ADDENDA

ANSI/ASHRAE Addendum a to
ANSI/ASHRAE Standard 140-2020

Method of Test for Evaluating Building Performance Simulation Software

Approved by ASHRAE and the American National Standards Institute on August 31, 2022.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum a adds the test cases of Sections 5.6 of Standard 140 for testing the ability of whole-building energy simulation programs to read and process standard weather files. These provide both comparisons to the source weather file data and software-to-software comparative tests, where simulation results are compared to each other. The tested properties include psychrometric and solar radiation properties. The test cases were developed by a working group of ASHRAE Standing Standard Project Committee 140 (SSPC 140) and other international software developers and simulation-trial participants. Related project funding for development was provided by the U.S. Department of Energy.

Background

For the test cases in ASHRAE Standard 140-2020, it is assumed that the software being tested can adequately read and interpret the weather data in the provided standard weather files. As differences between the programs have been reduced, and as more programs have shifted to subhourly time steps, this assumption has become more stretched. In addition, as building thermal fabric design trends toward greater energy efficiency, the effects of the weather on the simulated performance of the building becomes more important when assessing sensitivity of thermal fabric design improvements on resulting overall building load. Thus, errors in the interpretation of the weather drivers become more significant. To address these concerns, a new test suite that evaluates the ability of building performance simulation software to read and interpret the data from a standard weather file is developed by this addendum. These test cases are designed to test the ability to read and process standard format weather data files. While a test suite that concerns reading and interpreting weather files seems quite basic, there are potential algorithmic differences among programs having to do with psychrometrics, sky models, trigonometry for tilted surfaces, and differences in how instantaneous weather file data are mapped into the corresponding hour. It is important to identify these differences so that they can be traced through to differences in other calculations.

Thermal Energy System Specialists, LLC, under contract with Argonne National Laboratory, led the collaborative effort to (a) develop the test specifications such that they would be unambiguous for the input structures of most whole-building energy simulation programs with time steps of one (1) hour or less, and (b) field test the specifications with a variety of different simulation programs and associated software development groups around the world to ensure their suitability as a standard method of test that can be integrated into ASHRAE Standard 140. The collaboration included a number of software developer members of SSPC 140 along with other international software developers and participants; see Informative Annex B11, Table B11-3.

The resulting weather drivers modeling test suite includes a set of six (6) test cases. The test cases are presented in Section 5.6 with parametric variations summarized in Tables B1-18 of Informative Annex B1. The addendum also includes updated informative example simulation results, which were vetted in simulation trials and are indicated in Informative Annex B8.

Summary of Changes in This Addendum

A listing of the substantive changes to Sections 5.6 and related sections, annexes, and accompanying electronic media follows (listed sections are normative unless otherwise indicated):

- *New Section 5.6 "Input Specification for Weather Drivers Tests." This is the major substantive portion of the addendum.*
- *Updated Section 6, "Class I Output Requirements," includes output requirements related to addition of Section 5.6.*
- *Updated Informative Section 4.3, "Organization of Test Cases," (overall Standard 140 road map) for consistency with addition of the Section 5.6 test cases.*
- *Updated Informative Section 4.4, "Comparing Output to Other Results," for addition of the Section 5.6 test cases example results.*
- *Updated Annex A1, "Weather Data," to include weather data used for Section 5.6.*
- *Updated Annex A2, "Standard Output Reports," to include updates related to the addition of the new results template Sec5-6out.XLSX.*

- *Updated the following informative annexes to include new information relevant for the update of Section 5.6:*
  - *B1, "Tabular Summary of Test Cases"*
  - *B8, "Example Results for Building Thermal Envelope and Fabric Load and Ground-Coupled Slab-On-Grade Tests of Section 5.2 and Weather Drivers Tests of Section 5.6"*
  - *B9, "Diagnosing the Results Using the Flow Diagrams"*
  - *B10, "Instructions for Working with Results Spreadsheets Provided with the Standard"*
  - *B11, "Production of Example Results for Building Thermal Envelope and Fabric Load and Ground-Coupled Slab-On-Grade Tests of Section 5.2 and Weather Drivers Tests of Section 5.6"*
- *Updated accompanying electronic files as called out in this addendum (See Readme 140-2020-A.DOCX with the accompanying electronic media located at www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda.)*

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum a to Standard 140-2020

Update the Contents section as shown. (Note: Some unaffected text is omitted for brevity.)

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[. . .]

Normative Annexes

Informative Annexes

Online Supporting Files: http://www.ashrae.org/XXXXXX

Modify Section 4 as shown. (Note: Some unaffected text is omitted for brevity.)

4.3 (*Informative*) Organization of Test Cases. The specifications for determining test case configurations and input values are provided on a case-by-case basis in Section 5 and Section 7. The test cases are divided into two separate test classes to satisfy various levels of software modeling detail. Such classification allows more convenient citation of specific sections of Standard 140 by other codes and standards and by certifying and accrediting agencies, as appropriate. The Class I test cases (Section 5) are detailed diagnostic tests intended for simulation software capable of hourly or subhourly simulation time steps. The Class II test cases (Section 7) may be used for all types of building load calculation methods, regardless of time-step granularity. The Class I (Section 5) test cases are designed for more detailed diagnosis of simulation models than the Class II (Section 7) test cases.

Weather information required for use with the test cases is provided as described in Normative Annex A1. Informative Annex B1 provides an overview for all the test cases and contains information on those building parameters that change from case to case; Annex B1 is recommended for preliminary review of the tests, but do not use it for defining the cases. Additional information regarding the meaning of the cases is shown in Informative Annex B9 on diagnostic logic. In some instances (e.g., Case 620, Section 5.2.2.1.2), a case developed from modifications to a given base case (e.g., Case 600 in Section 5.2.1) will also serve as the base case for other cases. The cases are grouped as follows:

a. Class I Test Procedures

1. Building Thermal Envelope and Fabric Load Tests (see Section 4.3.1.1)
   i. Building Thermal Envelope and Fabric Load Base Case (see Section 4.3.1.1.1)
   ii. Building Thermal Envelope and Fabric Load Basic Tests (see Section 4.3.1.1.2)
      (a) Low mass (see Section 4.3.1.1.2.1)
      (b) High mass (see Section 4.3.1.1.2.2)
      (c) Free float (see Section 4.3.1.1.2.3)
   iii. Building Thermal Envelope and Fabric Load In-Depth Tests (see Section 4.3.1.1.3)
   iv. Ground-Coupled Slab-on-Grade Analytical Verification Tests (see Section 4.3.1.1.4)
2. Space-Cooling Equipment Performance Analytical Verification Tests (see Section 4.3.1.2)
   i. Space-Cooling Equipment Performance Analytical Verification Base Case (see Section 4.3.1.2.1)
   ii. Space-Cooling Equipment Performance Parameter Variation Analytical Verification Tests (see Section 4.3.1.2.2)
3. Space-Cooling Equipment Performance Comparative Tests (see Section 4.3.1.3)
   i. Space-Cooling Equipment Performance Comparative Test Base Case (see Section 4.3.1.3.1)
   ii. Space-Cooling Equipment Performance Comparative Tests (see Section 4.3.1.3.2)
4. Space-Heating Equipment Performance Tests (see Section 4.3.1.4)
   i. Space-Heating Equipment Performance Analytical Verification Base Case (see Section 4.3.1.4.1)
   ii. Space-Heating Equipment Performance Analytical Verification Tests (see Section 4.3.1.4.2)
   iii. Space-Heating Equipment Performance Comparative Tests (see Section 4.3.1.4.3)
5. Air-Side HVAC Equipment Analytical Verification Test Cases (see Section 4.3.1.5)
   i. Four-Pipe Fan-Coil (FC) System (see Section 4.3.1.5.1)
   ii. Single-Zone (SZ) System (see Section 4.3.1.5.2)
   iii. Constant-Volume Terminal Reheat (CV) System (see Section 4.3.1.5.3)
   iv. Variable-Air-Volume Terminal Reheat (VAV) System (see Section 4.3.1.5.4)
6. <u>Weather Drivers Tests (see Section 4.3.1.6)</u>

