BOPTEST Reference Test Case Peer Review Document

This document serves a peer review template for a reference test case emulation model.

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Section I is to be completed by the Model Developer. The remaining sections are to be completed by the designated Model Reviewer, and returned to the Model Developer so that they may make the appropriate edits. This process should be repeated until all concerns of the reviewer are addressed. Each review should be documented using a separate version of this document, specified by the Review # in Section 1 below.

# I. General Information

|  |  |
| --- | --- |
| **Reference Case** | Two Zone Residential Hydronic |
| **Current Location** | Test Case Directory: <https://github.com/EttoreZ/project1-boptest/tree/issue409_TwoZoneHydronicApartment>  Modelica Model Package: <https://github.com/ibpsa/project1-boptest/tree/issue273_tesCasMulZonOffSimAir/testcases/multizone_office_simple_air/models/MultiZoneOfficeSimpleAir>   Model Path: TwoZoneApartmentHydronic.TestCases.ApartmentModelQHTyp  Buildings, IDEAS, and IBPSA Library Versions:  See <https://github.com/EttoreZ/project1-boptest/blob/e75d56348ddc67f681fb80f1ad4cf5db20191a6a/testcases/two_zone_apartment_hydronic/models/library_versions.json#L1> |
| **Model Developer** (Name, Institution, Email) | Ettore Zannetti, Politecnico di Milano, [ettore.zanetti@polimi.it](mailto:ettore.zanetti@polimi.it)  Inputs in blue |
| **Model Reviewer**  (Name, Institution, Email) | Javier Arroyo, KU Leuven, javier.arroyo@kuleuven.be  Reviewing with Dymola version 2022x in Ubuntu 20.04 and OpenModelica in MacOS  Inputs in red  Action points are highlighted. |
| **Review #** | 1, Answer, 2 |

# II. General Comments

List each comment in separate row with number. Additional rows may be added as needed. They should be supported by the responses in Sections III and IV.

