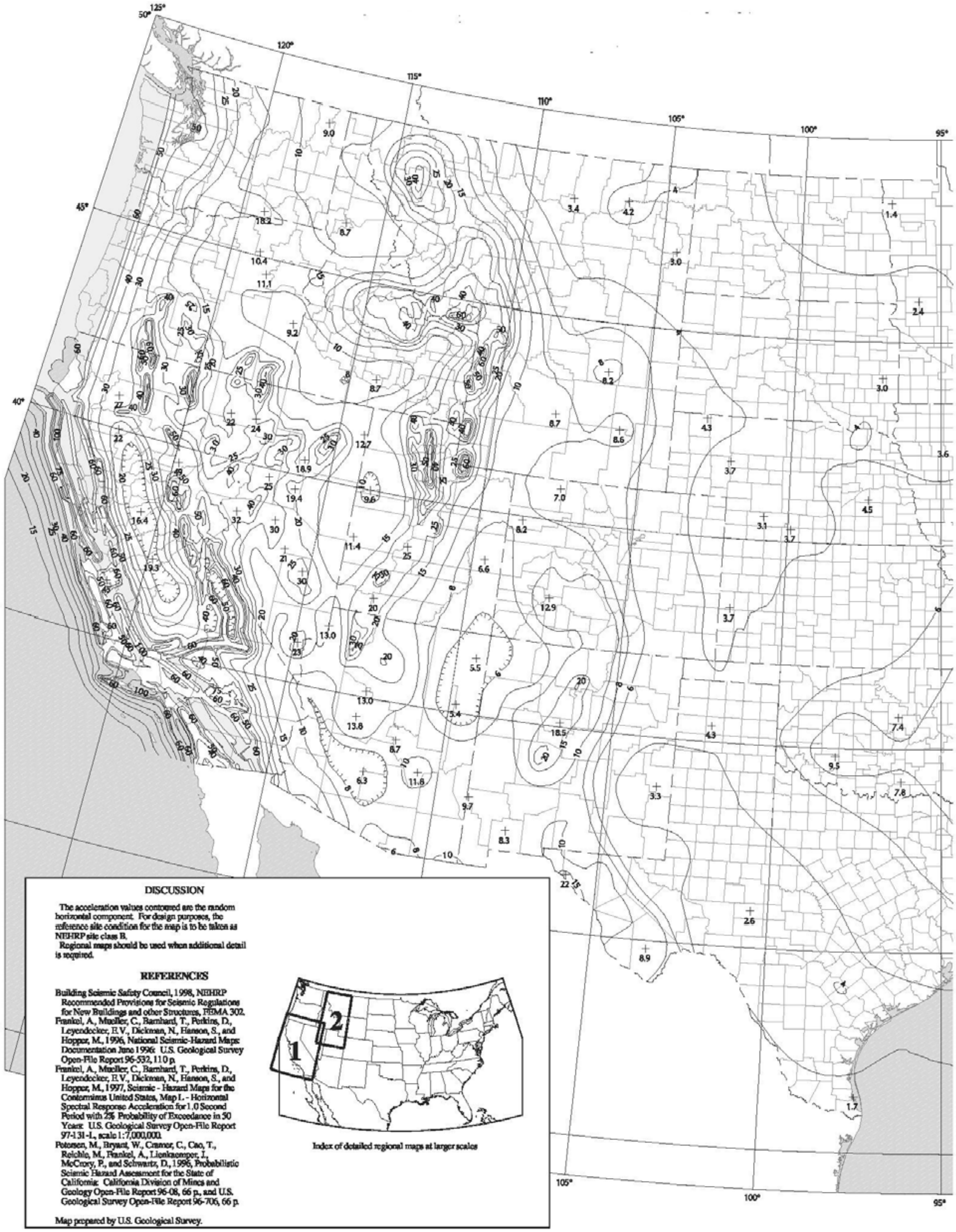


FIGURE A1-3c MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

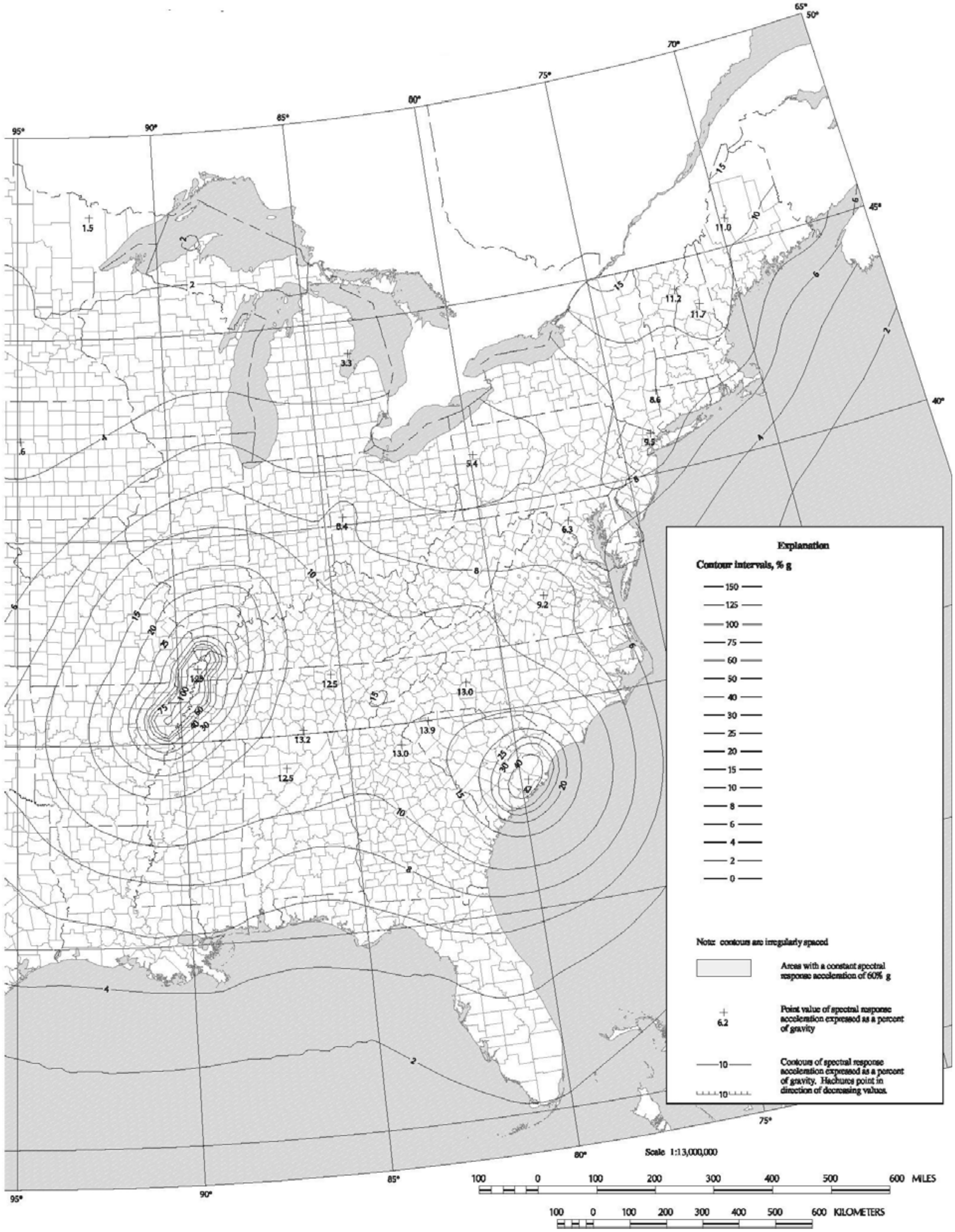


FIGURE A1-3d MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

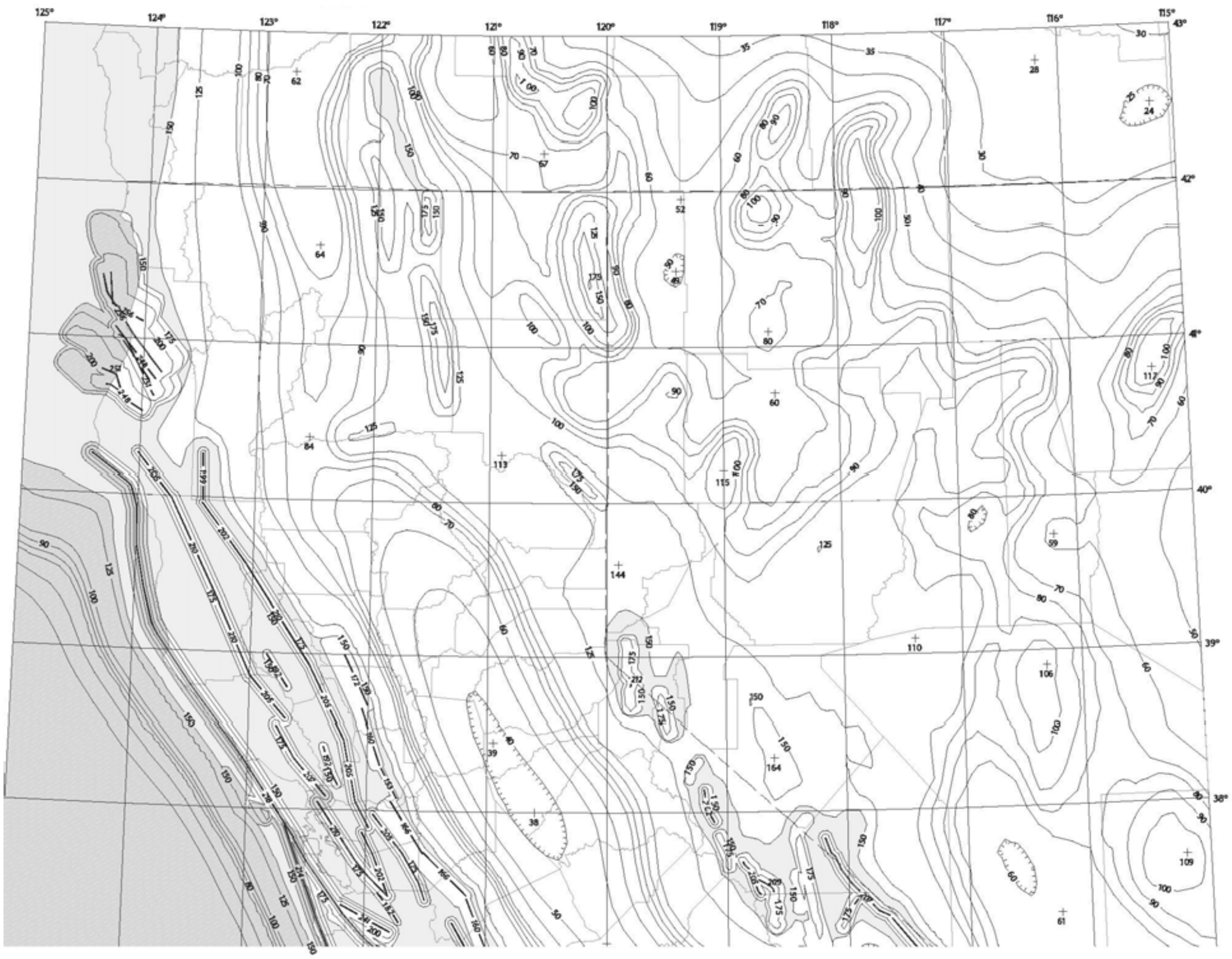