b. Class II Test Procedures
   1. Building Thermal Envelope and Fabric Load Base Case (see Section 4.3.2.1)
   2. Building Thermal Envelope and Fabric Load Tier 1 Tests (see Section 4.3.2.2)
   3. Building Thermal Envelope and Fabric Load Tier 2 Tests (see Section 4.3.2.3)

4.3.1 Class I Test Procedures

[. . .]

<u>**4.3.1.6 Weather Drivers Tests.** These test cases, presented in detail in Section 5.6, are designed to test the ability to read and process standard format weather data files. Different weather files test the ability to handle different climates, hemispheres, latitudes, time zones, and ground reflectance. The ability to process both meteorological and solar data from weather files is evaluated. While a test suite that concerns reading and interpreting weather files seems quite basic, there are potential algorithmic differences among programs having to do with psychrometrics, sky models, trigonometry for tilted surfaces, and differences in how instantaneous weather file data are mapped into the corresponding hour. It is important to identify these differences so that they can be traced through to differences in other calculations.</u>

[. . .]

4.4 (*Informative*) Comparing Output to Other Results. For Class I test procedures,

a. Informative Annex B8, Section B8.1, gives example simulation results for the building thermal envelope and fabric load tests of Sections 5.2.1, 5.2.2, and 5.2.3;
b. Informative Annex B8, Section B8.2, gives analytical solution, verified numerical model, and example simulation results for the ground-coupled slab-on-grade tests of Section 5.2.4; and
c. Informative Annex B16 gives quasi-analytical solution results and example simulation results for the HVAC equipment performance tests of Sections 5.3, 5.4, and 5.5.
d. <u>Informative Annex B8, Section B8.3, gives example simulation results for the weather drivers tests of Section 5.6</u>.

For Class II test procedures (See Section 7), Informative Annex B20 gives example simulation results.

The user may choose to compare output with the example results provided in Informative Annexes B8, B16, and B20 or with other results that were generated using this standard method of test (including self-generated quasi-analytical solutions related to cases where such solutions are provided). For Class I test procedures, information about how the example results were produced is included in Informative Annex B11 for building thermal envelope and fabric load, ~~and~~ ground-coupled slab-on-grade ~~tests~~, and weather drivers tests; and in Informative Annex B17 for HVAC equipment performance tests. For Class II test procedures, information about how the example results were produced is included in Informative Annex B21.

For the convenience of users who wish to plot or tabulate their results along with the example results, electronic versions of the example results are included with the accompanying electronic media: for Informative Annex B8 with the files RESULTS5-2A.XLSX and RESULTS5-2B.XLSX; for Informative Annex B16 with the files RESULTS5-3A.XLSX, RESULTS5-3B.XLSX, RESULTS5-4.XLSX, RESULTS5-5FCSZ.XLSX, and RESULTS5-5CVVV.XLSX; and for Informative Annex B20 with the file RESULTS7-2.XLS. For Annex Section B8.3, a Python script for comparing user results to the example results is available at http://data.ashrae.org/standard140. Documentation for navigating these results files is included on the accompanying electronic media and is printed in Informative Annex B10.

4.4.1 Criteria for Determining Agreement between Results. The requirements of the normative sections of Standard 140 ensure that users follow the specified method of test and that test results are provided as specified. There are no formal criteria for when results agree or disagree with either the example results provided in Informative Annexes B8, B16, or B20, or with other results generated using this method of test. Determination of when results agree or disagree is left to the organization referencing the method of test or to other users who may be running the tests for their own quality assurance purposes. In making this determination, the following should be considered:

a. Magnitude of results for individual cases.
b. Magnitude of difference in results between certain cases (e.g., Case 610 – Case 600).
c. Same direction of sensitivity (positive or negative) for difference in results between certain cases (e.g., Case 610 – Case 600).
d. Whether results are logically counterintuitive with respect to known or expected physical behavior.
e. Availability of analytical solution, quasi-analytical solution, or verified numerical model results (i.e., mathematical or secondary mathematical truth standards as described in Informative Annex B16, Section B16.2, and Informative Annex B8, Section B8.2.1).
f. For analytical verification tests, the degree of disagreement that occurred for other simulation results versus the analytical solution, quasi-analytical solution, or verified numerical model results.
g. Example simulation results do not represent a truth standard.
h. Availability of actual measured data, as in weather files used for the simulation.

[. . .]

Modify Section 5 as shown. (Note: Some unaffected text is omitted for brevity.)

5.1.8 Simulation Duration

5.1.8.1 Results for the tests of Sections 5.2.1, 5.2.2, 5.2.3, 5.3.3, ~~and~~ 5.3.4, and 5.6 shall be taken from full annual simulations.

[. . .]

5.6 Input Specifications for Weather Drivers Tests

5.6.1 Case WD100: Base Case—High Elevation, Dry with Hot Summers and Cold Winters. Begin with Case WD100. Case WD100 shall be modeled as specified in this section and its subsections.

5.6.1.1 Weather and Site Data

5.6.1.1.1 Weather Data. The WD100.tmy3 weather data provided with the electronic files accompanying this standard shall be used for Case WD100.

Informative Notes:

1. The TMY3 data format is described in NREL/TP-581-43156 [B-118].
2. Some weather parameters are provided as instantaneous values at the reported time, while others are provided as averaged values over a period ending at the reported time, as described in NREL/TP-581-43156 [B-118]. In particular, solar radiation is averaged over the previous 60 minutes.
3. The time convention for the weather file is standard time. No shift for daylight savings time is included.
4. For programs that cannot use the TMY3 file format directly, an equivalent EPW format file is provided in the accompanying files.

Table 5-122 Site Data for Weather File WD100.tmy3

Latitude	39.833° north
Longitude	104.65° west
Altitude	1650 m
Time zone	–7

Table 5-123 Azimuth and Slope for Surfaces

Azimuth	Slope
Horizontal	0° from horizontal
South	90° from horizontal
East	90° from horizontal
North	90° from horizontal
West	90° from horizontal
45° east of south	90° from horizontal
45° west of south	90° from horizontal
East	30° from horizontal
South	30° from horizontal
West	30° from horizontal

5.6.1.1.2 Site Data. The site latitude, longitude, altitude, and time zone provided in Table 5-122 shall be used.

5.6.1.2 Ground Reflectance. The ground reflectance shall be 0 (i.e., no ground reflected solar radiation).

Informative Note: The ground reflectance is set to 0 for the initial test cases to remove ground reflected solar radiation from the calculations. This allows for clearer comparison of the tilted surface solar radiation results.