|  |  |
| --- | --- |
| **#** | **Comment** |
| 1 | “I suggest changing instance name “NigZone” to be “NigZon” for consistency.”  Changed from NigZone to nigZon  Thanks! |
| 2 | “For some reason I get:  *Not possible to open file “/home/javi/Workspace/BOPTEST/testcases/two\_zone\_apartment\_hydronic/models/modelica://TwoZoneApartmentHydronic/Resources/ITA\_Milano-Linate.160800\_IGDG.mos” for reading: No such file or directory*  Even after adding “/home/javi/Workspace/BOPTEST/testcases/two\_zone\_apartment\_hydronic/models” to modelicapath.  I also tried with Modelica.Utilities.Files.loadResource(  “modelica://TwoZoneApartmentHydronic/Resources/ITA\_Milano-Linate.160800\_IGDG.mos”)  (instead of using ModelicaServices) without success.  This does not happen when changing filNam to be:  Modelica.Utilities.Files.loadResource(  “TwoZoneApartmentHydronic/Resources/ITA\_Milano-Linate.160800\_IGDG.mos”)  I tried on a Windows laptop and the weather file could be loaded properly with the original implementation. However, I suggest switching to the suggested approach not to have problems in Linux.”  Using Windows 10 and Ubuntu 18, Dymola 2020x for both the command Modelica.Utilities.Files.loadResource(  “TwoZoneApartmentHydronic/Resources/ITA\_Milano-Linate.160800\_IGDG.mos”). The command Modelica.Utilities.Files.loadResource(“modelica://TwoZoneApartmentHydronic/Resources/ITA\_Milano-Linate.160800\_IGDG.mos”) instead worked and simulated fine. Also the docker compose up and unit tests seem to run correctly.  As far as it works within the unit tests image it is fine. |
| 3 | “Please change the reference to the image plan in the documentation to be “SmallApartmentPlan.PNG” (with PNG as uppercase). On a Windows laptop it was rendered fine, but it seems Linux is not as flexible with capital letters.”  Changed so that it does not cause problem on a Linux machine  Thanks! Now it works.  “I also suggest changing all image directories to be relative to the modelicapath, E.g.  <img alt=\”SmallApartmentPlan.png\” src=\”modelica://TwoZoneApartmentHydronic/Resources/SmallApartmentPlan.PNG\”/>”  I followed the approach used in the various BESTETS (air, hydronic) for the images path. |
| 4 | “I can simulate, but get the following warnings and errors (for one week):  Warning: The following was detected at time: 0  Sensor ApartmentModelQHTyp.DayZon.density can lead to numerical problems if connected to a scalar fluid port.  Only connect it to a vectorized fluid port, such as used in ‘Buildings.Fluid.MixingVolumes`.  See Buildings.Fluid.Sensors.UsersGuide for more information.  To disable this warning, set ‘warnAboutOnePortConnection = false’ in ApartmentModelQHTyp.DayZon.density.  Failed condition: not DayZon.density.warnAboutOnePortConnection  Warning: The following was detected at time: 0  Sensor ApartmentModelQHTyp.NigZone.density can lead to numerical problems if connected to a scalar fluid port.  Only connect it to a vectorized fluid port, such as used in ‘Buildings.Fluid.MixingVolumes`.  See Buildings.Fluid.Sensors.UsersGuide for more information.  To disable this warning, set ‘warnAboutOnePortConnection = false’ in ApartmentModelQHTyp.NigZone.density.  Failed condition: not NigZone.density.warnAboutOnePortConnection  Warning: The following was detected at time: 0  Warning: In RadiantAverageResistance, require alpha = kIns/dIns <= 1.212 W/(m2.K).  Obtained alpha = 1.30769 W/(m2.K)  kIns = 0.034 W/(m.K)  dIns = 0.026 m  For these values, the radiant slab model is outside its valid range.  Failed condition: alpha < 1.212  The stack of functions is:  Buildings.Fluid.HeatExchangers.RadiantSlabs.BaseClasses.Functions.AverageResistance  Buildings.Fluid.HeatExchangers.RadiantSlabs.BaseClasses.Functions.AverageResistance(DayZon.RadiantSlab.disPip, DayZon.RadiantSlab.pipe.dOut, DayZon.RadiantSlab.layers.material[2].k, DayZon.RadiantSlab.sysTyp, DayZon.RadiantSlab.layers.material[3].k, DayZon.RadiantSlab.layers.material[3].x)  Warning: The following was detected at time: 0  Warning: In RadiantAverageResistance, require alpha = kIns/dIns <= 1.212 W/(m2.K).  Obtained alpha = 1.30769 W/(m2.K)  kIns = 0.034 W/(m.K)  dIns = 0.026 m  For these values, the radiant slab model is outside its valid range.  Failed condition: alpha < 1.212  The stack of functions is:  Buildings.Fluid.HeatExchangers.RadiantSlabs.BaseClasses.Functions.AverageResistance  Buildings.Fluid.HeatExchangers.RadiantSlabs.BaseClasses.Functions.AverageResistance(NigZone.RadiantSlab.disPip, NigZone.RadiantSlab.pipe.dOut, NigZone.RadiantSlab.layers.material[2].k, NigZone.RadiantSlab.sysTyp, NigZone.RadiantSlab.layers.material[3].k, NigZone.RadiantSlab.layers.material[3].x)  Model: TwoZoneApartmentHydronic.TestCases.ApartmentModelQHTyp  Integration started at 0 using integration method:  RK-method: radau IIa  Local extrapolation  FSAL  Continuous extension  Error: The following error was detected at time: 387.9167024009935  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 456.914 K exceeded its maximum allowed value of 130 degC (403.