FIGURE A1- 3e NORTHERN PORTION OF REGION 1 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

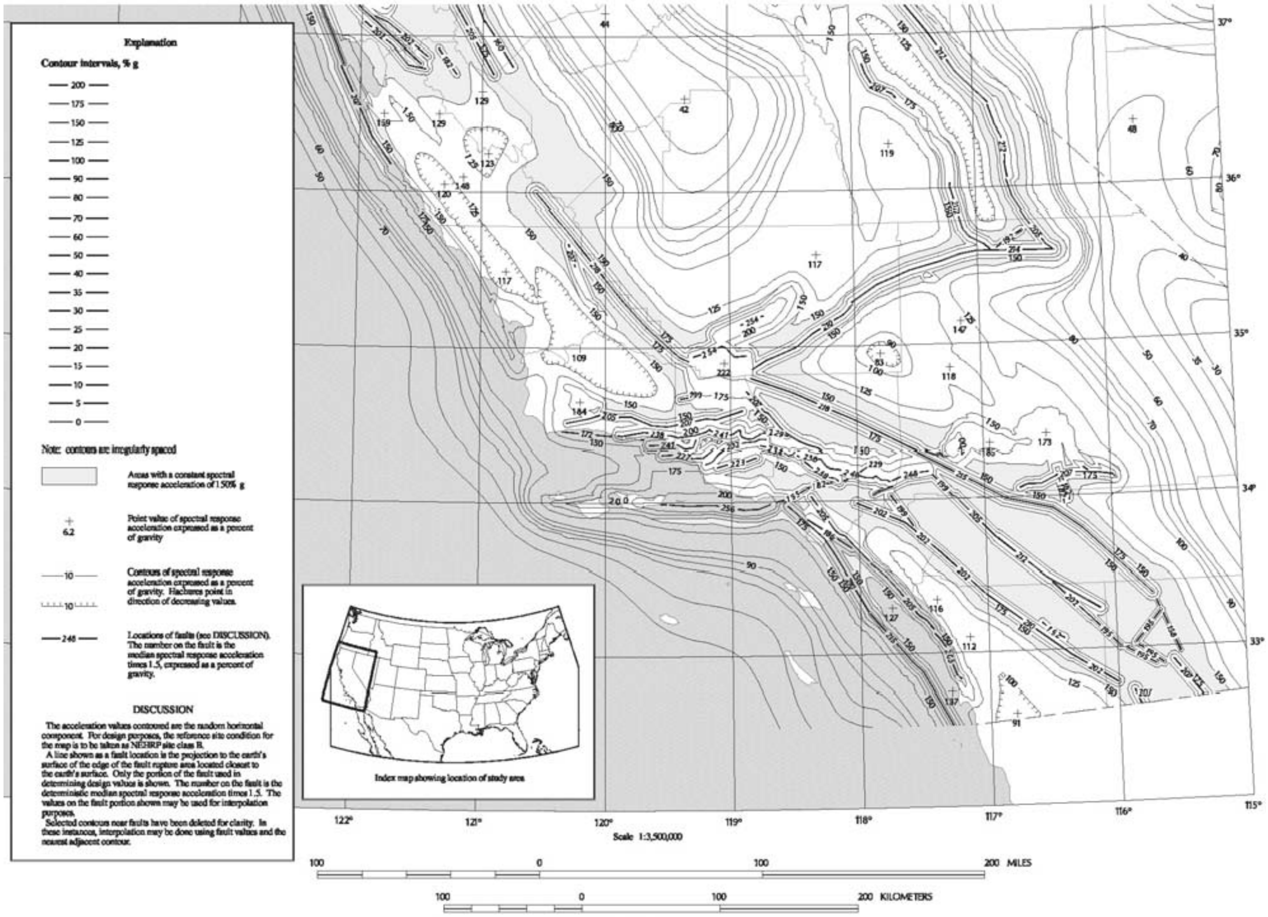


FIGURE A1- 3f SOUTHERN PORTION OF REGION 1 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