5.6.1.3 Output Requirements. Output shall be provided in accordance with Section 6.6.1.

5.6.1.4 Incident Radiation Surfaces. The incident solar radiation on the surfaces with the azimuths and slopes listed in Table 5-123 shall be calculated.

For programs that are not able to directly specify surfaces for calculating incident solar radiation without a building model, skip the remainder of this section and model the surfaces by applying the alternative building surfaces specified in Section 5.6.1.5.

5.6.1.5 Alternative Surface Specification

5.6.1.5.1 If the program being tested was able to model the solar radiation incident on the surfaces as specified in Section 5.6.1.4, skip the remaining instructions and proceed to Section 5.6.2.

5.6.1.5.2 The building surfaces are used to test the incident solar radiation on the different slopes and azimuths. Building geometry for a single-story building with the same surfaces as listed in Table 5-123 is given in Figure 5-33 and Figure 5-34. Any external shading or building self-shading shall be ignored.

Informative Note: Because the building is only used to determine the surfaces for the incident solar radiation, the actual construction materials have no influence on the results. Thus, any material properties can be used for the building model.

5.6.2 Case WD200: Low Elevation, Hot and Humid Case. Case WD200 shall be modeled exactly the same as Case WD100 except for the changes noted in the subsections below.

5.6.2.1 Weather and Site Data

5.6.2.1.1 Weather Data. The WD200.tmy3 weather data provided with the electronic files accompanying this standard shall be used for Case WD200.

5.6.2.1.2 Site Data. The site latitude, longitude, altitude, and time zone provided in Table 5-124 shall be used.

5.6.2.2 Output Requirements. Output shall be provided in accordance with Section 6.6.1.

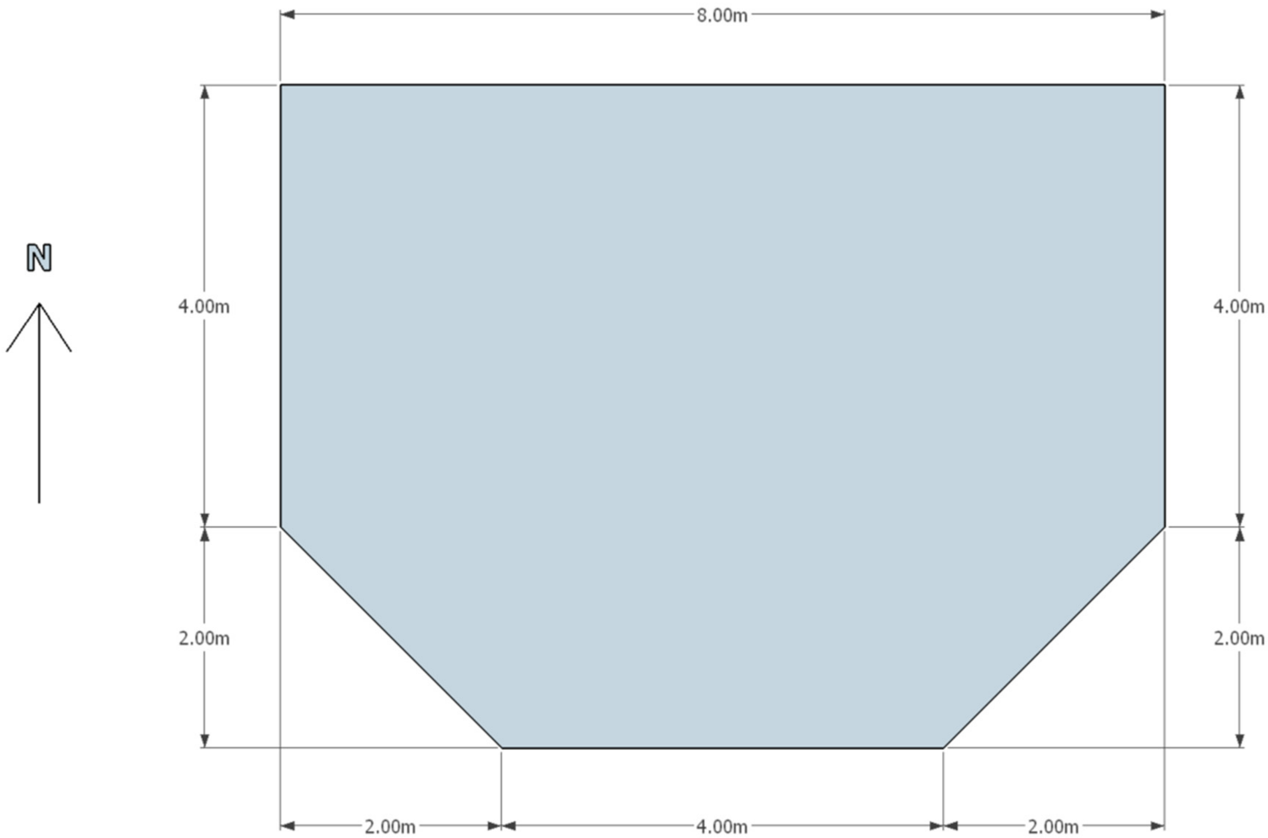

Figure 5-33 Floor plan for building geometry.

