Pro-Forma Questionnaire for ETNA ET100 Series Tests, August 2023

*Instructions: Replace empty boxes with symbols just below, as appropriate. Provide additional information and comments as appropriate.* ***Some responses may require marking more than one box for a given query.*** *If specific responses require disclosure of proprietary data not normally available to users in the program’s engineering manual, leave the response blank.*

◻ Not applicable

■ Used to develop simulation trial results

**Program Name (including version number):** CSE 0.920.0

* Operating System: Windows
* Software URL: https://github.com/cse-sim/cse

**Modeler Name and Organization:** Nathan Oliver, Big Ladder Software

**Date:** October 17, 2024

**Pro-Forma Queries** (◻ Not applicable, ■ Used to develop results)

***< General Program Settings for Simulation Trial >***

**G1. General simulation solution approach**

◻ Sequential loads, system, plant calculation without feedback

■ Simultaneous loads, system, and plant solution

■ Other (please describe: Space temperature calculation based on loads-systems feedback)

**G2. Time step approach in the software**

■ User selected (please describe: The user can select the number of steps per hour. 4 steps per hour is the default, and 30 steps per hour is typically used. 120 steps per hour was used in this test suite. This was adjusted from 10 to 120 steps per hour for round 2.)

◻ Automatically variable, constant intervals

◻ Automatically variable, dynamically varying based on solution transients

◻ Software fixed time step (please describe: )

◻ Other (please describe: )

**G3. Minimum time steps for this simulation trial**

◻ One hour

■ Sub hourly (please specify interval applied for the simulation trial: 0.5 minutes)

◻ > one hour (please specify interval, e.g., daily, monthly: )

**G4. Program Preconditioning**

■ Simulation of an initial pre-conditioning time period before recording simulation results for the designated analysis time period:

◻ Fixed duration (please specify pre-conditioning time period: )

■ Variable duration (please specify maximum allowed pre-conditioning time period: Unlimited)

■ Pre-conditioning time period applied for these simulations (please specify: Preconditioning time starting at January 1, Hour 1, and ending at start of specified simulation start time for each case.)

◻ Repeat January 1, Hour 1 until temperatures, fluxes or both converge versus previous iteration (please specify convergence criteria: )

◻ Repeat January 1 entire day until temperatures, fluxes or both converge versus previous iteration (please specify convergence criteria: )

◻ Test convergence after one or more annual cycles (please specify convergence criteria: )

◻ None – not needed with given period before steady state

◻ Other (please specify: )

**G5. Zone Air Initialization**

◻ Zone air temperature = Jan 1, Hour 1 thermostat set point

◻ Zone air humidity ratio = Jan 1, Hour 1 outdoor air humidity ratio

◻ Zone air temperature = Jan 1, Hour 1 outdoor air temperature (specify if this is default or if this is only applied if there is no thermostat set point specified during Jan 1, Hour 1: )

◻ Zone air initialization applied without program pre-conditioning

■ Zone air initialization applied for program pre-conditioning method indicated above

■ Other (please specify user defined preconditioning including “none”:

Case Series ET100: Guard and cell temperatures of 10°C and 35°C, respectively.

Case Series ET110: Guard and cell temperatures of 10°C)

**G6. Is weather data required by the software to run these artificial climate test cases?**

■ Yes

◻ No

*[If weather data is not required to run in this simulation trial, please skip questions G7 through G9. If “yes” above then answer the following.]*

**G7. Timing convention for meteorological data: sampling interval**

■ Fixed within code (please specify interval: 1 hour)

◻ User-specified (please describe: )

**G8. Timing convention for meteorological data: period covered by first record**

■ Fixed within code (start at the beginning of the weather data file)

◻ Fixed within code (others, please specify time which meteorological record covers: )

◻ User-specified(please describe: )

**G9. Meteorological data reconstruction scheme**

◻ Climate assumed stepwise constant over sampling interval

■ Linear interpolation used over climate sampling interval

◻ Other (please specify: )