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T <= 403.15)  Error: The following error was detected at time: 380.750001675899  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 410.953 K exceeded its maximum allowed value of 130 degC (403.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T <= 403.15)  Error: The following error was detected at time: 72167.54105645762  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 271.466 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 72156.86648135682  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 269.037 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 158566.084907391  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 271.504 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 158555.741974028  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 269.139 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 244965.1851585406  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 271.173 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 244955.0377332085  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 268.708 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 331376.1049561446  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 258.731 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 417784.4598738049  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 250.541 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 417752.182148716  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 271.169 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 504189.3733276397  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 249.732 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)  Error: The following error was detected at time: 504154.69553067  In ApartmentModelQHTyp.hydronicSystem.AirHeaPum.vol.dynBal.medium: Temperature T = 270.675 K exceeded its minimum allowed value of -1 degC (272.15 Kelvin) as required from medium model “Buildings.Media.Water”.  Failed condition: noEvent(hydronicSystem.AirHeaPum.vol.dynBal.medium.T >= 272.15)”  Could these (or at least some of these) warnings and errors be addressed? Even if the model simulates, addressing the warnings and errors would lead to a healthier implementation.”  Removed sensor warning (changing flag, it does not affect simulation)  Slightly adjusted the floor heating insulation board, it’s a small difference but in this way the warning will not appear.  To adjust the error with the exceeding temperature I guess a filter could be added to the IDEAS.Fluid.HeatPumps.HP\_AirWater\_Tset, the on-off control sequence that is present now will always cause drastic change in the HP setpoint that directly converts into a drastic thermal input from the HP into the water volume.  Thanks for addressing the sensor warnings and adjusting the floor heating insulation board. Good point about the on-off controller of the IDEAS heat pump model. To be discussed in our next meeting. |
| 5 | I suggest explicitly stating in the documentation that this is a residential building from the very beginning. E.g. saying: “The building is a two-room residential apartment representing a real case study in Milan.”  Documentation updated adding suggested sentece in first paragraph  Great. Thanks! |
| 6 | “I suggest changing roof, IntWall, ElevatorSep, and AptSep instance names to be matRoo, matIntWal, matEleSep, matAptSep for consistency and because instance names typically start by a lower case. This extends to other instance names I’ve found, e.g. I would better use radSla, dayZon, and nigZon instead of RadiantSlab, DayZon, or NigZone”  Updated names to be according to libraries standards  Thanks a lot! |
| 7 | In the documentation, it is mentioned that: “the maximum occupation is two people, one per thermal zone, from 8 P.M. to 8 A.M. for the weekdays”. I suggest saying something like: “when occupied, there are two occupants”. Talking in terms of the maximum of occupants could mislead people to think that there are periods where there is only one occupant. Also, what about the weekends? I think the same occupancy schedule applies, right? I would either not mention “for the weekdays” or changing it to something like: “… both for the weekdays and weekends”.  Documentation updated regarding weekdays removing maximum occupancy. Added part related to weekends “<p> The apartment is occupied from 8 P.M. to 8 A.M. from Monday to Friday by two people, one per thermal zone. The thermal zones are considered unoccupied on Saturday and Sunday.</p>”  That’s very clear. Thanks! |
| 8 | “Isn’t 620 l/h too large for the flow rate circulating through each thermal zone? From my experience, these flows range between 0-5 l/min (so up to 300 l/h), at least for residential buildings.”  It is indeed, but the system was designed that way, so I used the design specifications of the real apartment.  Okay! |