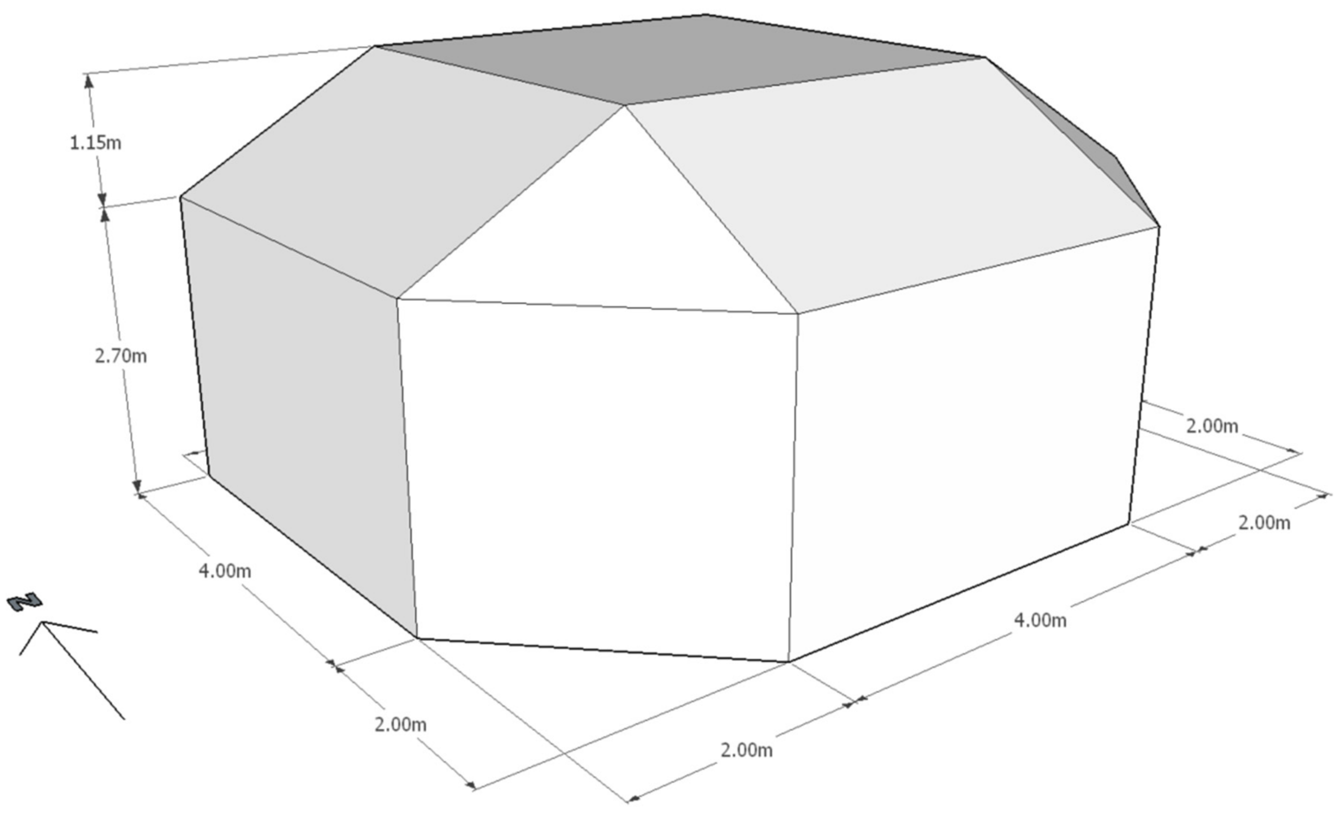

Figure 5-34 Dimensions for building geometry.

Table 5-124 Site Data for Weather File WD200.tmy3

Latitude	33.633° north
Longitude	84.433° west
Altitude	308 m
Time zone	–5

Table 5-125 Site Data for Weather File WD300.tmy3

Latitude	33.393° south
Longitude	70.786° west
Altitude	474 m
Time zone	–4

Table 5-126 Site Data for Weather File WD400.tmy3

Latitude	71.286° north
Longitude	156.767° west
Altitude	10 m
Time zone	–9

Table 5-127 Site Data for Weather File WD500.tmy3

Latitude	28.567° north
Longitude	77.103° east
Altitude	236.8 m
Time zone	5.5

5.6.3 Case WD300: Southern Hemisphere Case. Case WD300 shall be modeled exactly the same as Case WD100 except for the changes noted in the subsections below.

5.6.3.1 Weather and Site Data

5.6.3.1.1 Weather Data. The WD300.tmy3 weather data provided with the electronic files accompanying this standard shall be used for Case WD300.

5.6.3.1.2 Site Data. The site latitude, longitude, altitude, and time zone provided in Table 5-125 shall be used.

5.6.3.2 Output Requirements. Output shall be provided in accordance with Section 6.6.1.

5.6.4 Case WD400: High Latitude Case. Case WD400 shall be modeled exactly the same as Case WD100 except for the changes noted in the subsections below.

5.6.4.1 Weather and Site Data

5.6.4.1.1 Weather Data. The WD400.tmy3 weather data provided with the electronic files accompanying this standard shall be used for Case WD400.

5.6.4.1.2 Site Data. The site latitude, longitude, altitude, and time zone provided in Table 5-126 shall be used.

5.6.4.2 Output Requirements. Output shall be provided in accordance with Section 6.6.1.

5.6.5 Case WD500: Non-Integer Time Zone Case. Case WD500 shall be modeled exactly the same as Case WD100 except for the changes noted in the subsections below.

5.6.5.1 Weather and Site Data

5.6.5.1.1 Weather Data. The WD500.tmy3 weather data provided with the electronic files accompanying this standard shall be used for Case WD500.

5.6.5.1.2 Site Data. The site latitude, longitude, altitude, and time zone provided in Table 5-127 shall be used.

5.6.5.2 Output Requirements. Output shall be provided in accordance with Section 6.6.1.

5.6.6 Case WD600: Ground Reflectance. Case WD600 shall be modeled exactly the same as Case WD100 except for the changes noted in the subsections below.

Informative Note: In Case WD600, ground reflectance is added to Case WD100 to allow for comparison of the ground reflected solar calculations by checking the difference in the results between Case WD600 and Case WD100.

5.6.6.1 Weather and Site Data

5.6.6.1.1 Weather Data. The WD600.tmy3 weather data provided with the electronic files accompanying this standard shall be used for Case WD600.

5.6.6.1.2 Site Data. The site latitude, longitude, altitude, and time zone provided in Table 5-122 shall be used.

5.6.6.2 Ground Reflectance. The ground reflectance shall be 0.2.

5.6.6.3 Output Requirements. Output shall be provided in accordance with Section 6.6.1.

Modify Section 6 as shown. (Note: Some unaffected text is omitted for brevity.)

6.1.1 Standard Output Reports. The standard output reports included on the accompanying electronic media shall be used. Instructions regarding these reports are included in Normative Annex A2. Information required for this report includes the following:

a. Software name and version number
b. Modeling documentation using S140outNotes.TXT on the accompanying electronic media for the following:
    1. Software identifying information and operating requirements
    2. Modeling methods used when alternative methods are available in the software (as specified in Section 5.1.4)
    3. Equivalent modeling methods used when the software does not allow direct input of specified values (as specified in Section 5.1.5)
    4. Nonspecified inputs (as specified in Section 5.1.6)
    5. Changes to source code for the purpose of running the tests, where such changes are not available in publicly released versions of the software (as specified in Section 5.1.9)
    6. Omitted test cases and results (as specified in Section 6.1.3)
    7. Anomalous results (as specified in Section 6.1.4)
c. Results for simulated cases using the following files on the accompanying electronic media:
    1. Sec5-2Aout.XLSX for the building thermal envelope and fabric load tests of Sections 5.2.1, 5.2.2, and 5.2.3
    2. Sec5-2Bout.XLS for the ground-coupled slab-on-grade analytical verification tests of Section 5.2.4
    3. Sec5-3Aout.XLS for the space-cooling-equipment performance analytical verification tests of Sections 5.3.1 and 5.3.2
    4. Sec5-3Bout.XLS for the space-cooling-equipment performance comparative tests of Sections 5.3.3 and 5.3.4
    5. Sec5-4out.XLS for the space-heating-equipment performance tests of Section 5.4
    6. Sec5-5out.XLSX for the air-side HVAC equipment performance analytical verification tests of Section 5.5
    7. Sec5-6out.XLSX for the weather drivers tests of Section 5.6

For the specific output quantities required in the results report for each case, refer to the appropriate subsections of Sections 5.2, 5.3, 5.4, ~~and~~ 5.5, and 5.6.

[. . .]

6.6 Output Requirements for Weather Drivers Tests of Section 5.6. The values listed below shall be provided and entered into the appropriate standard output report; see Sec5-6out.xlsx included with the accompanying electronic media as specified in Normative Annex A2.