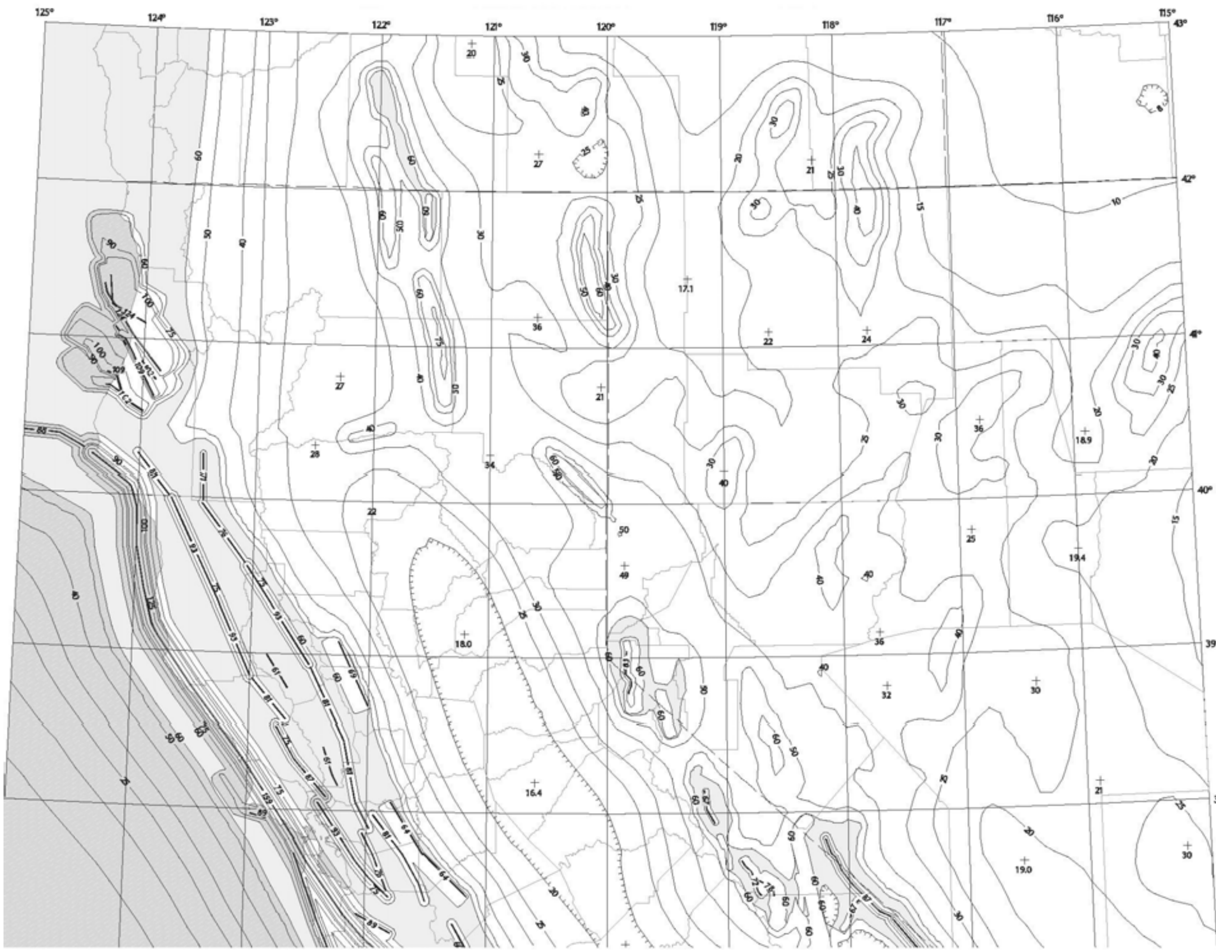


FIGURE A1- 3g NORTHERN PORTION OF REGION 1 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

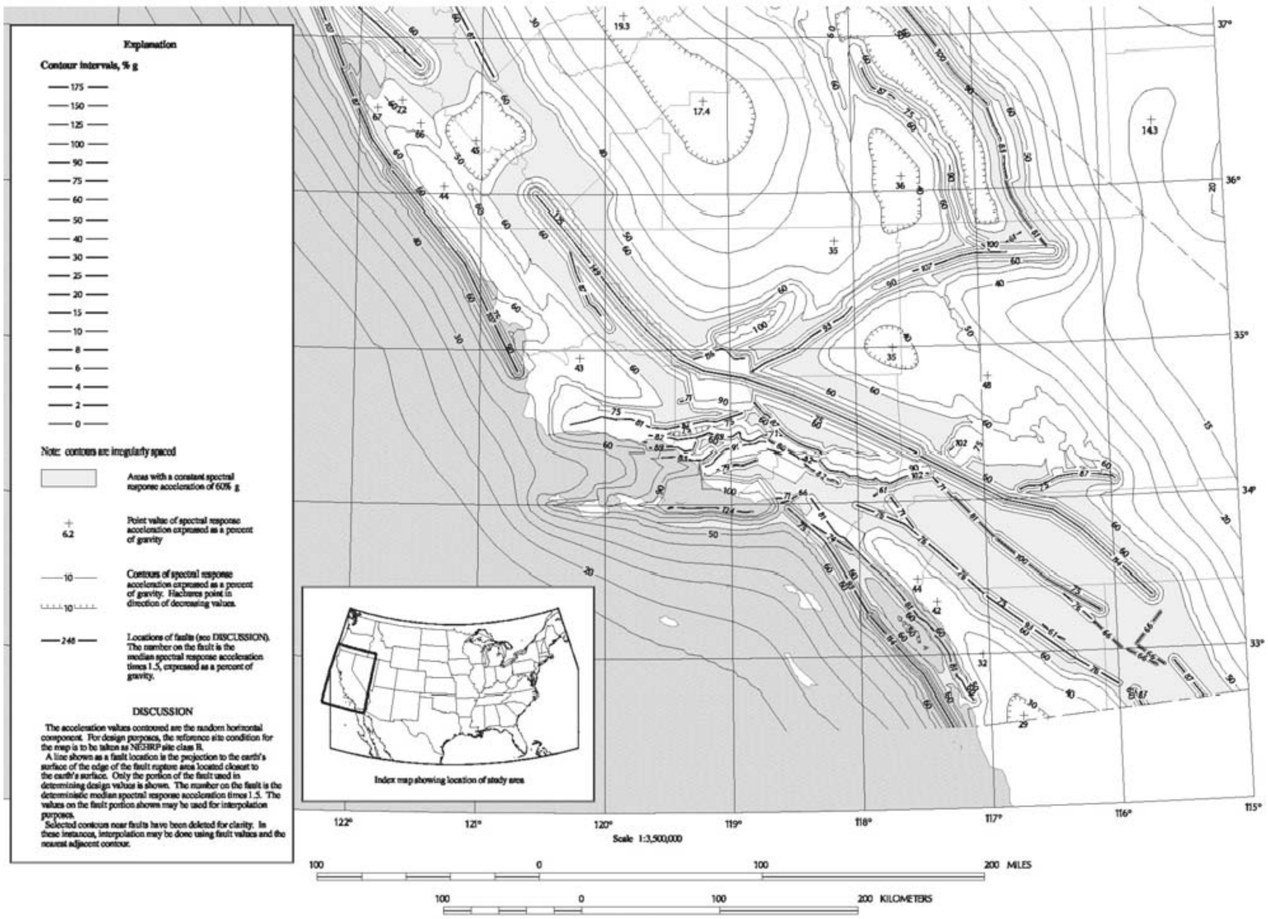


FIGURE A1- 3h SOUTHERN PORTION OF REGION 1 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

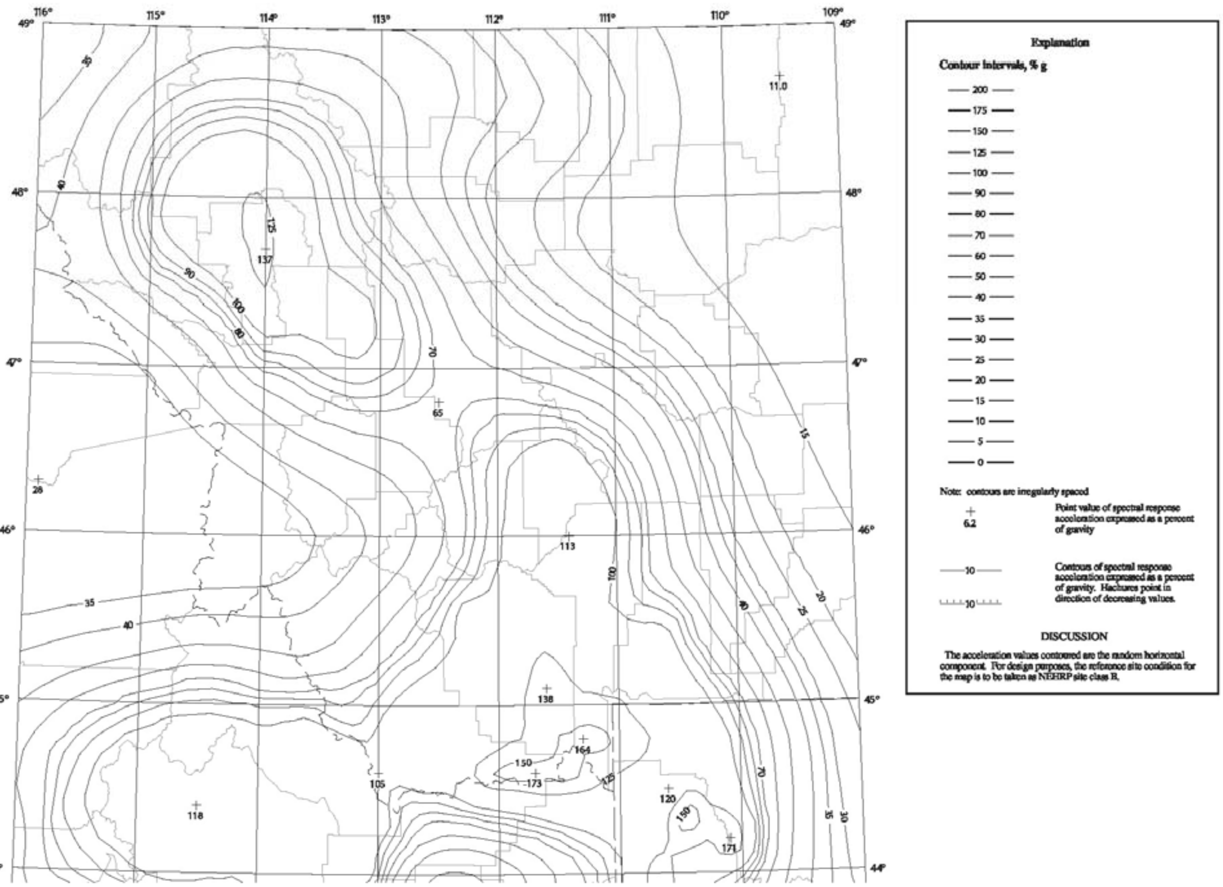


FIGURE A1- 3i NORTHERN PORTION OF REGION 2 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