| 9 | “The drawing for the primary and secondary system design shows a control connection between the temperature sensor of the living room and the thermostat of the bedroom. Is that intentional? I would expect it to be connected to the thermostat of the living room.”  No, it’s indeed a mistake, I updated the image.  Looking good. Thanks! |
| 10 | “In the documentation it is mentioned: “an air source 5kW heat pump”. I’d suggest to explicitly mention that that power refers to the nominal heating capacity of the heat pump.”  Updated documentation stating that is the nominal power: “the generation system is an air source heat pump with a nominal power of 5kW modelled after a Daikin heat pump.”  Thanks! Although my point was more about the heating capacity than the nominal power. Sometimes it is confused with the electric power if not explicitly stated. So my thought was to say: “the heating production system is an air source heat pump with a nominal heating capacity of 5 kW modelled after a Daikin heat pump.” |
| 11 | “Is there a reason why the HP\_AirWater\_TSet model is duplicated in the Components package instead of directly using the model from IDEAS? I would avoid this to facilitate future updates and maintenance.”  I did that to avoid a bug in the IDEAS library when I first implemented it. However, not it’s fixed, so I removed my instance of that model and called the original  Great. Thanks! |
| 12 | “Is it needed to define TSetHeaWee additionally to TSetHeaOcc? What does TSetHeaWee stand for?”  The variable TSetHeaWee is used to change the setpoint for the weekend so that occupancy schedule is not always the same  Ok I see. Could that distinction be made for the description of each variable? Now both state “Occupied heating setpoint” |
| 13 | “It should be possible to overwrite TSetHea in each thermostat for those users preferring to implement the temperature setpoint instead of the actuator signals directly.”  Added “oveTsetZon” and “reaTsetZon” to allow user to change and check setpoint temperature in the thermostat model.  Thanks! |
| 14 | “In reaPPlug, the KPIs parameter is assigned “SignalTypes.SignalsForKPIs.None” whereas it should be “SignalTypes.SignalsForKPIs.ElectricPower” (it should account for energy use and peak power calculation). Same applies for reaPLig.  Added to KPI  Thanks! |
| 15 | Circulation pump input should allow to be overruled and its electricity use should also be tagged as an output with “SignalTypes.SignalsForKPIs.ElectricPower” in its KPI parameter.”  Added reader component and KPI  Thanks! Could we extend the variable description to be more specific? Right now, variable description is “Mass flow rate”. I suggest something like: “Mas flow rate control input to circulation pump for water through floor heating system.” |
| 16 | “I suggest sorting the Model IO’s alphabetically. See e.g. [/testcases/bestest\_hydronic\_heat\_pump/models/get\_html\_IO.py](https://github.com/ibpsa/project1-boptest/blob/11e7e2c178b68967ce24dd8a5eae3c4d783037a6/testcases/bestest_hydronic_heat_pump/models/get_html_IO.py#L46) to see how to do so.”  Added new inputs and outputs, ordered them using script  Thanks! |
| 17 | “In “Other assumptions” it is mentioned that the supply air temperature is directly specified. Which air temperature is referenced here? I suggest specifying it in the documentation.”  Mistake due to copy paste from BESTEST air, removed from documentation  Okay! |
| 18 | “The CO2 needs to be modelled as to compute the indoor air quality, which is one of the core KPIs. “  CO2 is modelled. However being an Hydronic system there is no possibility for the controller to act on CO2 values.  That happens sometimes. Still the functionality should be there to compute the indoor air quality. I see the tags have been added. Thanks! |
| 19 | “Could the main test case data points be added to the [compare\_references.py](https://github.com/ibpsa/project1-boptest/blob/master/testing/compare_references.py) script analogously to other test cases? This helps to compare unit test reference data when checking updates of the emulator. Unit tests in general also need to be added.”  Added testcase to compare\_references. Merged with master v0.3 and added new unit tests.  That’s all great. Thanks!  The IDEAS\_COMMIT in library\_versions.json corresponds to IDEAS v2.2.1 but annotation in the test case package shows IDEAS(version="2.1.0")). This annotation needs to be corrected. I would also suggest to remove MultiZoneResidentialHydronic(version="2") from package annotation, and any other library not used in the test case. For future versions I suggest updating to latest Modelica 4.0.0 and newest |
| 20 | Ettore Zannetti is still to be added to the “contributors.md” file in the BOPTEST repository. |