6.6.1 Weather Driver Test Outputs. The following outputs shall be provided at each time step for the annual simulation:

a. Dry-bulb temperature, °C
b. Relative humidity, %

c. Dew-point temperature, °C
d. Humidity ratio, kg moisture/kg dry air
e. Wet-bulb temperature, °C
f. Windspeed, m/s
g. Wind direction, degrees from north
h. Station pressure, mbar
i. Total cloud cover, tenths of sky
j. Opaque cloud cover, tenths of sky
k. Sky temperature, °C
l. Total, beam, and diffuse solar radiation incident on each surface, W·h/m^2

Time steps shall be one (1) hour or less.

For each value, provide the time for the value. If the output value is an instantaneous value at a specific time, report the time for the value at the specific time (for example, if the dry-bulb temperature is 15°C at the end of the hour from 06:00 to 07:00, the output value is 15°C at 07:00 [7.0]). If the output value is an average value over a specific time period, report the time for the value at the midpoint of the time period (for example, if the dry-bulb temperature is an average of 12°C over the hour from 06:00 to 07:00, the output value is 12°C at 06:30 [6.5]).

Informative Note: A specific time step for the subhourly outputs is not specified. The choice of time step is left to the person running the tests; a typical subhourly time step for the software being tested is recommended.

Modify Normative Annex A1 as shown. (Note: Some unaffected text is omitted for brevity.)

Table A1-25 TMY3 Weather Data for Weather Drivers Tests

Data Files	Applicable Cases	Applicable Cases' Sections
WD100.tmy3	WD100	5.6.1
WD200.tmy3	WD200	5.6.2
WD300.tmy3	WD300	5.6.3
WD400.tmy3	WD400	5.6.4
WD500.tmy3	WD500	5.6.5
WD600.tmy3	WD600	5.6.6

Table A1-26 EPW Weather Data for Weather Drivers Tests

Data Files	Applicable Cases	Applicable Cases' Sections
WD100.epw	WD100	5.6.1
WD200.epw	WD200	5.6.2
WD300.epw	WD300	5.6.3
WD400.epw	WD400	5.6.4
WD500.epw	WD500	5.6.5
WD600.epw	WD600	5.6.6

A1.9 Weather Data for Weather Drivers Tests. Full-year TMY3 weather data listed in Table A1-25 shall be used as specified in Section 5.6. See Section A1.8 for details about TMY3 weather data file format.

For programs that cannot use the TMY3 format files directly, the equivalent EPW weather data listed in Table A1-26 shall be used as specified in Section 5.6. See Section A1.10 for details about the EPW weather data file format.

A1.10 EPW Weather Data Format. EPW weather data are provided in comma separated value (CSV) file format. The EPW data format has eight file header lines followed by 8760 lines of data, each with 36 data fields, as described below.

A1.10.1 File Headers. The first eight rows of each file is the file header that describes the location, design conditions, typical/extreme periods, ground temperatures, whether holidays and/or daylight savings time are considered, comments, and the data period covered by the data.

A1.10.2 Hourly Records. Following the file headers, 8760 rows of hourly data records provide one (1) year of solar radiation, illuminance, and meteorological data, along with their source and uncertainty flags.

Informative Note: For solar radiation and illuminance elements, the data values represent the energy received during the 60 minutes *preceding the hour indicated* (60-minute period ending at the time stamp). For meteorological elements (with some exceptions), observations or measurements were made *at the hour indicated*. Some of the meteorological elements had observations, measurements, or estimates made at other intervals.

Modify Normative Annex A2 as shown. (Note: Some unaffected text is omitted for brevity.)

NORMATIVE ANNEX A2
STANDARD OUTPUT REPORTS

The standard output reports, consisting of the following forms provided in the electronic media accompanying this standard, shall be used:

a. Output results for cases of Sections 5.2.1, 5.2.2, and 5.2.3 (Sec5-2Aout.XLSX, spreadsheet file)
b. Output results for cases of Section 5.2.4 (Sec5-2Bout.XLS, spreadsheet file)
c. Output results for cases of Sections 5.3.1 and 5.3.2 (Sec5-3Aout.XLS, spreadsheet file)
d. Output results for cases of Sections 5.3.3 and 5.3.4 (Sec5-3Bout.XLS, spreadsheet file)
e. Output results for cases of Section 5.4 (Sec5-4out.XLS, spreadsheet file)
f. Output results for cases of Section 5.5 (Sec5-5out.XLSX, spreadsheet file)
g. Output results for cases of Section 5.6 (Sec5-6out.XLSX, spreadsheet file)
~~g~~h. Output results for cases of Section 7.2 (sheet "Sec7-2out" within RESULTS7-2.XLS spreadsheet file)
~~h~~i. Modeling notes (S140outNotes.TXT, text file reprinted as Attachment A2.~~7~~8)

For entering output results into the above XLS and XLSX template files, the user shall follow the instructions provided at the top of the appropriate electronic spreadsheet file or designated sheet within the spreadsheet file. These instructions are reprinted as Attachments A2.1, A2.2, A2.3, A2.4, A2.5, ~~and~~ A2.6, and A2.7, respectively, within this section; instructions for sheet "Sec7-2out" within RESULTS7-2.XLS are not reprinted here.

For entering modeling notes into S140outNotes.TXT, the report author shall create one modeling notes text document for each section of tests, for example, as follows:

a. S140outNotes_5-2A.TXT for the Class-I building thermal envelope and fabric load tests of Sections 5.2.1, 5.2.2, and 5.2.3
b. S140outNotes_5-2B.TXT for the Class-I ground-coupled slab-on-grade tests of Section 5.2.4
c. S140outNotes_5-3A.TXT for the Class-I space-cooling equipment performance analytical verification tests of Sections 5.3.1 and 5.3.2
d. S140outNotes_5-3B.TXT for the Class-I space-cooling equipment performance comparative tests of Sections 5.3.3 and 5.3.4
e. S140outNotes_5-4.TXT for the Class-I space-heating equipment performance tests of Section 5.4
f. S140outNotes_5-5.TXT for the Class-I air-side HVAC equipment performance analytical verification tests of Section 5.5
g. S140outNotes_5-6.TXT for the Class-I weather drivers tests of Section 5.6
~~g~~h. S140outNotes_7-2.TXT for the Class-II test procedures of Section 7.2

Informative Note: For entering modeling notes into S140outNotes.TXT, the format of the examples applying S140outNotes_Examples.TXT given in Informative Attachment A2.~~8~~ 9 within this section is recommended. Changes to S140outNotes.TXT and S140outNotes_Examples.TXT since 140-2017 are indicated, respectively, in Informative-S140outNotes-txt-edits-140-2017-A.PDF and S140outNotes_Examples-txt-edits-140-2017-A.PDF; these PDF files are included only in the "Sec5-2AFiles" folder of the accompanying electronic media.

[. . .]

Attachment A2.7—Instructions for Entering Results into Sec5-6out.XLSX

INSTRUCTIONS:

1. Use specified units.
2. In the "Program Info" sheet, complete the information about the program submission in Cells B1 through B7.

