**Pro-Forma Questionnaire for Building Thermal Fabric Update Tests, August 2017**

***[Note to Participants (8/30/17): Revisions on p. 4 are based on Jun 2017 meeting minutes.]***

*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.*

⌧ Possible to use

◼ Used to develop simulation trial results

**Program name, including version number**

California Simulation Engine (CSE 0.861.1).

**Your name and organization**

Neal Kruis, Big Ladder Software.

**Date**

4/15/2019.

**Questions from June 30, 2014 Seattle SSPC 140 Meeting (updated May 2015)**

*[tkjn: Integrate with other queries topically after sim trials]*

**1. Are user input constant surface coefficients (not automatically calculated for each time step) applied by the program?**

⌧ Yes

◼ No

**2. If yes for #1, are constant coefficients applied for?**

⌧ Interior surfaces

⌧ Exterior surfaces

**3. If yes for #1, were the provided default coefficients of Sections 5.2.1.9, 5.2.1.10, and/or Annex B4 Section B4.1.3 applied?**

⌧ For all surfaces

🞎 For some surfaces (indicate which surfaces) .

🞎 No

**4. If yes for #1 (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) .

**5. For user input constant coefficients indicated in #4, 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) .

**6. If you provided detailed convective surface coefficient (hconv) results in Sec5-2Aout.xls (rows 910 – 976 [tk]), was this output?**

◼ hconv directly provided by the program

🞎 hconv calculated per instructions of Section 6.2.1.2.3.4

🞎 Other (please specify) .

**7. If you did not provide hconv results (see #6), was this because?**

🞎 Insufficient detailed output is provided by the program for calculating hconv

🞎 Other (please specify) .

**8. What is the maximum opaque (non-window) layer insulation R-value (m2K/W) allowed by your program? If this varies for opaque surface types, provide a listing – for now this query is more pertinent to surface types that could be used for modeling the raised floor.**

Infinite m2K/W.

**Pro-Forma Queries, updated Aug 2017**

**Program status**

🞎 Public domain

◼ Open source license available

🞎 Commercial

🞎 Other (please specify) .

**General simulation solution approach**

🞎 Sequential loads, system, plant calculation without feedback

◼ Simultaneous loads, system, and plant solution

◼ Space temperature calculation based on loads-systems feedback

🞎 Other (please describe) .

**Time step approach**

◼ User selected

🞎 Automatically variable, constant intervals

🞎 Automatically variable, dynamically varying based on solution transients

🞎 Other (please describe) .

**Minimum time steps for simulation**

🞎 One hour

◼ Subhourly (please specify minimum interval) None.

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

***[Note to Simulation Trial Participants (8/30/17): Enter responses for two new queries below]***

**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) .

🞎 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

🞎 Other (please specify) .

**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) .

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

◼ Fixed within code (please specify interval) 1 Hour.

🞎 User-specified

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

◼ Fixed within code (please specify period or time which meteorological record covers) 1 Year.

🞎 User-specified

**Meteorological data reconstruction scheme**

🞎 Climate assumed stepwise constant over sampling interval

◼ Linear interpolation used over climate sampling interval

🞎 Other (please specify) .

**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.) .

🞎 Other (please specify) .

**Full geometric description**

🞎 Walls, roof, floors

🞎 Windows

🞎 External shading devices

◼ Other (please describe) Tilt, area, and azimuth are input. Overhang and fin geometry defined on per-window basis.

**Element conduction solution method**

◼ Explicit finite difference

🞎 Implicit finite difference

🞎 Weighting factors

🞎 Response factor

🞎 Frequency domain

🞎 Other (please specify) .

**Surface conduction**

◼ 1-dimensional

🞎 2- or 3-dimensional

⌧ Variable thermal-physical properties

**Treatment of zone air**

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

🞎 Stratified model

🞎 Simplified distribution model

🞎 Full CFD model

🞎 Other (please specify) .

**Heat transfer within zones**

🞎 Radiation and convection combined

◼ Radiation and convection treated separately

**Convective heat transfer within zones**

🞎 Coefficients fixed within code

⌧ Coefficients specified by user

◼ Coefficients calculated by code as a function of surface orientation

◼ Coefficients calculated by code as a function of temperature difference

🞎 Coefficients calculated by code as a function of surface finishes

🞎 Coefficients calculated by code as a function of ventilation airflow

◼ Other (please specify) Coefficients calculated by code as a function of total air changes in the zone (including flow induced by mechanical systems as well as natural ventilation/infiltration).