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# III. Model Checks

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| **Criteria** | **Reviewer Response** |
| **Reference Case Representation** |  |
| Does the model represent overall intent of reference case?  Are the relevant thermal systems, heat loads, and control signals accounted for? | In general yes. Only concern: see general comment 8. 🡪 addressed in review process. |
| **Climate** |  |
| Complete weather data file, similar to TMY? | Yes |
| Sufficiently long period, e.g. one year? | Yes |
| **Internal Gains** |  |
| Occupancy schedule? | Yes, but see comment 7 🡪 addressed in review process. |
| Occupancy gain values reasonable for building type? | “reaPowQint ranges between 0 and 0.25 Watts. I guess units are wrong.”  Unit was in kW, changed to W  Great, thanks! |
| Lighting schedule/control? | Yes |
| Lighting gain values reasonable for building type? | Yes |
| Equipment schedule? | Yes |
| Equipment gain values reasonable for building type? | Yes |
| **Envelope Modeling** |  |
| Are IDEAS, Buildings, or AixLib component models used for building envelope and window modeling? | Yes |
| If not IDEAS, Buildings, or AixLib component models, are dynamic wall heat transfer models used? | N/A |
| If not IDEAS, Buildings, or AixLib component models, are complex fenestration models used? | N/A |
| If not IDEAS, Buildings, or AixLib component models, is latitude and longitude consistent with intended region or weather file? | N/A |
| If not IDEAS, Buildings, or AixLib component models, are convection models for inside and outside nonlinear? | N/A |
| If not IDEAS, Buildings, or AixLib component models, are the inside and outside radiation models appropriate? | N/A |
| Are window surface areas reasonable? | Yes |
| Are insulation levels reasonable? | Yes, 10 cm of material with k=0.034 W/m2K. |
| Are all surfaces accounted for? (e.g. the roof is not forgotten) | Yes |
| Which of the following is used for modeling air infiltration?  *None*  *Constant*  *Pressure-driven flow*  *Buoyancy-driven flow*  *Mixed pressure and buoyancy-driven flow* | Constant (0.5 ACH) |
| Inter-zone airflow and common wall heat transfer properly accounted for? | “No, inter-zone airflow no modelled? Also, since “AptSep” is assigned to both zones in “datConBou”, wouldn’t that mean that we have two partition walls?”  Inter-zone airflow added using Buildings.Airflow.Multizone.DoorDiscretizedOpen. In one thermal zone there is the actual wall (DayZon), on the other there are just optical properties (NigZone)  I see, thanks! |
| **HVAC Modeling** |  |
| Are moisture and condensation effects properly accounted for? | A moist air model is used, but condensation is not modeled in the HVAC and humidity is not monitored. |
| Are fluid components such as ducts, pipes, actuators, pumps, fans, and heat exchangers modeled with pressure-flow relationships? Are pressure drops reasonable? | “No. Nominal pressure difference in heat pump is 1 Pa.  DP\_n specifies nominal flow rate in comment (instead of pressure drop).  Would be nice to have all circuit pressure drops relative to one single value, e.g. pump.dp\_nominal or DP\_n.”  Changed all pressure drops in reference of DP\_n  Great. Thanks! |
| Is the heat transfer performance of other equipment such as heat exchangers and plant equipment modeled reasonably? | Yes |
| Are equipment capacities reasonable? | “Yes for DayZon. However, for NigZone I get that there is no heating? NigZone.RadiantSlab.surf\_b.Q\_flow is constantly 0.”  It is correct that …RadiantSlab.surf\_b.Q\_flow is zero for both DayZon and NigZone since both floors are adiabatic. The Power on the water side can be seen from …powFloHeat and the power released by the floor by RadiantSlab.surf\_a.Q\_flow  Okay that makes sense. Thanks for the clarification! |
| Are equipment efficiencies such as COP, heating, hydraulic, and motor reasonable? | Yes |
| Is reasonable baseline control provided in the model? Can the model be simulated without an external controller? | Yes, realistic default controller, but see comment 9 the diagram in the documentation. 🡪 addressed in review process. |
| **External Control Input Signals** |  |
| Are Modelica signal exchange blocks used? | Yes |
| Reasonable set of external control signals? | Yes, but see comment 13, 14, 15, 16 🡪 addressed in review process. |
| Units assigned?  In SignalExchange.Overwrite assign a unit to the input variable u. | Yes |
| Descriptions assigned?  In SignalExchange.Overwrite use the parameter description. | Yes |
| Min/max assigned?  In SignalExchange.Overwrite assign a min and max to the input variable u. | Yes |
| **Measurement Output Signals** |  |
| Are Modelica signal exchange blocks used? | Yes |
| Reasonable set of measurement output signals? | Yes |
| Is at least one, and more if necessary, of the following KPI labels used to account for equipment power/fuel consumptions for KPI calculation? Is power consumption from all relevant equipment tagged? {ElectricPower, DistrictHeatingPower, GasPower, BiomassPower, or SolarThermalPower}  In SignalExchange.Read, use the parameter KPIs. | Yes, but see comments 14 and 15 🡪 addressed in review process. |
| Are all necessary zone temperatures tagged with one of the following KPI labels for KPI calculations and appropriate zone identifier(s) given? {AirZoneTemperature or OperativeZoneTemperature}  In SignalExchange.Read, use the parameters KPIs and zone. | Yes |
| Are all zone CO2 measurements tagged with the following KPI label for KPI calculations and appropriate zone identifier(s) given? {CO2Concentration}  In SignalExchange.Read, use the parameters KPIs and zone. | “Yes, but missing CO2 concentration modelling. CO2 concentration is constantly the same concentration as ambient.”  Added generation term for CO2 and added reader to KPI  Great, thanks! |
| Units assigned?  In SignalExchange.Read assign a unit to the output variable y. | “Yes only  NigZone\_TretFloHea\_y seems to show the wrong unit.”  I did not see the mistake in Dymola, tbd  Now I see it is in [K]. |
| Descriptions assigned?  In SignalExchange.Read use the parameter description. | Yes |
| **Compilation and Simulation** |  |
| Uses official library release versions (with Modelica “Uses” statement)? | “Uses IDEAS v2.2.1 but no specific Buildings library version.”  These are the specific commits used for the testcase  "IBPSA\_COMMIT": "8a0d2372925b93c5c5aa536eb3afceee3a07bcb3",  "BUILDINGS\_COMMIT": "69bb7cf6b12898a2b17ad9d9371ed0eec3faaa12",  "IDEAS\_COMMIT": "32860eadbf59bee955993da936a8c5aeac2d90df"  See comment 19. I can’t check out the specified Buildings commit for some reason. |
| Can be compiled into model-exchange or co-simulation FMU that can be simulated without use of commercial licensing? | Yes, tested with the BOPTEST framework itself. |
| What is the intended solver, tolerance, and timestep (if constant timestep solver)? Are these reasonable to simulate the model dynamics? | Default solver was Radau with 1e-06 tolerance in Dymola. |
| Simulates for full year? | Yes, in less than a couple of minutes with /advance BOPTEST calls of 1 day and without overwriting any input. Output temperature seems reasonable.  Test with OM in MacOS as well. |