3. In the remaining sheets, enter the simulation results into the appropriate sheet starting in row 3. Apply the time convention described in item 6.
4. The results are analyzed using an automatic script. If the data are not placed in the appropriate columns, the comparison script will fail.
5. There are tabs for each test case. Enter the time step output for each variable in the assigned column.
6. For each value row, provide the time for the row using the following convention. If the output value is an instantaneous value at a specific time, report the time for the value at the specific time (for example, if the dry-bulb temperature is 15°C at the end of the hour from 06:00 to 07:00, the output value is 15°C at 07:00 [7.0]). If the output value is an average value over a specific time period, report the time for the value at the midpoint of the time period (for example, if the dry-bulb temperature is an average of 12°C over the hour from 06:00 to 07:00, the output value is 12 °C at 06:30 [6.5]).
7. If the output uses a different time convention for the solar radiation outputs than for the other results (i.e., temperatures instantaneous at the specified time and solar radiation averaged over the specified time), enter the time for the solar radiation outputs into the column titled "Solar Time of Year" following the convention above. Otherwise, either repeat the values from the column titled "Time of Year" in the "Solar Time of Year" column or delete the "Solar Time of Year" column. ***Informative Note:*** While the title of the column is "Solar Time of Year," enter the time for reported solar radiation outputs using the convention of item 6; this is not the scientific conception of "solar time" as defined in the second informative note of Annex A1, Section A1.5.

Attachment A2.~~7~~8—Standard 140 Output Form—Modeling Notes(S140outNotes.TXT)

[. . .]

Informative Attachment A2.~~8~~9—Examples of Modeling Notes (S140outNotes_Examples.TXT)

Informative Note: Attachment A2.~~8~~ 9 is all informative material and is not part of the standard.

[. . .]

Modify Normative Annex B1 as shown. (Note: Some unaffected text is omitted for brevity.)

INFORMATIVE ANNEX B1
TABULAR SUMMARY OF TEST CASES

Table B1-1 summarizes the content of the test-case tabular summary tables, including relevant sections of the standard for each suite of tests.

Nomenclature

Abbreviations and symbols used in Tables B1-2, B1-3, and B1-6 through B1-~~17~~ 18 are listed below. Abbreviations used for Tables B1-4, B1-5, and B1-~~18~~ 19 are listed with those tables.

Table B1-1 Description of Test-Case Tabular Summary Tables

Tables	Description of Test Cases	Sections	Units
B1-2, B1-3	Class-I building thermal fabric envelope and fabric load, comparative	5.2.1, 5.2.2, 5.2.3	SI
B1-4, B1-5	Class-I ground-coupled slab-on-grade, analytical verification	5.2.4	SI
B1-6	Space-cooling equipment performance, analytical verification	5.3.1, 5.3.2	SI
B1-7	Space-cooling equipment performance, analytical verification	5.3.1, 5.3.2	I-P
B1-8	Space-cooling equipment performance, comparative	5.3.3, 5.3.4	SI
B1-9	Space-heating equipment, analytical verification and comparative	5.4	SI
B1-10, B1-12, B1-14, B1-16	Air-side HVAC equipment performance, analytical verification	5.5	I-P
B1-11, B1-13, B1-15, B1-17	Air-side HVAC equipment performance, analytical verification	5.5	SI
B1-18	Weather drivers, analytical verification and comparative	5.6	SI
B1-19~~8~~	Class-II building thermal fabric envelope and fabric load, comparative	7.2	I-P

Table B1-18 Weather Drivers Case Descriptions

Case	Latitude	Longitude	Altitude, m	Time Zone	Ground Reflectance	Comment
WD100	39.833° north	104.65° west	1650	–7	0	Base case—high elevation, dry with hot summers and cold winters
WD200	33.633° north	84.433° west	308	–5	0	Low elevation, hot and humid case
WD300	33.393° south	70.786° west	474	–4	0	Southern hemisphere case
WD400	71.286° north	156.767° west	10	–9	0	High latitude case
WD500	28.567° north	77.103° east	236.8	5.5	0	Non-integer time zone case
WD600	39.833° north	104.65° west	1650	–7	0.2	Ground reflectance added to the base case

Table B1-~~18~~ 19 Section 7.2 Case Descriptions

Modify Normative Annex B8 as shown. (Note: Some unaffected text is omitted for brevity.)

INFORMATIVE ANNEX B8
EXAMPLE RESULTS FOR BUILDING THERMAL ENVELOPE AND FABRIC LOAD AND GROUND-COUPLED SLAB-ON-GRADE TESTS OF SECTION 5.2 AND WEATHER DRIVERS TESTS OF SECTION 5.6

Example results from various detailed building energy simulation programs that applied the tests of Section 5.2 and Section 5.6 are presented in tabular and graphic form in the electronic media provided with this standard; these also include the analytical solution and verified numerical model results for the ground-coupled slab-on-grade cases of Section 5.2.4. These results can be used for comparison with the software being tested. Alternatively, a user can run a number of different programs through this standard method of test or generate their own detailed numerical model results and, where applicable, draw comparisons from those results independently or in conjunction with the results listed here. In either case, when making comparisons, the user should employ the diagnostic logic presented in Informative Annex B9, Section B9.4.

[. . .]

B8.3 Weather Drivers Tests of Section 5.6. For the weather drivers tests, there are two different comparisons available: (a) for values that are included in the source weather files, the results from the simulation programs can be compared to the values from the source weather files (which provide a truth standard), and (b) for values that are derived from the values in the weather files, the results from the different simulation programs can be compared against each other.

Example results are included in both XLSX and PDF files in the electronic media accompanying this standard. Annual average results tables are provided in the file Annual_Results5-6.xlsx (see the "Introduction" sheet there). Annual average results charts are provided in PDF files for each test: WD100_annual_results.pdf, etc. Charts of results for specific days are provided in PDF files for each day using the naming scheme testname_month-day_charts.pdf (e.g., WD100_05-04_charts.pdf). These are compiled from the results files included in the electronic media accompanying files using the Python scripts available on data.ashrae.org/standard140. Nomenclature used in the tables and figures is defined in Section B8.3.1; listings of the tables and figures are provided in Section B8.3.2.

The charts of annual results include bar charts for the data directly from the source weather files (when available) and results from each of the simulation programs that submitted results for each variable. If the values were available in the source weather files, an additional bar chart with the absolute error of each program's results from the source results is included. If the values are derived from the values in the source weather files, a box and whisker plot showing a comparison of the simulation programs and the interquartile range (IQR) of the results is included. The IQR is the length of the box, and the whiskers are plus and minus 1.5 times the IQR. Results that lie outside of the whiskers should be investigated as potential outliers.

The charts of specific day results include time-series line plots of the data directly from the source weather file (when available) and results from each of the simulation programs that submitted results for each variable throughout the day. For the total and diffuse horizontal solar radiation results (where comparison with solar data directly from the weather files is possible), the values from the simulation programs are integrated hourly and then compared to the values in the source weather files. The mean bias error and root mean square error of the integrated total and diffuse horizontal solar radiation results and the values in the source weather files are included in bar charts.

When comparing results using the charts, it is important to consider the scale of the results. It is possible that differences that look large on a chart are actually insignificant, but the scale of the chart magnifies the difference. Similarly, large scales can make significant differences look insignificant.