**G10. Output timing conventions**

■ Produces spot output as calculated values at the end of each timestep

■ Produces spot output as calculated values at end of each hour

■ Produces average outputs for each hour (please specify period to which value relates, e.g., “Hour 1 = 0:00 to 1:00” or “Hour 1 = 0:30 to 1:30”, etc.: Hour 1 = 00:00 – 01:00)

◻ Other (please specify: )

**G11. Wall\*** (\*including ceiling and floor) **conduction solution method**

■ Explicit finite difference

◻ Implicit finite difference

◻ Weighting factors

◻ Response factor

◻ Frequency domain

◻ Conduction transfer functions

◻ Other (please specify: )

**G12. Wall\* conduction type**

■ 1-dimensional

◻ 2- or 3-dimensional

◻ Variable thermal-physical properties – for PCM walls

**G13. Treatment of zone air**

■ Single temperature (i.e., good mixing assumed)

◻ Stratified model

◻ Simplified distribution model

◻ Full CFD model

◻ Other (please specify: )

**G14. Airgaps within walls and slabs**

◻ Resistance fixed within code

■ User-specified constant resistance

◻ Resistance calculated within code as a function of orientation

◻ Radiation and convection treated separately across airgaps

◻ Treated as additional zones

◻ Other (please specify: )

***< Geometry and Construction >***

**C1. Full geometric description**

1. **Text Cell Geometry**

■ Modeled per alternative 16 1-D conduction paths described in Table 6 (Section 2.2.1.7.1.2.6)

◻ Model has surface areas and orientation only, not actual connected surface geometry

◻ Other (please describe: )

1. **Guard Zones**

◻ Geometry modelled – with dimensions and temperature measurements in the spec

■ Geometry not modelled – boundary condition inputs apply:

■ guard-zone temperature measurements

■ specified test-cell exterior combined surface heat transfer coefficients

◻ Other (please describe: )

◻ Other (please describe: )

**C2. How did you model the envelope construction where there are multiple 1-D conduction paths defined, e.g., the floor construction with three paths (Table 6, Section 2.2.1.7.1.2.6)?**

■ Surface divided into paths described in Table 6 (Section 2.2.1.7.1.2.6)

◻ One combined construction used per envelope, e.g., average UA per floor, ceiling, north wall, etc.

◻ Other (please specify: )

**C3. Infiltration** *[Note: Only Cases ET110A2 and B2 specify infiltration ACH > 0. Information here useful for consideration in specifying dynamic test cases.]*

■ User input, constant air exchange rate

◻ User input, scheduled air exchange rate

◻ Calculated from input air leakage data (e.g., effective leakage area, crack dimensions, “ACH50”, etc.)

◻ Calculated constant value (describe algorithm: )

◻ Calculated each time step, wind and buoyancy (stack) driven (describe algorithm: )

◻ Nodal network, user input wind pressure coefficients (describe algorithm: )

◻ Nodal network, wind pressure coefficients calculated each time step (describe algorithm: )

◻ Link to external calculation program (describe program: )

◻ Other (please describe: )

***< Ideal Heating System >***

**H1. Heaters (dynamics)**

■ No dynamics assumed (output is instantaneous)

◻ Simple first order dynamics

◻ Detailed modeling of heat source dynamics

**H2. Heaters (output characteristics)**

■ Purely convective

◻ Radiative/Convective split fixed within code (specify convective fraction (%): %)

◻ Radiative/Convective split specified by user (specify convective fraction (%): %)

◻ Detailed modeling of heat source output

**H3. Control temperature**

■ Air temperature

◻ Combination of air and radiant temperatures fixed within the code

◻ User-specified combination of air and radiant temperatures

◻ User-specified construction surface temperatures

◻ User-specified temperatures within construction

◻ Other (please specify: )

**H4. Control laws**

■ Perfect control

◻ On/Off thermostatic control

◻ On/Off thermostatic control with deadband

◻ Proportional control

◻ Other (please specify) .