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# IV. Test Case Checks

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| **Criteria** | **Response** |
| **Documentation** |  |
| Building Design and Use (including architecture, constructions, occupancy schedules and comfort, internal loads and schedules, climate) | All is documented |
| HVAC System Design (including primary and secondary system designs, equipment specifications and performance maps, rule based and/or local loop controllers) | “Performance maps documentation a bit short and missing for fluid movers.”  Added description for fluid movers:  The heating system circulation pump has the default efficiency of the pump model, which is 49%; at the time of writing. The flow rate for each thermal zone floor heating circuit is 620 [l/h].The heat pump perfomance map is the default map present in the IDEAS heat pump  model coming from a Darikin heat pump.  That helps. Thanks! |
| Additional System Design  (such as lighting, shading, onsite generation and storage) | Ok |
| Points List (including control inputs signals with descriptions, units, min/max, and default values, and measurement output signals with descriptions and units) | Yes |
| Important Model Assumptions  (such as infiltration models, moist/dry air assumptions, well-mixed assumptions, CO2 generation from occupants and concentration in outside air) | Yes, but see comment 17 🡪 addressed in review process. |
| Scenario Information (including time periods, energy pricing, and emission factors) | Ok |
| HTML template followed (see Appendix A)? | Yes |
| **BOPTEST Data Requirements** |  |
| If model DOES NOT make use of signal exchange Modelica blocks, is a KPI JSON provided for matching output signals to KPI keywords (see Appendix B)? | N/A |
| Is a Days JSON provided for specifying scenario time periods (see Appendix B)? | Yes |
| Data for weather provided as csv with correct header names (see Appendix C)?  Does the data of this type used within the model match the data provided in the csv? | “Yes, but seems that last values (~half day) for some variables (e.g. ambient temperature) are constant in both the model and the csv data.”  The data come from the Milan typical year TMY3 file. I saw the temperature in the last couple of hours of the year is constant. If it’s a problem I could look for a different TMY3 file for Milan  To be discussed during our next progress meeting. |
| Data for zone comfort setpoint temperature(s) for each zone provided as csv with correct header names (see Appendix C)? Does the data of this type used within the model match the data provided in the csv? | “Heating setpoint is fine, but cooling setpoint is not provided in the model.”  Cooling is not present at this time, will be added in future release (together with reversible heat pump model)  Do we have an idea of when these additions will come. We might want to hold the release until then to avoid inconsistent test case runs. To be discussed during our next progress meeting as well. |
| Data for occupancy (number of occupants) schedule for each zone provided as csv with correct header names (see Appendix C)?  Does the data of this type used within the model match the data provided in the csv? | Yes |
| Data for internal gains for each zone provided as csv with correct header names (see Appendix C)? Does the data of this type used within the model match the data provided in the csv? | “Internal gains in csv files are way too high. How these have been computed?”  They come from the model TwoZoneApartmentHydronic.TestCases.BoundaryConditions that uses the same sub models to estimate internal gains. The values come from Italian/ASHRAE standards (BESTEST air uses even higher values)  I see. I think I should have mistaken the file, they are indeed not as high… Thanks for checking! |
| Data for GHG emission factors for each fuel source provided as csv with correct header names (see Appendix C)? | Yes |
| Data for energy pricing provided as csv with correct header names (see Appendix C)? | Yes |

