Flood Resistant Design and Construction

This document uses both the International System of Units (SI) and customary units
American Society of Civil Engineers

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The 2014 edition has a number of significant technical revisions from the 2005 edition, including:

1. Defines Flood Design Class rather than using Risk/Occupancy Classification assigned under ASCE 7 and requires each building or structure governed by the standard to be assigned to Flood Design Class 1, 2, 3, or 4. Uses the assigned Flood Design Class to apply elevation requirements specified in Chapters 2, 4, 5, 6, and 7. Flood Design Class 4 buildings and facilities are equivalent to Occupancy Category/Risk Category IV buildings, which ASCE 7 identifies as essential facilities.
2. Adds definitions for Mixed Use and Residential Portions of Mixed Use in commentary to clarify limitations on use of dry floodproofing measures.
3. Changes the Coastal A Zone determination requirement from the designer’s responsibility to one depending on either: (1) delineation of a Limit of Moderate Wave Action (LiMWA) on a Flood Insurance Rate Map, or (2) designation by the Authority Having Jurisdiction.
4. Separates specifications for flood openings from the installation requirements. Requires the presence of louvers, blades, screens, faceplates, or other covers and devices to be accounted for in determining net open area for non-engineered openings and in determining the performance of engineered openings. Revises coefficient of discharge table for engineered flood openings. Adds commentary regarding selection of coefficient of discharge and for grouping or stacking of flood openings.
5. For Flood Design Class 4 buildings, requires the minimum lowest floor elevation (or floodproofing level of protection) to be the higher of the Base Flood Elevation plus freeboard specified in Chapters 2, 4, and 6, the Design Flood Elevation, or the 500-year flood elevation. The 500-year flood elevation requirement is new.
6. Clarifies text pertaining to alluvial fan high risk flood hazard areas.
7. In Coastal High Hazard Areas (V Zone) and Coastal A Zones (if delineated),
   a. Makes explicit that designs must account for local scour and erosion
   b. Provides for shallow foundations in Coastal A Zones under certain circumstances
   c. Requires flood openings in breakaway walls
   d. Eliminates orientation of the lowest horizontal structural member as a factor to determine elevation for lowest floors, equipment, and flood damage-resistant materials
   e. Requires exterior doors at the top of stairways that are located inside enclosed areas with breakaway walls
   f. Consolidates requirements for all nonstructural concrete slabs
   g. Allows substantial improvement of existing buildings seaward of the reach of mean high tide in V zones (makes ASCE 24 consistent with National Flood Insurance Program and Coastal A Zones).
8. Updates flood damage-resistant material requirements.
9. Clarifies emergency escape and rescue opening requirements for dry floodproofed buildings.
11. Consolidates requirements for tanks and more clearly distinguishes between requirements based on flood hazard area.
ACKNOWLEDGMENTS

The American Society of Civil Engineers (ASCE) acknowledges the work of the Flood Resistant Design and Construction Standard Committee of the Codes and Standards Activities Division of the Structural Engineering Institute. This group comprises individuals from many backgrounds including consulting engineering, research, construction, education, government, design, and private practice.

This standard was prepared through the consensus standards process by balloting in compliance with procedures of ASCE’s Codes and Standards Activities Committee. Those individuals who served on the ASCE 24-14 Standard Committee include