***<Surface Heat Transfer>***

**S1. Are user input constant surface coefficients (not automatically calculated for each time step) applied by the program for ET110A1/B1, ET110A2/B2, and ET100A1/B1?**

■ Yes

◻ No

1. If yes, are constant coefficients applied for?

■ Interior surfaces

■ Exterior surfaces

1. If yes, were the provided default coefficients of Table 17 (Section 2.2.1.7.4 [ET110A1]), Table 38 (Section 2.2.3.8 [ET110B1]), and Table 43 (Section 2.2.5.9 [ET100 A1 (and B1)]) applied?

■ For all surfaces

◻ For some surfaces (indicate which surfaces: )

◻ No

1. If yes (whether actually used for simulation results or not), are user input constant coefficients applied as?

For Interior surfaces:

◻ Total Combined Convective and Radiative Heat Transfer

■ Convection Only

◻ Radiation Only

◻ Other (please specify: )

For Exterior surfaces:

◻ Total Combined Convective and Radiative Heat Transfer

■ Convection Only

◻ Radiation Only

◻ Other (please specify: )

1. For user input constant coefficients, indicated in #c, are values allowed to vary with individual surfaces and their orientations?

For Interior surfaces:

■ Yes

◻ No

◻ Other (please specify: )

For Exterior surfaces:

■ Yes

◻ No

◻ Other (please specify: )

**S2. For Cases ET100A3 and B3, are user selected surface heat transfer algorithms (with convection coefficients and radiation exchange automatically calculated for each time step) applied by the program for ET100A3/B3?**

■ Yes

◻ No

1. If yes, are user selected algorithms applied for?

■ Interior surfaces

◻ Exterior surfaces

1. If yes (whether actually used for simulation results or not), are user selected algorithms applied as?

For Interior surfaces:

■ Total Combined Convective and Radiative Heat Transfer

◻ Convection Only

◻ Radiation Only

◻ Other (please specify: )

For Exterior surfaces:

◻ Total Combined Convective and Radiative Heat Transfer (as required in **Table 17, Section 2.2.1.7.4)**

■ Convection Only (Constant convective coefficients as required in **Table 17, Section 2.2.1.7.4)**

◻ Radiation Only

◻ Other (please specify: )

1. If yes for *interior* surfaces, which *convection* coefficient algorithms were applied (please specify the name of algorithms and references, if possible)?

◻ Coefficients fixed within code (e.g., ASHRAE, CIBSE fixed, etc.) (please specify: )

◻ Coefficients specified by user (e.g., buoyancy-driven algorithm (TARP), forced convection algorithm (CeilingDiffuser), etc.) (please specify: )

◻ Coefficients calculated by code as a function of surface orientation (please specify: )

■ Coefficients calculated by code as a function of temperature difference (please specify: Default CSE model is a dynamic correlation based on temperature differences and internal airflow derived largely from Clear et at. (2001) and presented in Ferris et al. (2019) (Appendix G, section 1.5.2).)

◻ Coefficients calculated by code as a function of surface finishes (please specify: )

■ Coefficients calculated by code as a function of ventilation airflow (please specify: Default CSE Model is a dynamic correlation based on temperature differences and internal airflow derived largely from Clear et at. (2001) and presented in Ferris et al. (2019) (Appendix G, section 1.5.2).)

◻ Other (please specify: )

References

Clear, R.D., L. Gartland and F.C. Winkelmann, 2001, "An Empirical Correlation for the Outside Convection Air Film Coefficient for Horizontal Roofs," Lawrence Berkeley National Laboratory, Jan 2001.

T. Ferris, L. Froess, and D. Ross, “Residential Alternative Calculation Method Reference Manual for the 2019 Building Energy Efficiency Standards,” 2019. https://www.energy.ca.gov/sites/default/files/2020-10/2019%20Residential%20ACM%20Reference%20Manual\_ada.pdf

c-1. For user defined *convection* algorithms indicated in #c, are values allowed to vary with individual surfaces and their orientations?

