Dataset of the EnergyPlus model used in the assessment of natural ventilation potential through building simulation

N.R.M. Sakiyama\textsuperscript{a,b,*}, L. Mazzaferro\textsuperscript{c}, J.C. Carlo\textsuperscript{d}, T. Bejat\textsuperscript{e}, H. Garrecht\textsuperscript{a}

\textsuperscript{a} Materials Testing Institute (MPA) University of Stuttgart, Pfaffenwaldring 2b, 70569 Stuttgart, Germany
\textsuperscript{b} Institute for Science, Engineering and Technology (ICET), Federal University of the Jeq. and Muc. Valleys (UFVJM), R. Cruzeiro, 01 – Jardim São Paulo, 39803-371 Teofilo Otoni, Brazil
\textsuperscript{c} Laboratory of Energy Efficiency in Buildings (LabEEE), Federal University of Santa Catarina (UFSC), Caixa Postal 476, 88040970 Florianópolis, Brazil
\textsuperscript{d} University Grenoble Alpes, CEA, LITEN, DTS, LIPV, INES, F-38000 Grenoble, France
\textsuperscript{e} Architecture and Urbanism Department (DAU), Federal University of Vicosa (UFV), Av P. H. Rolfs, 36570 900 Viçosa, Brazil

\begin{abstract}
The data set compiled in this file refers to the Multizone EnergyPlus model, used in the investigations of the research article entitled "Natural ventilation potential from weather analyses and building simulation". The technical information regarding the model has been grouped into tables, which include: the general simulation settings, the properties of the building materials, the Airflow Network opening settings used in the annual investigation, in addition to the controls established in the Energy Management System (EMS) for hybrid ventilation system operation. The user behaviour, regarding the living and bedrooms occupancy schedule, is also presented in a graph. This data set is made available to the public to clarify details of the EnergyPlus model and how the hybrid operation was defined. In this way, other researchers can perform an extended analysis of the information.
\end{abstract}
Specifications Table

| Subject          | Engineering, Architecture |
|------------------|----------------------------|
| Specific subject area | Building simulation in hybrid mode: heating loads and thermal comfort assessment |
| Type of data     | Tables, Graph, Text        |
| How data were acquired | Building energy modelling – Computer simulation using EnergyPlus software |
| Data format      | Raw                        |
| Parameters for data collection | Building energy model (input data file -.idf) created from a full-scale test passive house |
| Description of data collection | The model geometry was developed using SketchUp Make 2017 with OpenStudio Plugin for EnergyPlus and the computer simulation run using EnergyPlus software, version 9.1 |
| Data source location | French National Institute for Solar Energy - INES Chambery, French Alps |
| Data accessibility | With the article EnergyPlus files (.idf); https://data.mendeley.com/datasets/rp6xy7rfhn/1 |
| Related research article | Sakiyama NRM, Mazzaferro L, Carlo JC, Bejat T, Garrecht H. Natural ventilation potential from weather analyses and building simulation. Energy and Buildings 2021;231:110596. https://doi.org/10.1016/j.enbuild.2020.110596 |

Value of the Data

- The detailed data related to the EnergyPlus model guarantees a better and deeper understanding of the building addressed in the research paper [1], grounding the study developed and providing more information to aid in reading the paper.
- Both building modelling and simulation are performed using EnergyPlus software. Different configurations/simulation techniques could be employed based on this available data, so different studies might be compared.
- The data presented in this article can assist designers and researchers who deal with the modelling of naturally ventilated buildings, especially with Airflow Network and multizone approach.
- The use of Energy Management System (EMS) to model hybrid ventilation operation could be adopted as a reference for further research on naturally ventilated buildings.

1. Data Description

The data in this article present the input data regarding the EnergyPlus model used at the investigations addressed in the research paper. General simulation settings are summarised in Table 1, while the building materials properties are listed in Table 2. Table 3 shows the Airflow Network opening settings used in the annual investigation. Finally, the occupancy schedule, which specifies when the living and bedrooms were occupied, as well as its respective number of people, can be seen in Fig. 1.

The model set up is based on consolidated practices used in studies involving INES’ experimental houses, and therefore does not use the EnergyPlus database. Since they are originally
unoccupied, a classic family occupancy schedule was established, which would represent an extreme/worse possible scenario.

Besides, the EnergyPlus input data files (.idf) are available for download in the Mendeley repository [2], and the link can be found in the Specifications table/ Data accessibility. The files supplied include: the calibration (a) and the annual analysis (b) models, which are summarized in Table 1.

2. Experimental Design, Materials and Methods

The controls developed in the Energy Management System (EMS) object for the consolidation of the hybrid behaviour at the annual analyses are presented below. The operation mode was adopted in all occupied zones, exemplified here by the living room zone.

