BSR/ASHRAE Addendum a
to ANSI/ASHRAE Standard 160-2016

Public Review Draft

Proposed Addendum a to Standard 160-2016, Criteria for Moisture-Control Design Analysis in Buildings

First Public Review (April 2021)
(Draft shows Proposed Changes to Current Standard)

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FOREWORD

This addendum revises the definition of the moisture-design reference year in Sections 3.1 and 4.5 as indicated below and adds a related evaluation criterion in Section 6. Since the publication of Standard 160, ASHRAE Research Project 1325-RP, "Environmental Weather Loads for Hygrothermal Analysis and Design of Buildings," was completed. This research project analyzed several existing weather year selection methods, including the 10th percentile warm and cold years currently used by Standard 160, and showed that the existing methods were not successful in correctly ranking the severity of weather years for hygrothermal analysis. The project developed a new method of ranking weather years that was found to be consistently successful. This addendum will bring the standard in line with these research results, incorporating the new weather years and removing the old.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum a to 160-2016

Revise Section 3.1 as follows.

3.1 Definitions

***~~Moisture design reference years~~ Moisture design reference year*:** the ~~10th-percentile warmest and 10th-percentile coldest years~~93rd percentile year in severity index for hygrothermal performance from ~~a 30-year weather~~ an analysis of 30 years of weather data (see Section 4.5.1 and Equation 4-7[B-3]).

Revise Section 4.5 as follows.

4.5 Moisture Design Weather Data. The analysis shall be performed using Section 4.5.1 or Section 4.5.2, ~~The analysis shall be performed using a minimum of ten consecutive years of weather data or using the moisture-design reference years weather data. The~~ and the weather data shall include hourly data for the following:

a. Dry-bulb air temperature
b. Vapor pressure, dew-point temperature, wet-bulb temperature, relative humidity, or humidity ratio
c. Total solar insolation on a horizontal surface
d. Average wind speed ~~and direction~~
e. Average wind direction~~Rainfall~~
f. Rainfall~~Cloud index~~
g. Cloud index

4.5.1 Moisture Design Reference Year. This analysis shall be performed using the moisture design reference year selected from 30 years of hourly weather data according to the method below[B-3].

1. Calculate annual average values of the following weather parameters for each year:
   a. Dry-bulb temperature T_o, °C (°F)
   b. Relative humidity ϕ, where $0 \le \phi \le 1$
   c. Cloud index I_{cl}, where $0 \le I_{cl} \le 8$
   d. Vapor pressure p_v, Pa (in. Hg). If vapor pressure is included in the hourly weather data, then take the average over the year. If vapor pressure is not included, then calculate vapor pressure for every hour using temperature and relative humidity and then take the average over the year.
   e. Solar radiation E_v, W/m^2 [Btu/(ft^2·h)], on the wall with orientation receiving the least solar radiation. (*Informative Note*: For locations in the northern hemisphere, take solar radiation on a north-facing wall. For locations in the southern hemisphere, take solar radiation on a south-facing wall.)
   f. Wind-driven rain r_{wd}, kg/(m^2·h) [lb/(ft^2·h)], on the wall with orientation specified below, calculated according to Equation 4-6:

$$r_{wd} = C \cdot U \cdot r_h^{0.88} \cdot cos\theta \qquad (4\text{-}6)$$

where

C = empirical constant, 0.222 (SI), 0.350 (I-P)
U = hourly average wind speed at 10 m (33 ft) above ground level, m/s (mi/h)
r_h = rainfall intensity on a horizontal surface, mm/h (in./h)
θ = angle between wind direction and normal to the wall

For locations in the northern hemisphere, take wind-driven rain on a north-facing wall. For locations in the southern hemisphere, take wind-driven rain on a south-facing wall. For locations at or near the equator, select north or south on the basis of which has the higher wind-driven rain.

2. Calculate the severity index I_{sev} for each year according to Equation 4-7:

$$I_{sev} = 108307 - 241 \cdot E_v - 1391 \cdot I_{cl} - 312326 \cdot \phi + 183308 \cdot r_{wd} + 15.2 \cdot p_v + 27.3 \cdot T_o^2 + 261079 \cdot \phi^2 - 0.00972 \cdot p_v^2 \qquad (4\text{-}7a)\ (SI)$$

$$I_{sev} = 116935 - 760.2 \cdot E_v - 1391 \cdot I_{cl} - 312326 \cdot \phi + 894543 \cdot r_{wd} + 51473 \cdot p_v - 539.3 \cdot T_o + 8.426 \cdot T_o^2 + 261079 \cdot \phi^2 - 111466 \cdot p_v^2 \qquad (4\text{-}7b)\ (I\text{–}P)$$

3. Rank the weather years in order of ascending severity index.

4. The moisture design reference year shall be the year with severity index corresponding to the 93rd percentile, which is the year with the second highest severity index in a 30-year period.

4.5.2 Weather Data. This analysis shall be performed using a minimum of 10 consecutive years of hourly meteorological weather data.

Revise Section 6 as follows.

6. MOISTURE PERFORMANCE EVALUATION CRITERIA

~~This s~~Sections 6.1, 6.2, and 6.3 set~~s~~ performance criteria that shall be met to minimize the undesirable effects of moisture in a building or building envelope[B-21]. These criteria apply to all materials and surfaces except the exterior surface of the building envelope. The analysis shall be performed for a minimum of two orientations: the orientation with the highest amount of annual wind-driven rain, calculated according to Equation 4-6; and the orientation with the least annual solar radiation. Analysis of additional orientations shall be optional.

6.1 Moisture Accumulation Criteria. This section shall apply if the moisture-design reference year is used in the analysis in accordance with Section 4.5.1. Moisture accumulation shall be analyzed for a minimum of five consecutive moisture-design reference years, not to exceed 10 years. The maximum total moisture content of the assembly in the final year of analysis shall be equal to or less than that of the prior year.

Exception: An alternate analysis shall be permitted in accordance with accepted engineering practice. The alternate analysis method, justification, and the results shall be reported. The analysis results of Section 6.1 shall also be reported.

6.2 Conditions Necessary to Minimize Mold Growth.
(No changes to this section other than revising the section number from 6.1 to 6.2.)

~~6.2~~6.3 Corrosion.
(No changes to this section other than revising the section number from 6.2 to 6.3.)

Revise Section 7 as follows.

7. REPORTING

7.3 g. Moisture Design Weather ~~d~~Data: ~~(Moisture Design Reference Year or 10 years consecutive) (Section 4.5)~~ Moisture Design Reference Year (See Section 4.5.1) or Weather Data (See Section 4.5.2). If Section 4.5.2 is used, report the specific years used and data source.

Revise Informative Annex B, Commentary on Standard 160, as follows.

[B-3]The source for the definition of "moisture-design reference ~~years~~year" is ~~IEA Annex 24, Heat, Air and Moisture Transfer in New and Retrofitted Insulated Envelope Parts (IEA 1996)~~ "RP-1325 -- Environmental Weather Loads for Hygrothermal Analysis and Design of Buildings" (Salonvaara 2011) (see Annex C, "Bibliography").

Revise Informative Annex C, Bibliography, as follows.

~~IEA. 1996. Annex 24, Heat, Air and Moisture Transfer in New and Retrofitted Insulated Envelope Parts. International Energy Agency, Leuven, Belgium.~~

Salonvaara, M. 2011. RP-1325 -- Environmental Weather Loads for Hygrothermal Analysis and Design of Buildings. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.