For Interior surfaces:

■ Yes

◻ No

◻ Other (please specify: )

1. If yes for *exterior* surfaces, which *convection* coefficient algorithms were applied (please specify the name of algorithms and references, if possible)?

◻ Coefficients fixed within code (e.g., ASHRAE, CIBSE fixed, etc.) (please specify: )

◻ Coefficients specified by user (e.g., buoyancy-driven algorithm (TARP), forced convection algorithm (CeilingDiffuser), etc.) (please specify: )

◻ Coefficients calculated by code as a function of surface orientation (please specify: )

◻ Coefficients calculated by code as a function of temperature difference (please specify: )

◻ Coefficients calculated by code as a function of surface finishes (please specify: )

◻ Coefficients calculated by code as a function of ventilation airflow (please specify: )

■ Other (please specify: constant coefficients applied as in Table 17)

d-1. For user defined *convection* algorithms indicated in #d, are values allowed to vary with individual surfaces and their orientations?

For Exterior surfaces:

◻ Yes

◻ No

■ Other (please specify: constant coefficients applied as in Table 17)

1. If yes for *interior* surfaces, which *radiation* exchange algorithms were applied (please specify the name of algorithms and references, if possible)?

◻ Constant linearized coefficients (please specify: )

◻ Linearized coefficients based on viewfactors (e.g., ScriptF, etc.) (please specify: )

◻ Linearized coefficients based on surface emissivities (please specify: )

■ Non-linear treatment of radiation heat exchange (please specify: See CarrollMRT method in Carroll (1981).)

◻ Other (please specify: )

References

Carroll, J. A., 1981, “A Comparison of Radiant Interchange Algorithms,” Proceedings of the 3rd Annual Systems Simulation and Economics Analysis/Solar Heating and Cooling Operational Results Conference, Reno. Solar Engineering, Proceedings of the ASME Solar division.

e-1. For user selected *radiation* algorithms indicated in #e, are surface temperatures allowed to vary with individual surfaces and their orientations?

For Interior surfaces:

■ Yes

◻ No

◻ Other (please specify: )

1. If yes for *exterior* surfaces, which *radiation* exchange algorithms were applied (please specify the name of algorithms and references, if possible)?

◻ Constant linearized coefficients (please specify: )

◻ Linearized coefficients based on viewfactors (e.g., ScriptF, etc.) (please specify: )

◻ Linearized coefficients based on surface emissivities (please specify: )

◻ Non-linear treatment of radiation heat exchange (please specify: )

■ Other (please specify: Radiation was turned off)

f-1. For user selected *radiation* algorithms indicated in #f, are surface temperatures allowed to vary with individual surfaces and their orientations?

For Interior surfaces:

◻ Yes

◻ No

■ Other (please specify: Radiation was turned off)

***< Modeling Methods, Omitted Cases, Changes to Source Code, Anomalous Results, and Other >***

*[****Note to sim trial participants: Skip this until we’re done with the simulation trials; we’ll ask you to include this information when this test suite is brought into Std 140.]***

**M1. Alternative Modeling Methods or Algorithms, pertaining to test spec Section 2.1.4**

If alternative modeling methods are applicable, a separate note for each alternative modeling method or algorithm situation shall be provided. The standard format shown below and a separate number and title for each note shall be applied. If alternative modeling methods are not applicable, specify "NONE" in place of the information below.

1. List the applicable test case
2. Describe the Effect Being Simulated:
3. Optional Settings or Modeling Capabilities

(list setting or capability and its physical meaning):

* <name>

Physical Meaning: <explanation>

* <name>

Physical Meaning: <explanation>

* <name>

Physical Meaning: <explanation>

1. Setting or Capability Used:

**M2. Equivalent Modeling Methods, pertaining to test spec Section 2.1.5**

If equivalent modeling methods are applied, a separate note for each instance of equivalent modeling shall be provided. The standard format shown below and a separate number and title for each note shall be applied. If equivalent modeling methods are not applicable, specify "NONE" in place of the information below.