The set up enables the following changes: triggering the thermal load calculation at a temperature different from the thermostat; deactivation of the thermal load calculation only after occupancy in a room is null; hybrid control, where the local thermal prognosis is not allowed to occur together with the window opening for natural ventilation in the same time step.

**All objects in class: energymanagementsystem:sensor**

EnergyManagementSystem:Sensor,
OT_Living, !- Name
Living, !- Output:Variable or Output:Meter Index Key Name
Zone Operative Temperature; !- Output:Variable or Output:Meter Name
EnergyManagementSystem:Sensor,
Occ_Living, !- Name
Living_Occ, !- Output:Variable or Output:Meter Index Key Name
People Occupant Count; !- Output:Variable or Output:Meter Name
EnergyManagementSystem:Sensor,
Ext_Temp, !- Name
Environment, !- Output:Variable or Output:Meter Index Key Name
Site Outdoor Air Drybulb Temperature; !- Output:Variable or Output:Meter Name
EnergyManagementSystem:Sensor,
T_Living, !- Name
Living, !- Output:Variable or Output:Meter Index Key Name
Zone Mean Air Temperature; !- Output:Variable or Output:Meter Name
EnergyManagementSystem:Sensor,
Heat_Living, !- Name
Heat_Living, !- Output:Variable or Output:Meter Index Key Name
Schedule Value; !- Output:Variable or Output:Meter Name

**All objects in class: energymanagementsystem:Actuator**

EnergyManagementSystem:Actuator,
HeaterControl_Living, !- Name

| Table 1 | General simulation settings. |
|---------|-------------------------------|
| Run period | Calibration Model (a) | Annual Analyses (b) |
| Airflow simulation | 19th till 25th August | 1st January till 31th Dezember |
| HVAC template:Zone:PTHP | Airflow Network | EMS: Airflow Network |
| Solar distribution | FullExteriorWithReflections | TARP |
| Surface convection Algorithm: Inside | ConductionTransferFunction | DOE-2 |
| Surface convection Algorithm: Outside | | |
| Heat Balance Algorithm | | |
| Monthly ground temperature (°C) | 4.5, 6.21, 9.3, 12.99, 16.28, 18.27, 18.43, 16.69, 13.55, 9.86, 6.58, 4.62 | 6 |
| Time steps per hour | | |
Table 2
Building material properties.

| Construction type | Construction name | Material layers (outside to inside) | Thickness (m) | Conductivity (W/m-K) | Density (kg/m3) | Specific Heat (J/kg-K) | Thermal Absorptance | Solar Absorptance | Visible Absorptance |
|-------------------|-------------------|------------------------------------|---------------|----------------------|-----------------|------------------------|---------------------|-------------------|---------------------|
| Façade            | MurExt_isole      | Porotherm R42 (Hollow brick)       | 0.425         | 0.115                | 700             | 986                    | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Plaster                            | 0.01          | 0.4                  | 1200            | 1000                   | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Placo_13mm                          | 0.013         | 0.25                 | 825             | 1008                   | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Glass Wool 5cm                      | 0.05          | 0.032                | 12              | 840                    | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Placo_13mm                          | 0.013         | 0.25                 | 825             | 1008                   | 0.9                 | 0.6               | 0.6                 |
| Internal walls    | Cloisons_Etage    | Structural Wall                     | 0.425         | 2.5                  | 2500            | 1000                   | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Structural Wall                     | 0.05          | 1.4                  | 2100            | 650                    | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Structural slab                      | 0.2           | 2.5                  | 2500            | 1000                   | 0.9                 | 0.6               | 0.6                 |
|                   |                   | PolystyreneXtrude                    | 0.16          | 0.027                | 35              | 1400                   | 0.9                 | 0.6               | 0.6                 |
| Underground walls | Mur_vs            | Concrete screed                     | 0.08          | 1.75                 | 2400            | 880                    | 0.9                 | 0.6               | 0.6                 |
|                   | PB_VS             | Compression slab                    | 0.04          | 1.75                 | 2400            | 880                    | 0.9                 | 0.6               | 0.6                 |
|                   | PH_VS_isole       | Hollow concrete slab                 | 0.16          | 1.23                 | 1300            | 648                    | 0.9                 | 0.6               | 0.6                 |
| Ground floor slab | PH_RCD            | Glass Wool Filling                  | 0.44          | 0.032                | 12              | 840                    | 0.9                 | 0.6               | 0.6                 |
|                   |                   | OSB Floor                           | 0.022         | 0.13                 | 640             | 1700                   | 0.9                 | 0.6               | 0.6                 |
|                   |                   | Tiles                               | 0.015         | 2.2                  | 1121            | 1460                   | 0.9                 | 0.7               | 0.7                 |
|                   |                   | Wood Structure                       | 0.08          | 0.055                | 265             | 836                    | 0.9                 | 0.7               | 0.7                 |
|                   |                   | Metal Decking                       | 0.0015        | 45                   | 7680            | 418                    | 0.9                 | 0.6               | 0.6                 |
Table 3
AFN opening settings – annual investigation.