**Longwave radiative heat transfer within zones**

🞎 Constant linearized coefficients

◼ Linearized coefficients based on viewfactors

◼ Linearized coefficients based on surface emissivities

🞎 Non-linear treatment of radiation heat exchange

◼ Other (please specify) Linearized coefficients based on temperature differences.

**Number of nodes placed within each layer of walls and slabs**

🞎 Not applicable for this solution method

🞎 Fixed number of nodes per layer (please specify) .

🞎 User-specified number of nodes per layer

◼ Other (please specify) Calculated to enforce stability.

**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) Resistance may vary with temperature.

**Windows (heat loss)**

🞎 Fixed resistance used for window element

🞎 Dynamic treatment of window heat loss using same scheme as for opaque elements

◼ Other (please specify) Dynamic treatment using steady-state scheme.

**Airgaps within windows**

🞎 Resistance fixed within code

🞎 User-specified constant resistance

🞎 Resistance calculated within code as a function of orientation

◼ Radiation and convection treated separately across airgaps

🞎 Airgaps treated as additional zones

🞎 Other (please specify) .

**Windows (transmission of direct shortwave radiation)**

🞎 Fixed transmission used

◼ Solar heat gain coefficients used

◼ Calculated by code as a function of incidence angle

🞎 Calculated by code from user-specified function of incidence angle

🞎 Other (please specify) .

**Sky model for diffuse solar radiation**

🞎 Isotropic

◼ Other (please specify model used) Hay anisotropic model.

**Windows (transmission of diffuse radiation)**

◼ Diffuse radiation treated as direct from fixed altitude or incidence angle (please specify) At normal incidence.

🞎 Other (please specify) .

**Advanced fenestration**

🞎 Data sets of glazing types

🞎 Data sets of frame types

🞎 Gas fill specifiable as single gas (e.g., Argon) or mixture (e.g., air, Argon/Krypton)

🞎 Window frame interaction with edge of glass explicitly modeled

🞎 WINDOW data import or calculations (http://windows.lbl.gov/software/window/window.html)

🞎 THERM data import or calculations (http://windows.lbl.gov/software/therm/therm.html)

◼ Other (please describe) ASHWAT model with “ratings matching” scheme.

**Ground reflectance**

🞎 User defined constant

◼ User defined variation (please specify, e.g., daily, monthly, seasonal) hourly variation defined once per month.

🞎 Automatically varies hourly or each time step, according to weather data (please describe algorithm, and weather data parameters that drive variation) .

🞎 Other (please describe algorithm) .

**Shading of windows and walls by a shading object**

◼ Only direct beam radiation is shaded

🞎 Both direct beam and diffuse radiation are shaded

🞎 Reflected solar radiation from ground, other buildings, etc., is shaded

◼ Only one side of a defined shading object actively performs shading

🞎 Both sides of a defined shading object actively perform shading

🞎 Solar radiation is allowed to be reflected by a shading object

🞎 Shading surface transmittance is adjustable

◼ Other (please specify) Shading overhangs and fins applied only to windows.

**Distribution of transmitted direct beam solar radiation within zones, and cavity albedo**

🞎 Fixed within the code

⌧ Constant user-specified distribution

◼ Calculated once by code and used throughout (please describe algorithm) initial insolation is distributed to all surfaces weighted by the product of area and absorptivity.

🞎 Calculated as a function of solar position (please describe algorithm) .

**Distribution of transmitted diffuse solar radiation within zones, and cavity albedo**

🞎 Fixed within the code

⌧ Constant user-specified distribution

◼ Calculated once by code and used throughout (please describe algorithm) initial insolation is distributed to all surfaces weighted by the product of area and absorptivity.

🞎 Calculated as a function of solar position (please describe algorithm) .

**Heat transfer between external surfaces and surrounding environment**

🞎 Radiation and convection combined

◼ Radiation and convection treated separately

**External convection**

🞎 Coefficients fixed within code

⌧ User-specified constant coefficients

◼ Calculated within code as a function of surface orientation

◼ Calculated within code as a function of surface finish

◼ Calculated within code as a function of wind speed

🞎 Calculated within code as a function of wind speed and wind direction relative to surface orientation

🞎 Other (please specify) .