B8.3.1 Nomenclature for Section 5.6 Results Files

B8.3.1.1 Definitions

absolute error: difference between the simulation value ($\hat{y}$) and the actual value (y), calculated as *error* = $\tilde{y} - y$.

interquartile range (IQR): difference between the 75th and 25th percentiles of the data.

mean bias error (MBE): captures the average bias between the simulation and the actual value for *n* hours and is calculated as follows:

$$\text{MBE} = \frac{1}{n}\sum_{i=1}^{n}(\tilde{y}_i - y_i)$$

root-mean-square error (RMSE): square root of the mean of the square of all of the error for *n* hours, calculated as follows:

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\tilde{y}_i - y_i)^2}$$

B8.3.1.2 Abbreviations and Acronyms. Abbreviations and acronyms used in the results tables and figures are defined below. Results are grouped by case numbers; e.g., “WD100” is Case WD100 (Section 5.6.1). Sensitivity results are listed using two case numbers separated by a minus sign: e.g., “WD600 – WD100” is the difference between Case WD600 (Section 5.6.6) and Case WD100 (Section 5.6.1).

45 East 90	surface-facing 45 degrees east of south and sloped 90 degrees from horizontal
45 West 90	surface-facing 45 degrees west of south and sloped 90 degrees from horizontal
Actual	values from the source weather files
BSIMAC	BSIMAC, Version 9.0.75 (see Table B11-3); simulation model
CSE	California Simulation Engine, Version 0.875.0 (see Table B11-3); simulation model
DeST	DeST 2.0, Version 190709 (see Table B11-3); simulation model
East 30	east-facing surface sloped 30 degrees from horizontal
East 90	east-facing surface sloped 90 degrees from horizontal
EnergyPlus	EnergyPlus, Version 9.5.0 (see Table B11-3); simulation model
Error	absolute error
ESP-r	ESP-r, version 13.3.9 (see Table B11-3); simulation model
IBPSA	IBPSA Project 1, Version v4.0.0dev (see Table B11-3); simulation model
IDA ICE	IDA ICE, Version 4.8 SP2 (see Table B11-3); simulation model
MBE	mean bias error
nan	not a number – used to indicate when data are not present
North 90	north-facing surface sloped 90 degrees from horizontal
RMSE	root-mean-square error
South 30	south-facing surface sloped 30 degrees from horizontal
South 90	south-facing surface sloped 90 degrees from horizontal
TRNSYS	TRNSYS, version 18.03.0002 (see Table B11-3); simulation model
West 30	west-facing surface sloped 30 degrees from horizontal
West 90	west-facing surface sloped 90 degrees from horizontal

B8.3.2 Listing of Tables and Figures. Table B8-5 lists the variables for which results are included in tables and figures in each results file

Table B8-5 Weather Drivers Results Variables

Dry-bulb temperature
Relative humidity
Humidity ratio
Dew-point temperature
Wet-bulb temperature
Wind speed
Wind direction
Station pressure
Total cloud cover
Opaque cloud cover
Sky temperature
Horizontal solar radiation—total, beam, and diffuse
Solar radiation on south-facing vertical surface—total, beam, and diffuse
Solar radiation on east-facing vertical surface—total, beam, and diffuse
Solar radiation on north-facing vertical surface—total, beam, and diffuse
Solar radiation on west-facing vertical surface—total, beam, and diffuse
Solar radiation on southeast-facing vertical surface—total, beam, and diffuse
Solar radiation on southwest-facing vertical surface—total, beam, and diffuse
Solar radiation on east-facing 30 degree sloped surface—total, beam, and diffuse
Solar radiation on south-facing 30 degree sloped surface—total, beam, and diffuse
Solar radiation on west-facing 30 degree sloped surface—total, beam, and diffuse

Modify Normative Annex B9 as shown. Renumber existing Section B9.6 and its subsections accordingly. (Note: Some unaffected text is omitted for brevity.)

INFORMATIVE ANNEX B9
DIAGNOSING THE RESULTS USING THE FLOW DIAGRAMS

B9.1 General Description. Figures B9-1 through B9-~~10~~ 11 contain a set of flow diagrams that serve as a guide for diagnosing the cause of disagreeing results that may arise from using this method of test. These flow diagrams list the features being tested, thus indicating potential sources of algorithmic differences.

B9.2 Comparing Tested Software Results to Other Example Results

B9.2.1 Example results are either results presented in Informative Annexes B8 and B16 or other results that were generated using this standard method of test.

B9.2.2 In this annex we provide no formal criteria for when results agree or disagree. Determination of when results agree or disagree is left to the user. In making this determination, the user should consider the following:

a. Magnitude of results for individual cases.
b. Magnitude of difference in results between certain cases (e.g., "Case 610 – Case 600").
c. Same direction of sensitivity (positive or negative) for difference in results between certain cases (e.g., "Case 610 –Case 600").
d. Whether results are logically counterintuitive with respect to known or expected physical behavior.
e. Availability of analytical solution, quasi-analytical solution, or verified numerical model results (i.e., mathematical or secondary mathematical truth standards as described in Informative Annex B16, Section B16.2, and Informative Annex B8, Section B8.2.1).
f. For the analytical verification test cases, the degree of disagreement that occurred for other simulation results versus the analytical solution, quasi-analytical solution, or verified numerical model results.
g. Example simulation results do not represent a truth standard.
h. Availability of measured data.

[. . .]

B9.6 Diagnostic Logic Flow Diagrams for Weather Drivers Tests (Section 5.6)

B9.6.1 Introduction. The weather drivers test suite is different from the other test suites in that it uses different weather files to test a program's ability to process different weather conditions rather than incremental changes in program inputs. This means that the results do not produce as many case differences to help isolate potential algorithmic issues if there are anomalous results. Figure B9-11 shows the test cases and the primary weather file condition being tested with each case. The only sensitivity case is WD600 – WD100. If a program demonstrates a difference on a test case, that does not mean that the difference is caused by the indicated primary weather file property being tested; the cause could also be from variation of other properties in the weather file.

Modify Normative Annex B10 as shown. (Note: Some unaffected text is omitted for brevity.)

INFORMATIVE ANNEX B10
INSTRUCTIONS FOR WORKING WITH RESULTS SPREADSHEETS PROVIDED WITH THE STANDARD

For the convenience of users, a printout of documentation for navigating the example results files is included below.

[. . .]

B10.7 Documentation for Annual_Results5-6.XLSX, Annual Results PDFs, and Daily Results PDFs (given in RESULTS5-6.DOCX). These files contain the results that are presented as informative example results for the Section 5.6 weather drivers tests as described in Informative Annex B8, Section B8.3.

The Annual_Results5-6.XLSX workbook contains two sheets:

a. The "Introduction" sheet provides:
   1. An overview of the information in the workbook and the programs for which results are included.
   2. Instructions for comparing new results (entered into the Sec5-6out.xlsx workbook) with the example results for the weather-drivers tests. (The "Readme" sheet within the Sec5-6out.xlsx workbook provides a general overview of that workbook and instructions for adding new results there.)
b. The "Annual Average Results" sheet contains the annual average values from each program, for each variable and for each test case, and includes appropriate values from the source weather files when available.