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## UNIT CONVERSIONS

<table>
<thead>
<tr>
<th>Measurement</th>
<th>S.I. Units</th>
<th>Customary Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abbreviations</strong></td>
<td>m = meter (S.I. base unit of length)</td>
<td>yd = yard</td>
</tr>
<tr>
<td></td>
<td>cm = centimeter</td>
<td>in. = inch</td>
</tr>
<tr>
<td></td>
<td>km = kilometer</td>
<td>mi = mile</td>
</tr>
<tr>
<td></td>
<td>ha = hectare</td>
<td>acre</td>
</tr>
<tr>
<td></td>
<td>L = liter (S.I. base unit of volume)</td>
<td>gal = gallon</td>
</tr>
<tr>
<td></td>
<td>mL = milliliter</td>
<td>qt = quart</td>
</tr>
<tr>
<td></td>
<td>kg = kilogram (S.I. base unit of mass)</td>
<td>lb = pound</td>
</tr>
<tr>
<td></td>
<td>g = gram</td>
<td>oz = ounce</td>
</tr>
<tr>
<td></td>
<td>N = Newton (m·kg·s⁻²)</td>
<td>lbf = pound-force (lb/ft)</td>
</tr>
<tr>
<td></td>
<td>Pa = Pascal (N/m²)</td>
<td>psi = pounds per square inch</td>
</tr>
<tr>
<td></td>
<td>kPa = kilopascal</td>
<td>atm = atmosphere</td>
</tr>
<tr>
<td></td>
<td>J = Joule</td>
<td>ft-lbf = feet per pound-force</td>
</tr>
<tr>
<td></td>
<td>W = watt</td>
<td>Btu = British thermal unit</td>
</tr>
<tr>
<td></td>
<td>kW = kilowatt</td>
<td>hp = horsepower</td>
</tr>
<tr>
<td></td>
<td>s = second (S.I. base unit of time)</td>
<td>h = hour</td>
</tr>
<tr>
<td></td>
<td>min = minute</td>
<td>day</td>
</tr>
<tr>
<td></td>
<td>°C = degrees Celsius</td>
<td>°F = degrees Fahrenheit</td>
</tr>
<tr>
<td></td>
<td>ppm = parts per million</td>
<td>ppm = parts per million</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>1 m = 3.2808 ft = 1.0936 yd</td>
<td>1 ft = 0.333 yd = 0.3048 m</td>
</tr>
<tr>
<td></td>
<td>1 cm = 0.3937 in.</td>
<td>1 in. = 2.54 cm</td>
</tr>
<tr>
<td></td>
<td>1 km = 0.6214 mile</td>
<td>1 mile = 0.869 nautical mile</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>1 m² = 10.7643 ft²</td>
<td>1 ft² = 0.0929 m²</td>
</tr>
<tr>
<td></td>
<td>1 km² = 0.3861 mi²</td>
<td>1 mi² = 2.59 km²</td>
</tr>
<tr>
<td></td>
<td>1 ha = 2.4710 acre</td>
<td>1 acre = 43,560 ft²</td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>1 L = 0.2642 gal</td>
<td>1 gal = 4 qt = 3.7854 L</td>
</tr>
<tr>
<td></td>
<td>1 ml = 1 cm³</td>
<td>1 ft³ = 7.481 gal</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>1 g = 0.0353 oz</td>
<td>1 oz = 28.3495 g</td>
</tr>
<tr>
<td></td>
<td>1 kg = 2.2046 lb</td>
<td>1 lb = 453.592 g</td>
</tr>
<tr>
<td><strong>Force</strong></td>
<td>1 N = 0.2248 lbf/ft</td>
<td>1 lbf = 4.4482 N</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td>1 kg/m³ = 0.2480 lb/ft³</td>
<td>1 lb/ft³ = 0.8345 kg/m³</td>
</tr>
<tr>
<td></td>
<td>1 g/cm³ = 6.2427 lb/ft³</td>
<td>1 lb/ft³ = 10.062 N/m³</td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td>1 kPa = 0.145 psi</td>
<td>1 atm = 14.7 psi</td>
</tr>
<tr>
<td><strong>Energy and Power</strong></td>
<td>1 J = 1.00 W·s = 0.7376 ft-lbf</td>
<td>1 lbf·ft = 1.3558 J</td>
</tr>
<tr>
<td></td>
<td>1 kJ = 2777.8 W·h = 9488 Btu</td>
<td>1 Btu = 1.0551 kJ</td>
</tr>
<tr>
<td></td>
<td>1 W = 0.7376 ft-lbf/s = 3.4122 Btu/h</td>
<td>1 ft-lbf/s = 1.3558 W</td>
</tr>
<tr>
<td></td>
<td>1 kW = 1,3410 hp</td>
<td>1 hp = 550 ft-lbf/s</td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td>1 L/s = 15.85 gal/min = 2.119 ft³/min</td>
<td>1 gal/min = 0.1337 ft³/min = 0.0631 L/s</td>
</tr>
<tr>
<td><strong>Concentration</strong></td>
<td>mg/L = ppmₗ (in dilute solutions)</td>
<td></td>
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