# Appendix A: Documentation Template

<html>

General model description.

<h3>Building Design and Use</h3>

<h4>Architecture</h4>

<p>

…

</p>

<h4>Constructions</h4>

<p>

…

</p>

<h4>Occupancy schedules</h4>

<p>

…

</p>

<h4>Internal loads and schedules</h4>

<p>

…

</p>

<h4>Climate data</h4>

<p>

…

</p>

<h3>HVAC System Design</h3>

<h4>Primary and secondary system designs</h4>

<p>

…

</p>

<h4>Equipment specifications and performance maps</h4>

<p>

…

</p>

<h4>Rule-based or local-loop controllers (if included)</h4>

<p>

…

</p>

<h3>Model IO's</h3>

<h4>Inputs</h4>

The model inputs are:

<ul>

<li>

<code>Input1</code> [UNIT1]: Description

</li>

</ul>

<h4>Outputs</h4>

The model outputs are:

<ul>

<li>

<code>Output1</code> [UNIT1]: Description

</li>

<li>

<code>Output2</code> [UNIT2]: Description

</li>

</ul>

<h3>Additional System Design</h3>

<h4>Lighting</h4>

<p>

…

</p>

<h4>Shading</h4>

<p>

…

</p>

<h4>Onsite Generation and Storage</h4>

<p>

…

</p>

<h3>Model Implementation Details</h3>

<h4>Moist vs. dry air</h4>

<p>

…

</p>

<h4>Pressure-flow models</h4>

<p>

…

</p>

<h4>Infiltration models</h4>

<p>

…

</p>

<h4>CO2 models</h4>

<p>

…

</p>

<h3>Scenario Information</h3>

<h4>Time Periods</h4>

<p>

…

</p>

<h4>Energy Pricing</h4>

<p>

…

</p>

<h4>Emission Factors</h4>

<p>

…

</p>

</html>

# Appendix B: JSONs

KPI JSON

{<kpi\_ID> : // Unique identifier for KPI

[<output\_ID>] // List of FMU outputs to be included in calculation

}

Saved as “kpis.json”

For kpi\_IDs requiring zone designations, the zone designation can be appended to the end of the kpi\_ID as <kpi\_ID>[z], where z is the zone designation. These are AirZoneTemperature[z], OperativeZoneTemperature[z], and CO2Concentration[z].

Days JSON

{<time\_period\_ID> : // Unique identifier for specifying time period

<day #> // Integer value indicating day number to use for specifying time period

}

Saved as “days.json”

# Appendix C: Specifications for Data CSV Files

This information is taken from the BOPTEST Development Requirements and Guide Section IV. D.

The CSV data files should accomplish the following requirements:

1. The files can have any name.
2. The files should have a “*time*” column indicating the time since the beginning of the year in seconds.
3. The files should have column names using the key-words specified by the conventions below. Columns that do not apply to the test case may be omitted (e.g. *EmissionsGasPower* if the test case does not use gas power).
4. The files can have optional header rows for holding information about the data contained in the csv file. These header rows can be indicated by starting the row with the character "#".