1. Describe the Effect Being Simulated:
2. Section(s) of the Standard where Relevant Inputs are Specified:
3. Equivalent Input(s) Used:
4. Physical, Mathematical or Logical Justification of the Equivalent Input(s)

Provide supporting calculations, if relevant:

**M3. Non-specified Inputs, pertaining to test spec Section 2.1.6**

If nonspecified inputs are applied, a separate note for each use of nonspecified inputs shall be provided. The standard format shown below and a separate number and title for each note shall be applied. If nonspecified inputs are not applied, specify "NONE" in place of the information below.

1. Describe the Effect Being Simulated:
2. Section(s) of the Standard where Relevant Inputs are Specified:
3. Nonspecified Input(s) Used:
4. Physical, Mathematical or Logical Justification for Use of the Nonspecified Input(s)

Provide supporting calculations, if relevant:

**M4. Omitted Test Cases and Results**

If test cases were omitted, a separate note to describe each type of omission shall be provided. The standard format shown below and a separate number and title for each note shall be applied. If there are no omitted test cases, specify "NONE" in place of the information below.

1. List the Case(s) where Results Were Omitted, and which Results Were Omitted

for the Case(s):

1. Explanation for Omitting the Test Case(s) Results:

**M5. Changes to Source Code** (not included in the publicly released version of the software, pertaining to test spec Section 2.1.9.2)

If changes to the source code for the purpose of running a test are applied, separate notes to describe each source code modification shall be provided. The standard format shown below and a separate number and title for each note shall be applied. If changes to source code are not applied, specify "NONE" in place of the information below.

1. List the Change(s) to the Source Code:
   1. Added capability to set infiltration air temperature equal to a user-defined temperature (e.g., guard temperatures). Previously, infiltration air temperature could only be equal to the dry bulb temperature imported from the weather file.
   2. Fixed bug where the exterior surface natural convection coefficient was incorrectly set equal to the default value of the exterior surface air film conductance and not the user-defined convection coefficient. This bug only occurred when the exterior surface temperature boundary condition was set to a user input temperature, such as the guard temperatures in the ETNA cases.
2. List the Test Case(s) Relevant to the Change(s) in the Source Code:
3. Cases with infiltration (ET110A2, ET110B2)
4. All cases
5. Explanation of Why the Change is Not Included in the Publicly Released Version of the Software:
6. This capability was not previously considered and will be added to a future version.
7. This was a bug and will be removed in a future version.

**M6. Anomalous Results**

If anomalous test results are described, each type of anomalous result shall be described in a separate note. The standard format shown below and a separate number and title for each note item shall be applied. If anomalous results are not discussed, it shall be permitted to specify "NONE" in place of the information below.

1. Test Case(s) and Specific Results from the Case(s) that are Anomalous:
2. Explanation of Reason for the Anomalous Results:

**M7. Others**

M7-1. Modeling Difficulties

1. Describe each input error that was fixed after comparing results

A post-processing error incorrectly calculated the total surface heat flux in cases ET100A3 and ET100B3. A missing set of parentheses did not apply the unit conversion to a portion of the calculation.

1. For each input error, was it ascribable to an ambiguity(s) in the test specification? (e.g., not a typo in your input file)

No

1. If yes to b, describe the test spec issue [your feedback here is very important]

M7-2. Test Spec Ambiguities / Issues

Describe any issues with interpreting the test spec or suggestions for improvement

M7-3. Improvements or Possible Improvements to Software Based on Running the Test Cases

Describe any improvements made to your software, or improvements recommended for making to the software, based on running the test cases.

M7-4. Other Comments and/or Recommendations

Any additional feedback is welcome