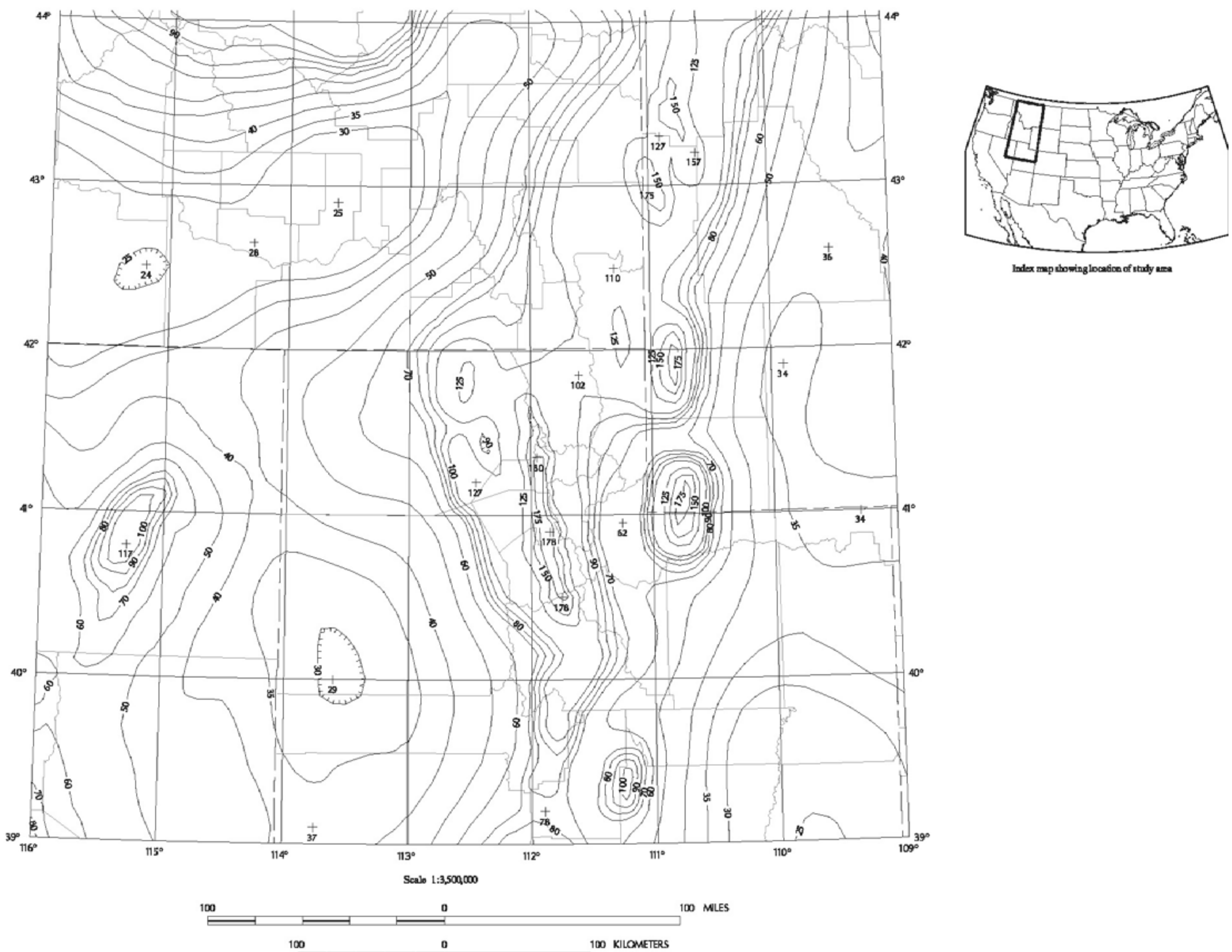


FIGURE A1- 3j SOUTHERN PORTION OF REGION 2 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

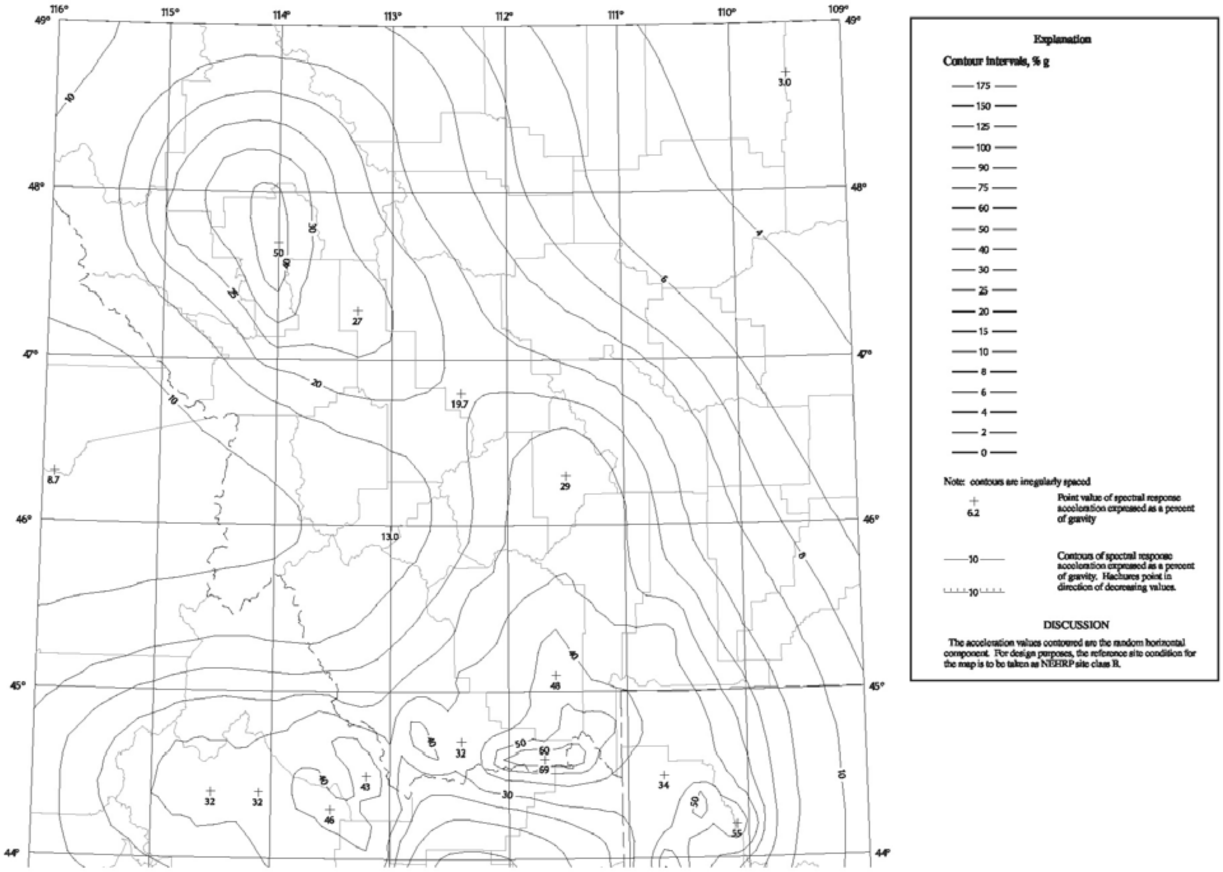


FIGURE A1- 3k NORTHERN PORTION OF REGION 2 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