| Opening name/orientation | U-factor (W/m²K) | Solar Heat Gain Coefficient | Opening Factor | Ventilation Control Mode | Discharge Coefficient | Temp. set point | Ventilation Availability schedule |
|--------------------------|------------------|-----------------------------|----------------|--------------------------|------------------------|----------------|----------------------------------|
| External Windows         |                  |                             |                |                          |                        |                |                                  |
| Cellar_N                 | 1.68             | 0.24                        | 0.75           | Temp.                    | 0.50                   | 20             | EMS                              |
| Living_E                 | 1.4              | 0.21                        | 0.75           | Temp.                    | 0.50                   | 20             | EMS                              |
| Hall_E                   | 1.4              | 0.21                        | 0.75           | Temp.                    | 0.50                   | 20             | EMS                              |
| Living_S                 | 1.28             | 0.47                        | 0.75           | Temp.                    | 0.50                   | 20             | EMS                              |
| Bedroom3_S               | 1.34             | 0.39                        | 0.75           | Temp.                    | 0.50                   | 20             | EMS                              |
| Stairs_N                 | 1.32             | 0.21                        | 0.75           | Temp.                    | 0.50                   | 20             | EMS                              |
| Internal Doors           |                  |                             |                |                          |                        |                |                                  |
| Horizontal Opening       |                  |                             |                |                          |                        |                |                                  |
| (Stair case)             |                  |                             |                |                          |                        |                |                                  |

**Fig. 1.** Occupancy schedule – annual simulation a=Weekdays schedule; b=Weekend schedule.

Heat_Living, !- Actuated Component Unique Name
Schedule:Constant, !- Actuated Component Type
Schedule Value; !- Actuated Component Control Type
EnergyManagementSystem:Actuator,
NVControl_Living, !- Name
NV_Living, !- Actuated Component Unique Name
Schedule:Constant, !- Actuated Component Type
Schedule Value; !- Actuated Component Control Type

All objects in class: energymanagementSystem:programcallingmanager
EnergyManagementSystem:ProgramCallingManager,
HybridControl, !- Name
BeginTimestepBeforePredictor, !- EnergyPlus Model Calling Point
Hyb_Living, !- Program Name 1

All objects in class: energymanagementSystem:program
EnergyManagementSystem:Program,
Hyb_Living, !- Name
SET Temp_Heat = T_Living <= 19, !- Program Line 1
IF ((Occ_Living > 0) && (Temp_Heat <=1)), !- Program Line 2
SET HeaterControl_Living =1, !- A4
SET NVControl_Living =0, !- A5
ELSEIF ((Occ_Living > 0) && (Heat_Living >0)), !- A6
SET HeaterControl_Living = 1, !- A7
SET NVControl_Living =0, !- A8
ELSEIF (Occ_Living > 0), !- A9
IF ((Ext_Temp<T_Living) && (Ext_Temp>20)), !- A10
SET HeaterControl_Living = 0, !- A11
SET NVControl_Living = 1, !- A12
ELSEIF ((Ext_Temp > T_Living) && (Ext_Temp > 20)), !- A13
SET HeaterControl_Living = 0, !- A14
SET NVControl_Living = 0, !- A15
ELSEIF (Ext_Temp < 20), !- A16
SET HeaterControl_Living = 0, !- A17
SET NVControl_Living = 0, !- A18
ENDIF, !- A19
ELSEIF (Occ_Living == 0), !- A20
SET HeaterControl_Living = 0, !- A21
SET NVControl_Living = 0, !- A22
ENDIF; !- A23

CRediT Author Statement

Nayara R. M. Sakiyama: Conceptualization, Methodology, Software, Data-curation, Formal analysis, Investigation, Writing-Original draft preparation; Leonardo Mazzaferro: Software, Visualization, Validation, Writing-Reviewing and Editing; Joyce C. Carlo: Supervision; Timea Bejat: Resources; Harald Garrecht: Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which, or could be perceived to have, influenced the work reported in this article.

Acknowledgements

This research was possible thanks to the contributions of the French National Institute for Solar Energy (INES, France), the Federal University of the Jequitinhonha and Mucuri Valleys (UFVJM, Brazil), and the Materials Testing Institute University of Stuttgart (MPA, Germany), which collectively supported this work.

Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi: 10.1016/j.dib.2021.106753.

References

[1] N.R.M. Sakiyama, L. Mazzaferro, J.C. Carlo, T Bejat, H. Garrecht, Natural ventilation potential from weather analyses and building simulation, Energy and Buildings 231 (2021) 110596, doi: 10.1016/j.enbuild.2020.110596.
[2] N. Sakiyama, EnergyPlus Models - Research paper: Natural ventilation potential from weather analyses and building simulation, Mendeley Data V2 (2021), doi: 10.17632/rp6xy7rfhn.2.