**External infrared radiative heat transfer**

🞎 Non-linear treatment of radiation heat exchange

🞎 Constant linearized coefficients (or as constant combined convective + radiative coefficients)

🞎 Assumed to be to ambient air temperature

🞎 Assumed to be to sky temperature read from met file

◼ Based on calculated sky temperature (please specify algorithm and requirements) Berdahl-Martin with Palmiter adjustments.

◼ Includes view factor to sky.

◼ Includes view factor to surrounding obstruction(s).

◼ Includes view factor to ground.

🞎 Other (please specify model used) .

**Surrounding ground surface temperature**

◼ Same as weather data air temperature, and varies by time step with weather data

🞎 Other (please describe algorithm) .

**Detailed zone surface output capabilites**

◼ Interior-face surface temperatures

◼ Exterior-face surface temperatures

◼ Interior-face surface heat flow

◼ Exterior-face surface heat flow

🞎 Surface heat flows disaggregated by convective and radiative portions

🞎 Other (please describe) .

**Infiltration – *[Note: Information useful for consideration of extension 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) Sherman-Grimsrud.

⌧ Nodal network, user input wind pressure coefficients

🞎 Nodal network, wind pressure coefficients calculated each time step (describe algorithm) .

🞎 Link to external calculation program (describe program) .

🞎 Other (please describe) .

**Heaters (dynamics)**

◼ No dynamics assumed (output is instantaneous)

🞎 Simple first order dynamics

🞎 Detailed modeling of heat source dynamics

**Heaters (output characteristics)**

◼ Purely convective

🞎 Radiative/Convective split fixed within code

🞎 Radiative/Convective split specified by user

🞎 Detailed modeling of heat source output

**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) .

**Control laws**

◼ Perfect control

🞎 On/Off thermostatic control

🞎 On/Off thermostatic control with deadband

🞎 Proportional control

🞎 Other (please specify) .

**Previously applied validation tests related to building thermal fabric load modelinga**

🞎 IEA BESTEST (Judkoff and Neymark 1995a; ASHRAE Standard 140-2014, Sections 5.2.1, 5.2.2, 5.2.3)

🞎 IEA 34/43 Multi-zone non-airflow (Neymark et al 2008), cases MZ340, MZ350

◼ HERS BESTEST (Judkoff and Neymark 1995b; ASHRAE Standard 140-2014, Section 7)

🞎 ASHRAE 1052-RP (Spitler, Rees, and Xiao 2001) analytical verification tests

🞎 Other software-to-software comparative tests (please describe) .

🞎 Other analytical verification tests (please describe) .

🞎 Other empirical validation tests (please describe) .

*a Application of other test cases is recommended. We explicitly requested the simulation trial participants to separately run multi-zone cases MZ340 and MZ350 as part of the simulation trial process.*

***Validation Test References***

ASHRAE. 2014. ANSI/ASHRAE Standard 140-2014. *Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs*. Atlanta GA: ASHRAE

Judkoff, R., and J. Neymark. 1995a. *International Energy Agency Building Energy Simulation Test (BESTEST) and Diagnostic Method*. NREL/TP-472-6231. Golden, CO: National Renewable Energy Laboratory. [www.nrel.gov/docs/legosti/old/6231.pdf](http://www.nrel.gov/docs/legosti/old/6231.pdf).

Judkoff, R., and J. Neymark. 1995b. *Home Energy Rating System Building Energy Simulation Test (HERS BESTEST), Volume 1: Tier 1 and Tier 2 Tests User’s Manual*. NREL/TP-472-7332a. Golden, CO: National Renewable Energy Laboratory. www.nrel.gov/docs/legosti/fy96/7332a.pdf.

Neymark, J., R. Judkoff, D. Alexander, D., C. Felsmann, P. Strachan, A. Wijsman. 2008. *International Energy Agency Building Energy Simulation Test and Diagnostic Method (IEA BESTEST) Multi-Zone Non-Airflow In-Depth Diagnostic Cases: MZ320–MZ360.* NREL Report No. TP-550-43827. Golden, CO: National Renewable Energy Laboratory. www.nrel.gov/docs/fy08osti/43827.pdf

Spitler, J.D., S.J. Rees, and D. Xiao. 2001. *Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs—Building Fabric*. Final Report for ASHRAE 1052-RP. Atlanta: ASHRAE.