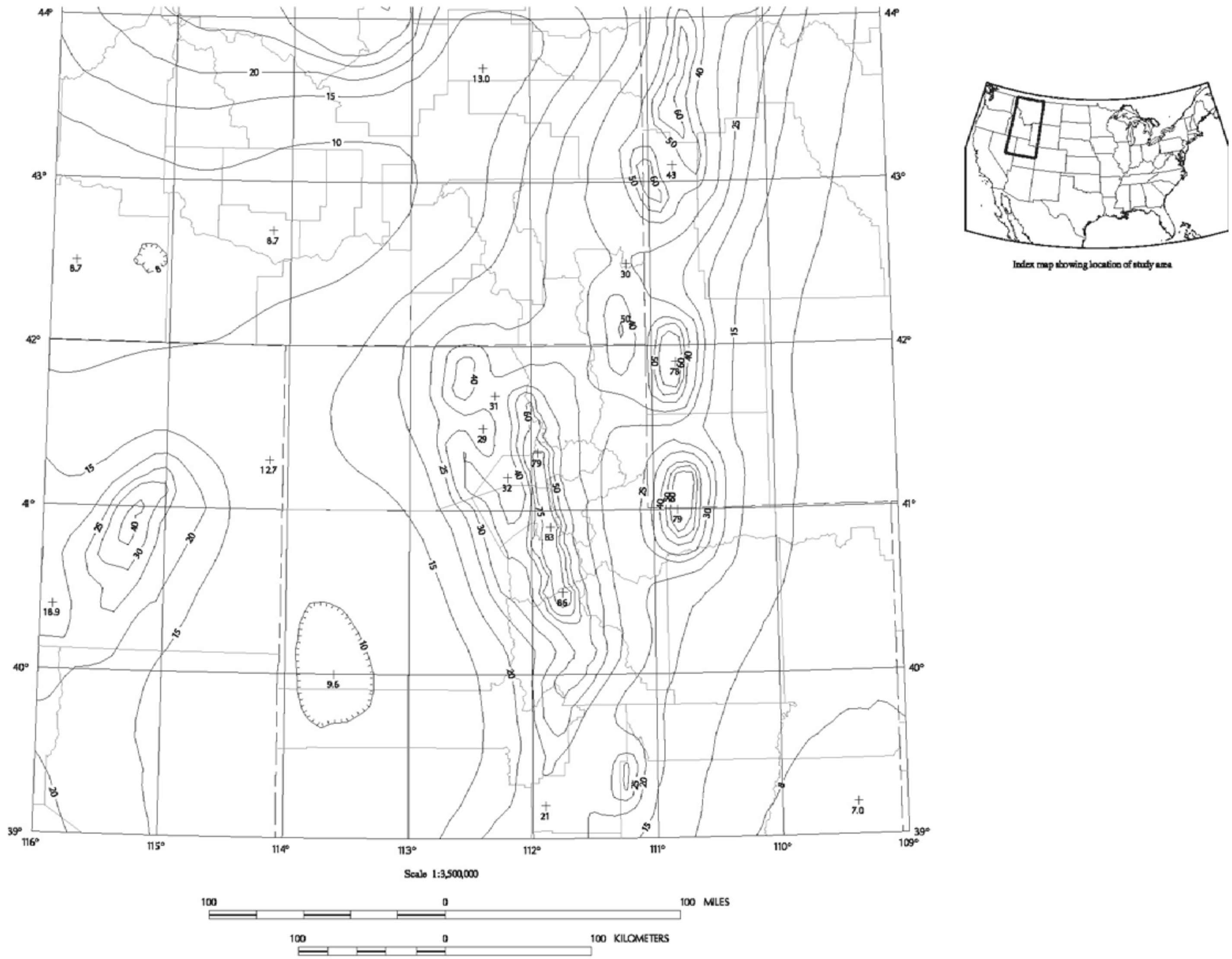


FIGURE A1- 3I SOUTHERN PORTION OF REGION 2 MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