Data for the CSV files may optionally be generated using the functions that are available in the module *data/data\_generator.py* located in the software repository at https://github.com/ibpsa/project1-boptest. Default parameters for these functions may be used, or modified based on the test case. If default parameters are used, care should be taken to make sure the resulting data matches that which may be used in the test case model.

|  |  |  |
| --- | --- | --- |
| **CATEGORY: *weather*** | | |
| **NAME** | **UNIT** | **DESCRIPTION** |
| *HDifHor* | W/m2 | Horizontal diffuse solar radiation. |
| *HDifNor* | W/m2 | Direct normal radiation. |
| *HGloHor* | W/m2 | Horizontal global radiation. |
| *HHorIR* | W/m2 | Horizontal infrared irradiation. |
| *TBlaSky* | K | Output temperature. |
| *TDewPoi* | K | Dew point temperature. |
| *TDryBul* | K | Dry bulb temperature at ground level. |
| *TWetBul* | K | Wet bulb temperature. |
| *celHei* | m | Ceiling height. |
| *cloTim* | s | One-based day number in seconds. |
| *lat* | rad | Latitude of the location. |
| *lon* | rad | Longitude of the location. |
| *nOpa* | 1 | Opaque sky cover [0, 1]. |
| *nTot* | 1 | Total sky Cover [0, 1]. |
| *pAtm* | Pa | Atmospheric pressure. |
| *relHum* | 1 | Relative Humidity |
| *solAlt* | rad | Altitude angel. |
| *solDec* | rad | Declination angle. |
| *solHouAng* | rad | Solar hour angle. |
| *solTim* | s | Solar time. |
| *solZen* | rad | Zenith angle. |
| *winDir* | rad | Wind direction. |
| *winSpe* | m/s | Wind speed |

|  |  |  |
| --- | --- | --- |
| **CATEGORY: *prices*** | | |
| **NAME** | **UNIT** | **DESCRIPTION** |
| *PriceElectricPowerConstant* | ($/€)/kWh | Completely constant electricity price |
| *PriceElectricPowerDynamic* | ($/€)/kWh | Electricity price for a day/night tariff |
| *PriceElectricPowerHighlyDynamic* | ($/€)/kWh | Spot electricity price |
| *PriceGasPower* | ($/€)/kWh | Price to produce 1 kWh thermal from gas |
| *PriceDistrictHeatingPower* | ($/€)/kWh | Price of 1 kWh thermal from district heating |
| *PriceBiomassPower* | ($/€)/kWh | Price to produce 1 kWh thermal from biomass |
| *PriceSolarThermalPower* | ($/€)/kWh | Price to produce 1 kWh thermal from solar irradiation |

|  |  |  |
| --- | --- | --- |
| **CATEGORY: *emissions*** | | |
| **NAME** | **UNIT** | **DESCRIPTION** |
| *EmissionsElectricPower* | kgCO2-eq/kWh | Kilograms of carbon dioxide equivalent to produce 1 kWh of electricity |
| *EmissionsGasPower* | kgCO2-eq/kWh | Kilograms of carbon dioxide equivalent to produce 1 kWh thermal from gas |
| *EmissionsDistrictHeatingPower* | kgCO2-eq/kWh | Kilograms of carbon dioxide equivalent to produce 1 kWh thermal from district heating |
| *EmissionsBiomassPower* | kgCO2-eq/kWh | Kilograms of carbon dioxide equivalent to produce 1 kWh thermal from biomass |
| *EmissionsSolarThermalPower* | kgCO2-eq/kWh | Kilograms of carbon dioxide equivalent to produce 1 kWh thermal from solar irradiation |

|  |  |  |
| --- | --- | --- |
| **CATEGORY: *occupancy*** | | |
| **NAME** | **UNIT** | **DESCRIPTION** |
| *Occupancy[z]* | Number of occupants | Number of occupants at zone ‘z’ |

|  |  |  |
| --- | --- | --- |
| **CATEGORY: *internalGains*** | | |
| **NAME** | **UNIT** | **DESCRIPTION** |
| *InternalGainsRad[z]* | W | Radiative internal gains at zone ‘z’ |
| *InternalGainsCon[z]* | W | Convective internal gains at zone ‘z’ |
| *InternalGainsLat[z]* | W | Latent internal gains at zone ‘z’ |

|  |  |  |
| --- | --- | --- |
| **CATEGORY: *setpoints*** | | |
| **NAME** | **UNIT** | **DESCRIPTION** |
| *LowerSetp[z]* | K | Lower temperature set point of the comfort range at zone ‘z’ |
| *UpperSetp[z]* | K | Upper temperature set point of the comfort range at zone ‘z’ |
| *UpperCO2[z]* | ppm | Upper CO2 concentration limit for zone ‘z’ |