The annual results PDFs are provided for each test, and daily results PDFs are provided for specific days for each test.

a. Annual results PDFs are indicated as "WD*n*00_annual_results.pdf," where "*n*" varies for case number.
b. Daily results PDFs are indicated as "WD*n*00_mm-dd_charts.pdf," where "*n*" varies for case number and "mm-dd" indicates month and day of month.

When implementing a new results comparison, a new comparison spreadsheet and plots are created automatically using a Python script. So, it is vital that all of the information entered in the Sec5-6out.xlsx workbook is entered in the appropriate cells. **See data.ashrae.org/standard140 for information on downloading and using the Python script to generate the comparison spreadsheet and plots with the new results included.**

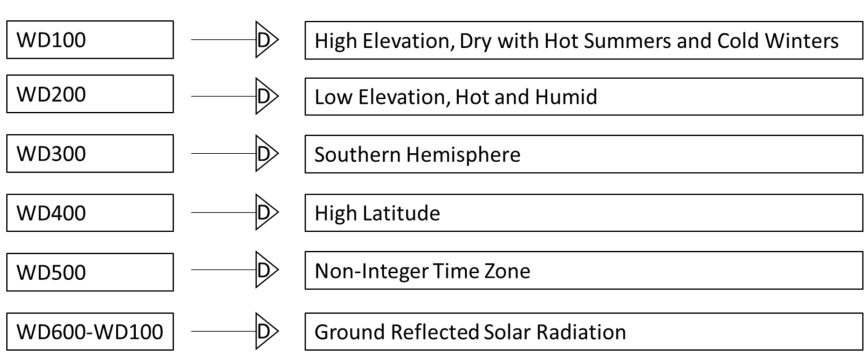

Figure B9-11 Cases WD100 through WD600 logic flow diagram.

B10.~~7~~ 8 Documentation for RESULTS7-2.XLS (given in RESULTS7-2.DOCX). This file contains Tier 1 and Tier 2 test case example simulation results presented in Informative Annex B20. Table B10-8 presents an index of all sheets contained in the RESULTS7-2.XLS file.

Enter data within the sheet with tab label "Sec7-2out" (leftmost tab) within appropriate yellow highlighted cells. Entered data automatically flows to the sheet with tab label "PlotData" and to all of the plots (see contents of sheets, listed below). Example results shown in charts are automatically adjusted for seasonal comparison for heating and cooling seasons identified by the tested software entered in sheet "Sec7-2out."

Modify Normative Annex B11 as shown. (Note: Some unaffected text is omitted for brevity.)

INFORMATIVE ANNEX B11
PRODUCTION OF EXAMPLE RESULTS FOR BUILDING THERMAL ENVELOPE AND FABRIC LOAD AND GROUND-COUPLED SLAB-ON-GRADE TESTS OF SECTION 5.2 AND WEATHER DRIVERS TESTS OF SECTION 5.6

This section describes the criteria used to select programs to produce the example results, provides details of the program versions used, and provides details of the analytical solutions.

Example results were created as part of the original research projects that developed the test cases in Section 5.2 and Section 5.6. Each project used different programs and/or program versions. Simulation programs used to develop the results were the current versions at the time of the original research; programs may have been updated since the example results were produced. For some test cases, analytical solutions or verified numerical-model results have been developed and serve as mathematical truth standards and secondary mathematical truth standards, respectively.

For the test cases of Section 5.6, for some output variables from the test cases, values from the source weather files can be used as a truth standard.

[. . .]

B11.3 Results for Weather Drivers Cases of Sections 5.6. The programs used to generate the example results for Section 5.6 are described in Table B11-3. Under the "Simulation Program" column, the first entry in each cell is the proper program name and version number. The entries in the "Abbreviation" column are the abbreviations for the programs used in Informative Annex B8, Section B8.3, and occasionally elsewhere in the informational annexes.

The "Authoring Organization" column indicates the university, national research facility, or industry organization with expertise in building science that wrote the simulation software. The "Implemented by" column indicates the university, national research facility, or industry organization with expertise in building science that performed the simulations. The majority of participating organizations that performed simulations ran software written by their organization.

Where improvements to simulation programs or simulation inputs were made as a result of running the tests, such improvements must have mathematical and physical bases and must be applied consistently across tests. Also, all improvements were required to be documented in modeler reports (see "ModelerReports.PDF" included in the electronic accompanying files available on data.ashrae.org/standard140). Arbitrary modification of a simulation program's input or internal code for the sole purpose of more closely matching a given set of results was not allowed.

Input files used to generate the results are provided with the electronic files accompanying this standard; see the README*.DOCX file. **The accompanying files can be downloaded online at data.ashrae.org/standard140**.

B11.3.1 Selection of Programs for Producing Example Results. The criteria for selection of programs used for producing example results required that

a. the program be a true simulation based on hourly weather data and calculational time increments of one (1) hour or less.
b. the program was currently maintained at the time of publication of the originating test suite.
c. a program be representative of the state of the art in whole-building energy simulation as defined by the working group participants making the selection.

The programs used to generate example results have been subjected to extensive prior validation testing. The programs (to various extents) have been subjected to other comparative, empirical validation and/or analytical verification tests, such as those referenced in Informative Annex B23 and 2017 *ASHRAE Handbook—Fundamentals* B-101, Chapter 19, Section 8.

B11.3.2 Legitimate Modeling Differences. Legitimate modeling differences or disagreements are defined in Section B11.1.4.

For the current results set, the eight programs have good agreement for most outputs that are also in the source weather files. Other differences can be attributed to legitimate modeling differences, such as non-ASHRAE psychrometric routines, sky temperature models, and tilted-surface solar radiation algorithms.

Table B11-3 Computer Programs, Program Authors, and Producers of Example Results

Simulation Program	Authoring Organization	Implemented by	Abbreviation
Source TMY3 Weather File	Provided in the accompanying files		Actual
BSIMAC, Version 9.0.75	Alec Johannsen Consulting Engineers, South Africa	Alec Johannsen Consulting Engineers, South Africa	BSIMAC
California Simulation Engine, Version 0.875.0	J.R. Barnaby/C.S. Barnaby/Big Ladder Software LLC/Wrightsoft Corp., United States	Big Ladder Software LLC, United States	CSE
DeST 2.0, Version 190709	Tsinghua University, China	Beijing University of Civil Engineering and Architecture/ Southeast University/Tsinghua University, China	DeST
EnergyPlus, Version 9.5.0	U.S. Department of Energy, Building Technologies Office, United States	GARD Analytics, Inc., United States	EnergyPlus
ESP-r, Version 13.3.9	University of Strathclyde, United Kingdom	University of Strathclyde, United Kingdom	ESP-r
IBPSA Project 1, Version v4.0.0dev	Lawrence Berkeley National Laboratory, United States	Lawrence Berkeley National Laboratory, United States	IBPSA
IDA ICE, Version 4.8 SP2	EQUA Simulation AB, Sweden	EQUA Simulation AB, Sweden	IDA ICE
TRNSYS, Version 18.03.0002	Solar Energy Laboratory, University of Wisconsin, United States; Thermal Energy System Specialists, LLC, United States	Thermal Energy System Specialists, LLC, United States	TRNSYS

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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