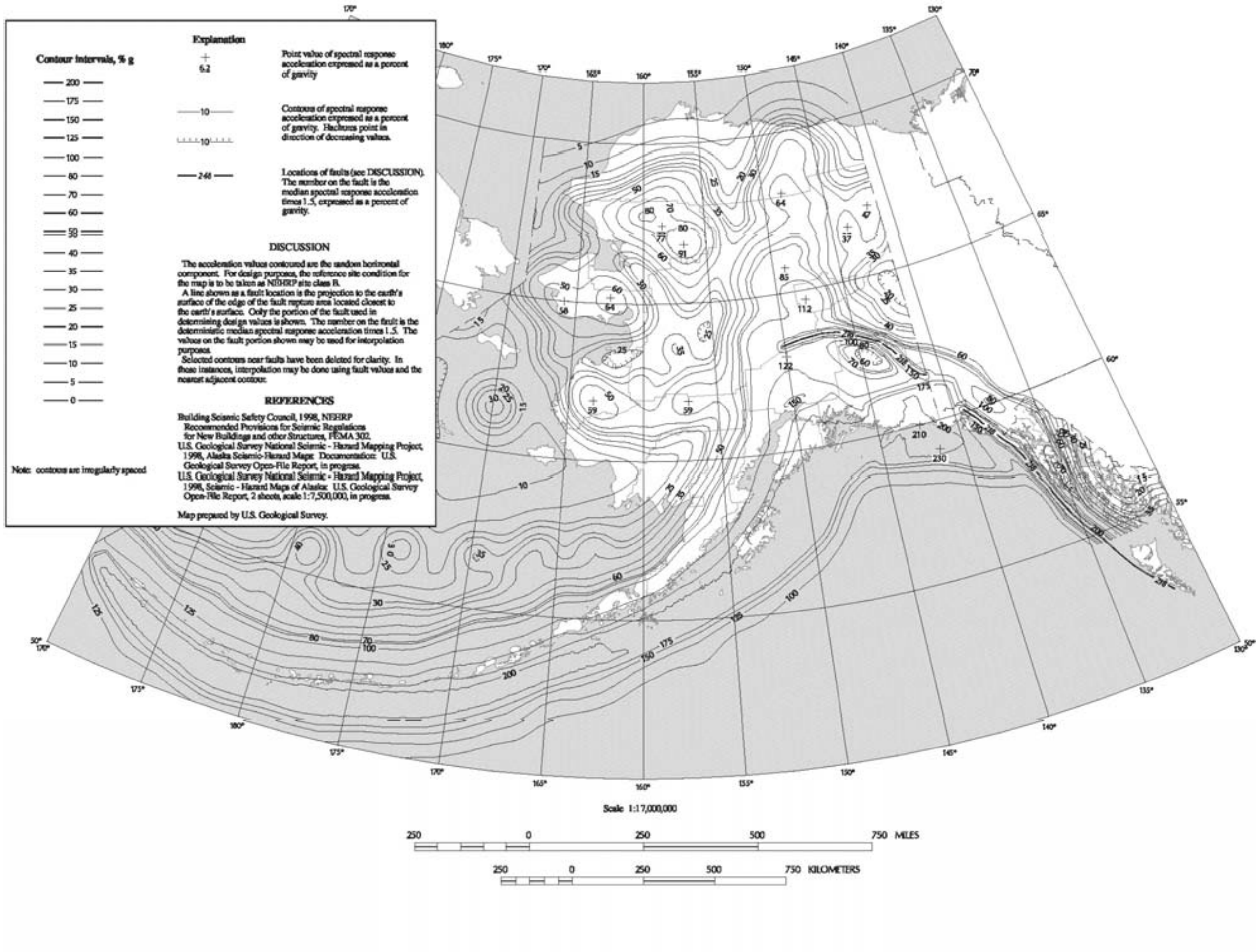


FIGURE A1- 3m MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

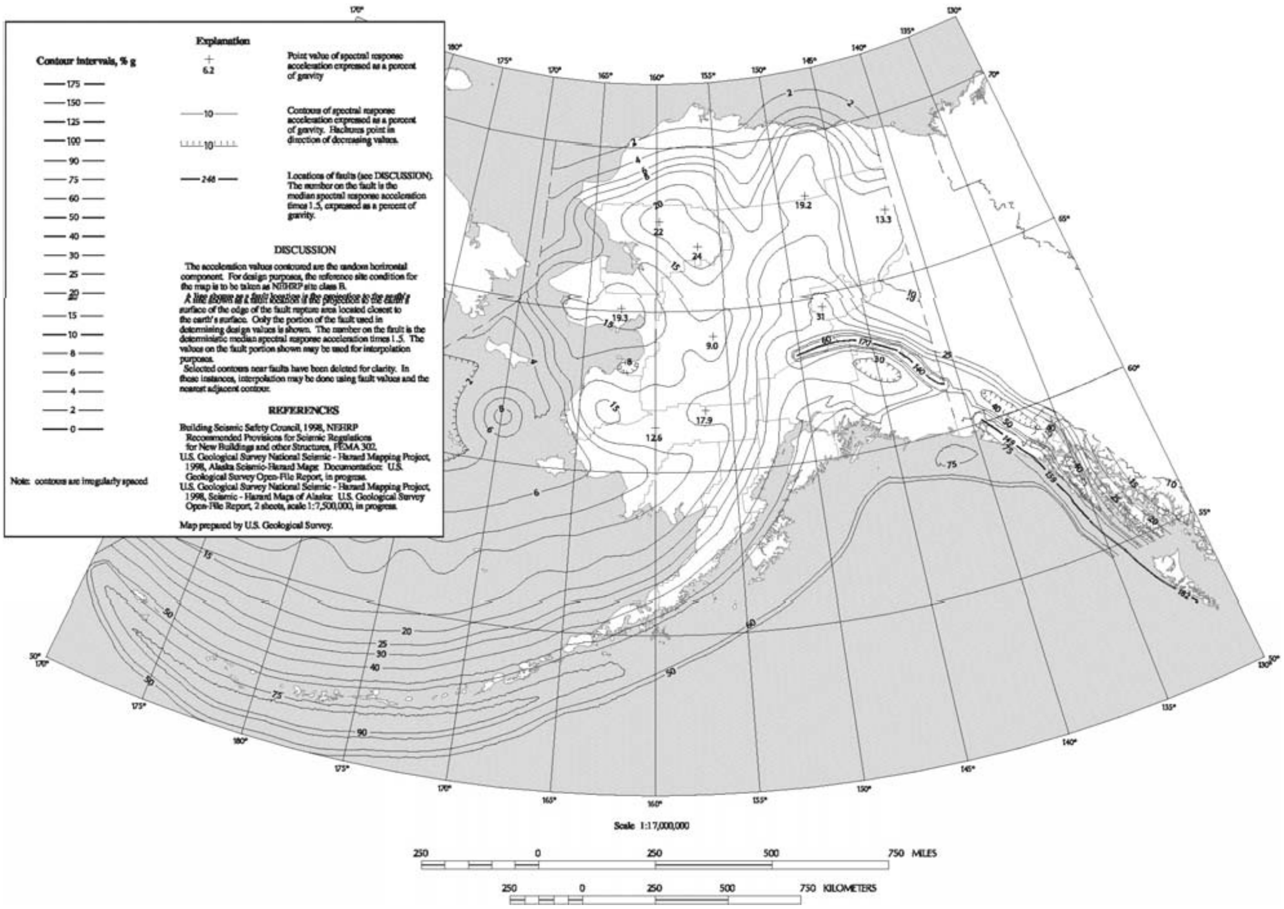


FIGURE A1- 3n MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

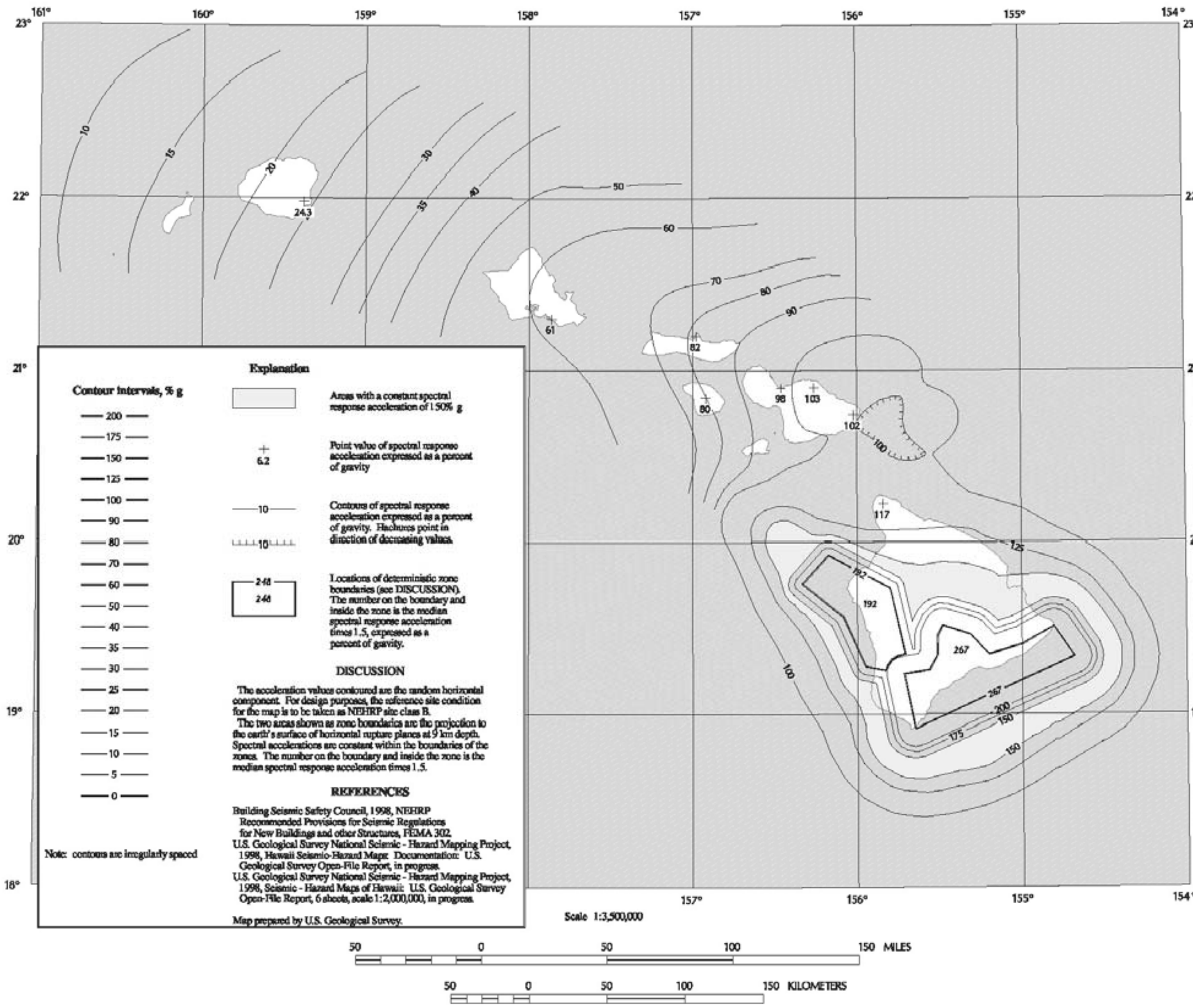


FIGURE A1- 3o MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)

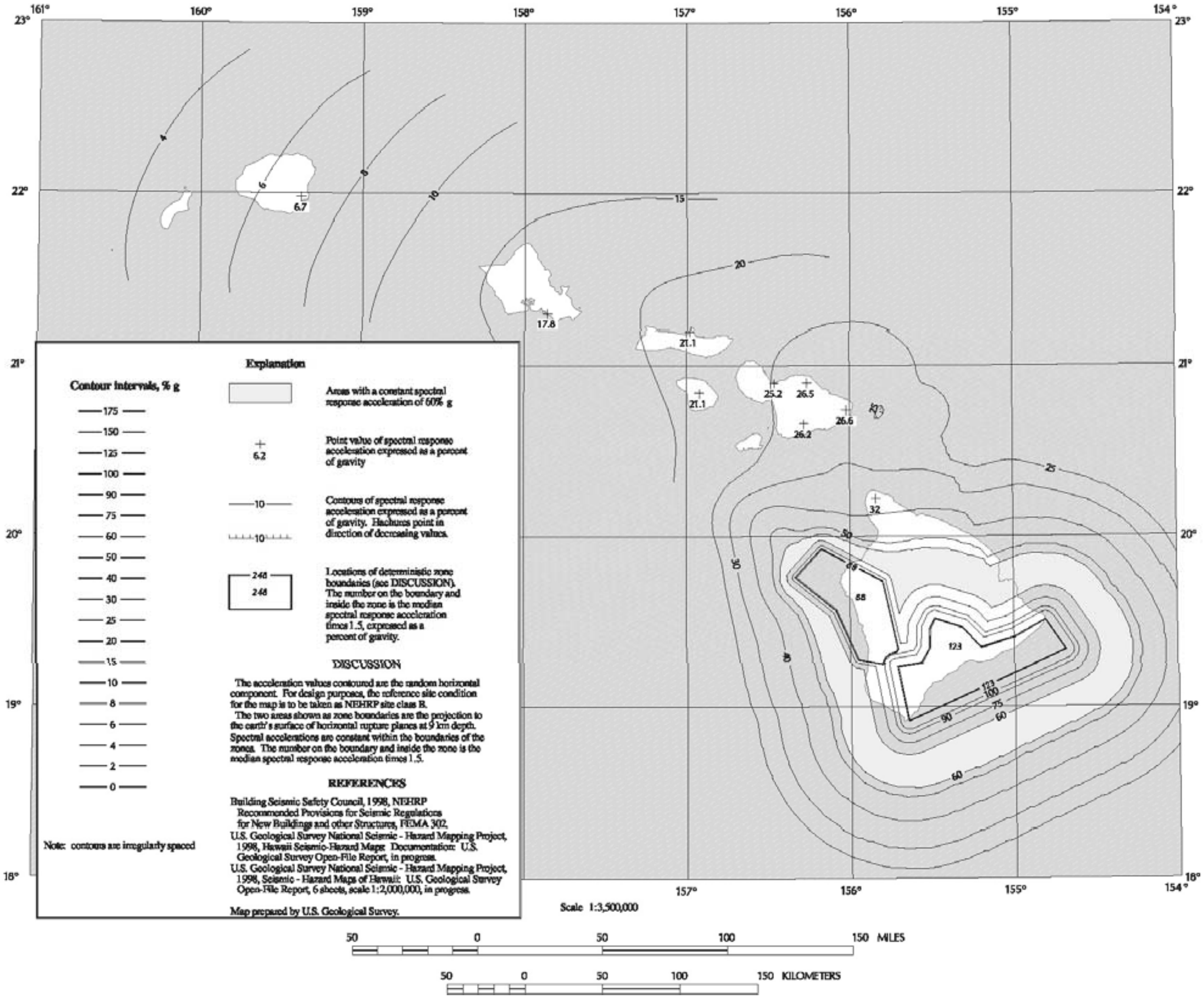


FIGURE A1- 3p MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT 1 SECOND (S_1)

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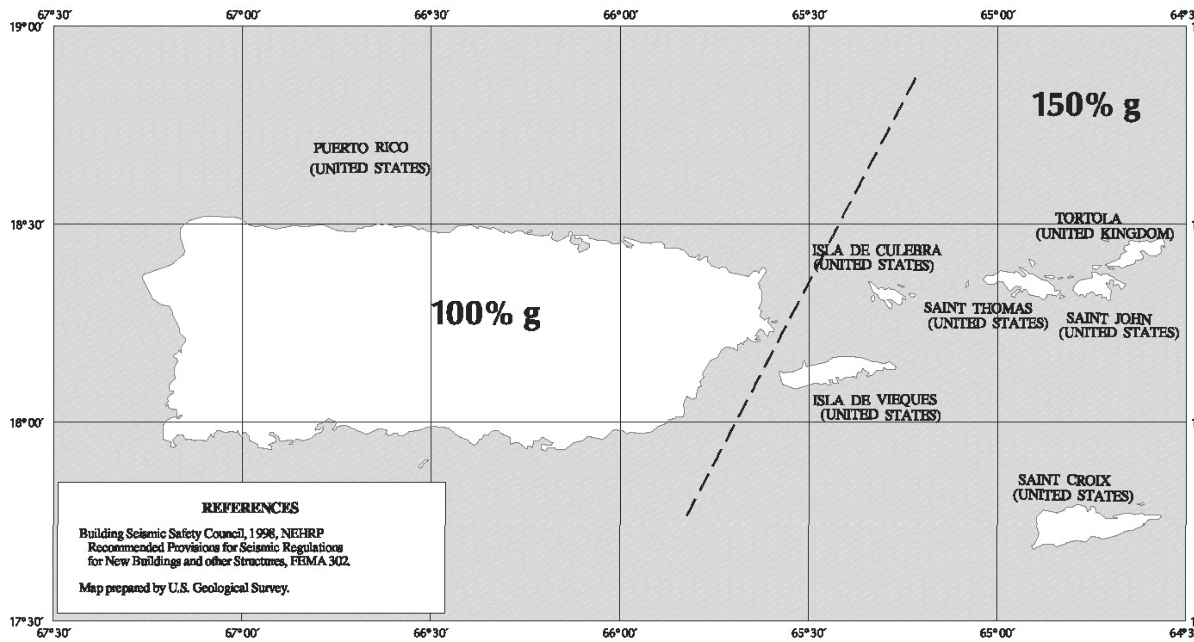
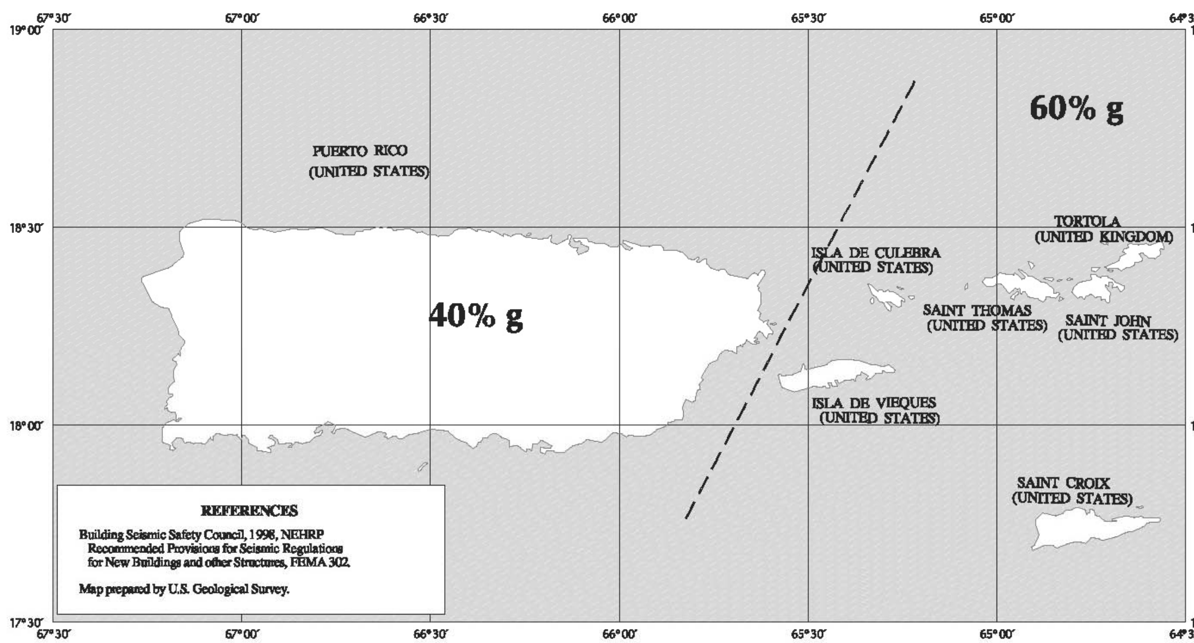


0.2 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING)



1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING)

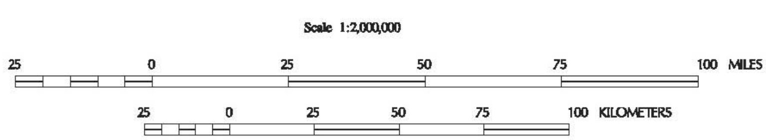
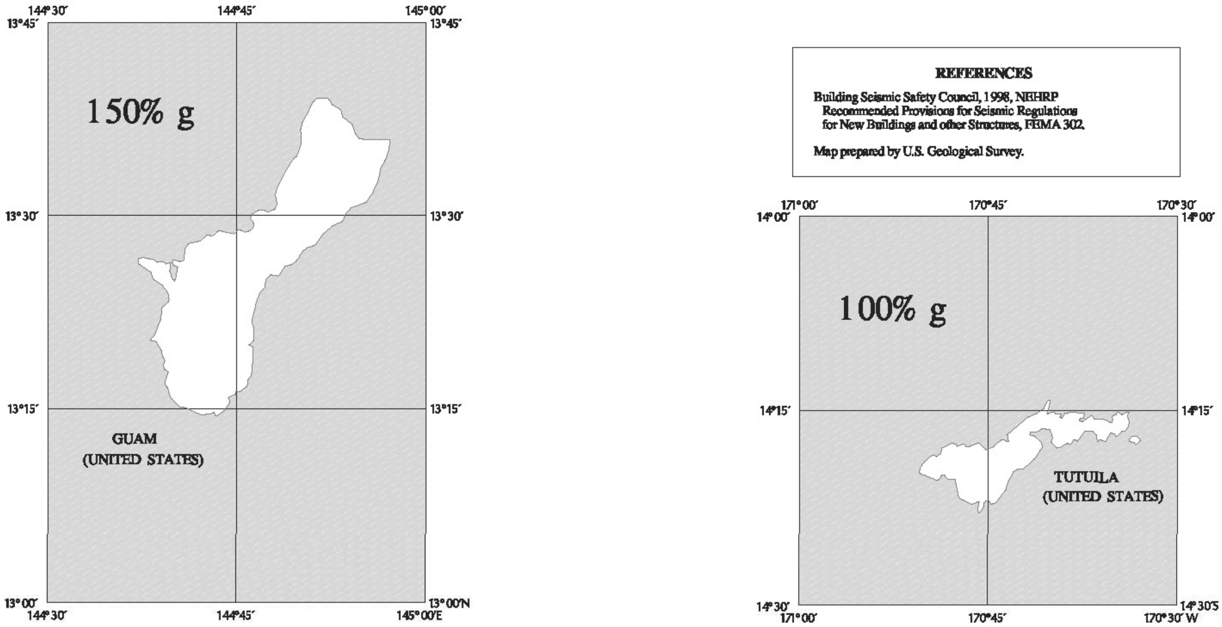
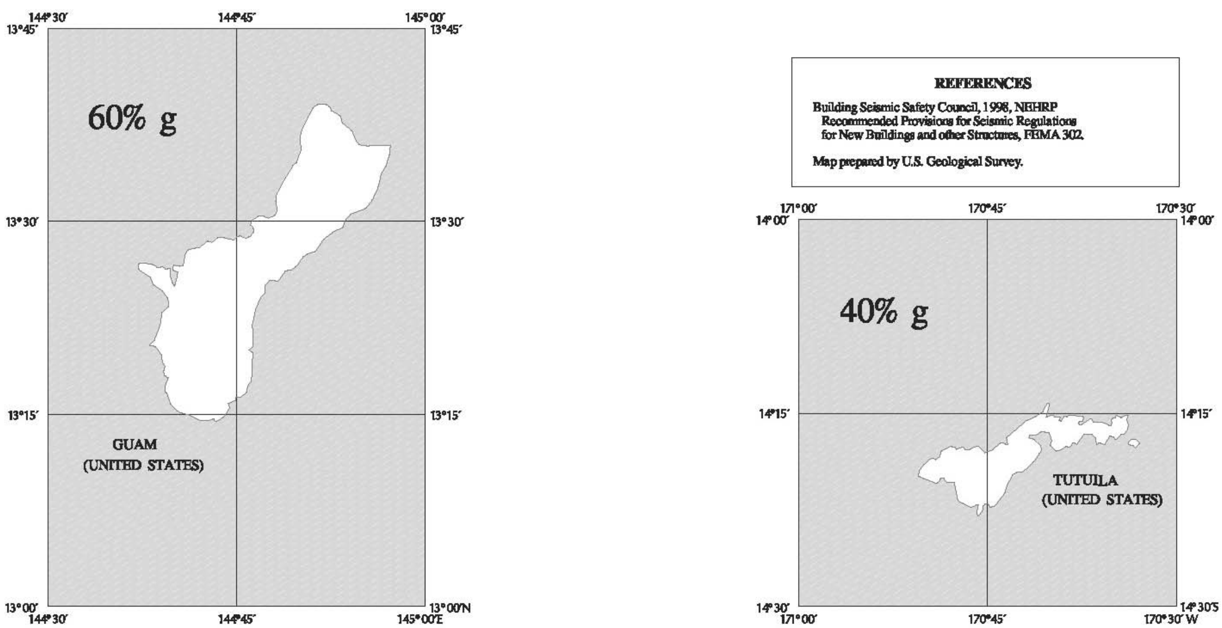


FIGURE A1- 3q MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S) AND AT 1 SECOND (S_1)



0.2 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING)



1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING)

Scale 1:1,000,000

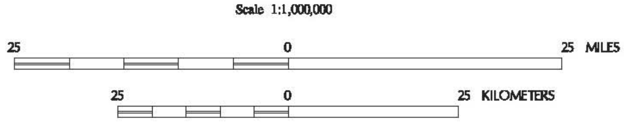


FIGURE A1- 3r MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S) AND AT 1 SECOND (S_1)

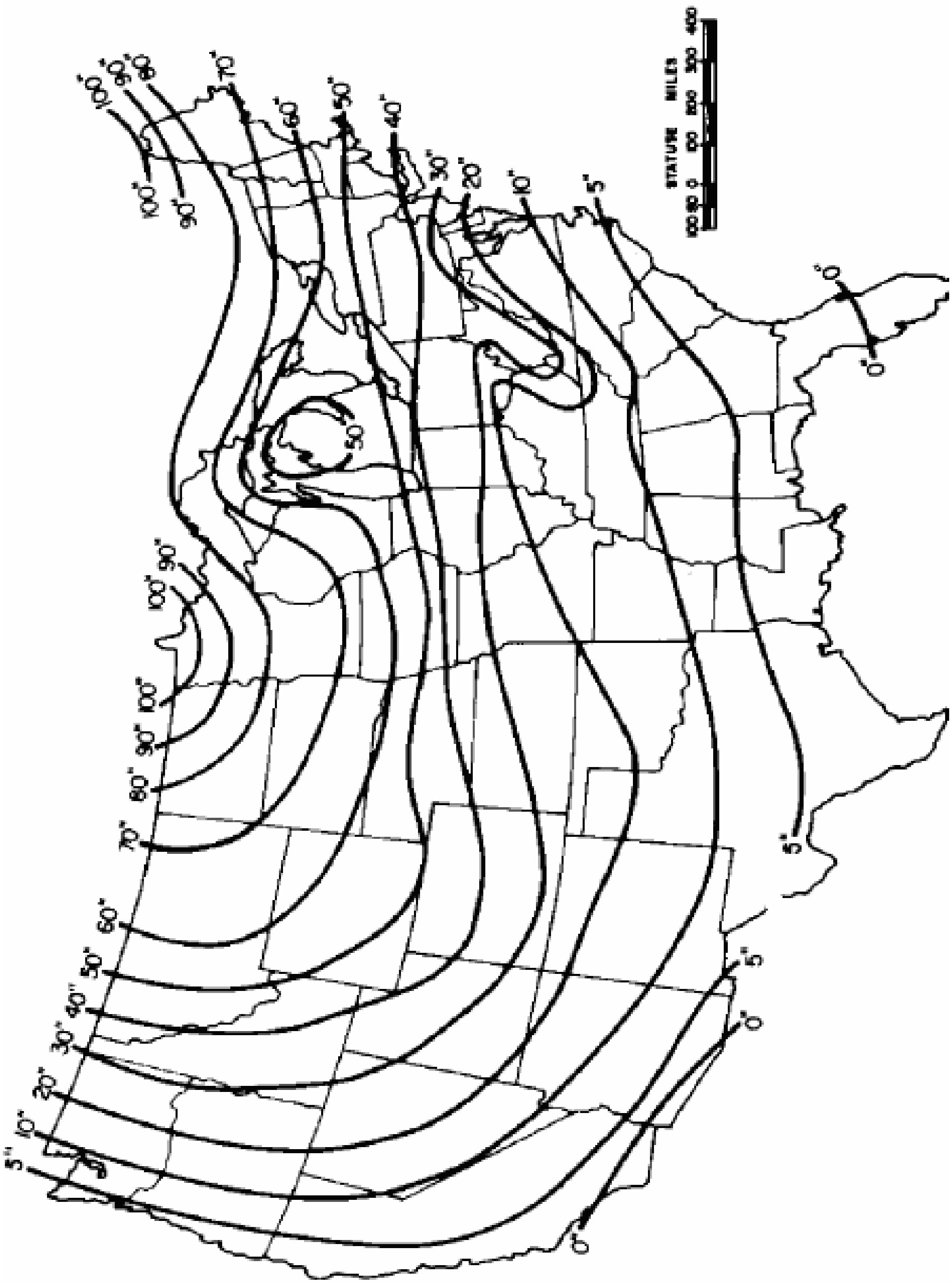


FIGURE A1- 4 DESIGN FROST DEPTH

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