ENVI
_MET

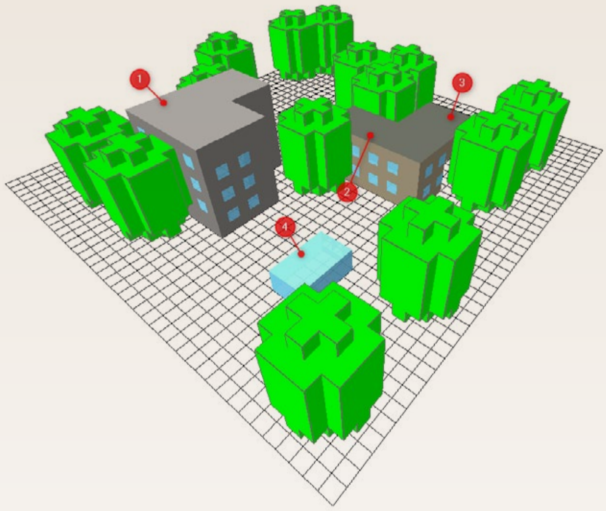
CASE STUDY
INSIDE OUTSIDE 1 / 2
provided by ENVI-met
07 / 2019

Connecting Inside and Outside

ANALYSIS OBJECTIVE

ENVI-met provides a multitude of tools to simulate and analyze the different aspects of building physics.

In an exemplary study, a 10-day-long simulation of a model area extending over 80 m x 80 m x 60 m with three buildings has been run in order to analyze the different behaviors of the materials and their influence on the inside air temperatures. The wall parameters of the different buildings – one concrete building (1), one well-insulated brick building (2), a well-insulated overhang that has its own distinct air volume (3), and one greenhouse (4) – mainly vary in the reflection/absorption, transmission, and thermal conductivity values.

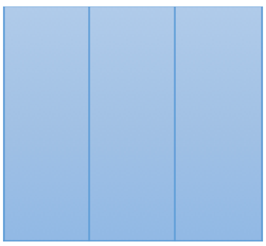


PHYSICAL PROPERTY	GLASS	CONCRETE	PLASTER	INSULATION	BRICK
Thickness [m]	0.01, 0.01, 0.01	0.01, 0.12, 0.18	0.03	0.07	0.3
Absorption	0.7	0.6	0.3	0.5	0.6
Transmission	0.4	0.0	0.0	0.0	0.0
Reflection	0.3	0.4	0.7	0.5	0.4
Emissivity	0.9	0.9	0.9	0.9	0.9
Specific Heat [J kg-1 K-1]	840	850	1250	1500	550
Thermal Conductivity [W m-1 K-1]	0.05	1.85	0.7	0.035	0.44
Density [kg m-3]	140	2220	2000	600	1500

1. GLASS

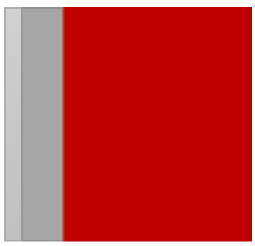
2. CONCRETE

**3. PLASTER
INSULATION
BRICK**



1.

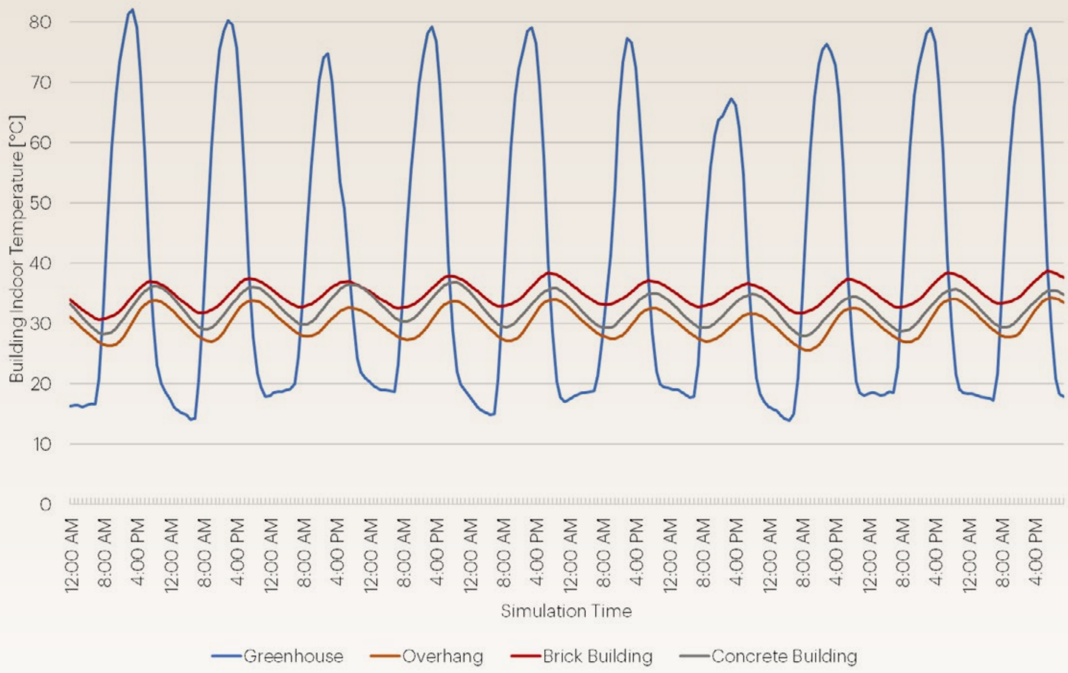
2.



3.

Connecting Inside and Outside

SIMULATION RESULTS



ANALYSIS

The four buildings with their specific materials lead to different inside temperatures throughout the day.
During the day, due to a high transmission and a low reflection rate, the greenhouse (4) clearly shows the highest temperatures, rising up to 81.95 °C. At night, the same properties lead to much cooler temperatures inside the greenhouse, as the heat, which accumulated during the day, transfers through the glass: A heat transfer through radiation caused by the high transmission and conduction through the walls take place.
Due to higher reflection, lower absorption, and much lower transmission rates, the indoor temperatures of the other three buildings are comparably cooler during the day and less heat exchange occurs at nighttime.
While the concrete building (1) has no insulation and only consists out of concrete, the brick building (2) has a strong insulation with a thermal conductivity of 0.035 W m-1 K-1. In the beginning of the 10-day simulation, the inside air temperatures of the brick and the concrete building only show small differences. As the conduction is much lower in the brick building compared to the concrete building, the inside air temperature of the brick building increases slightly more over time. This happens due to the lack of natural ventilation taken into account. With natural ventilation, the brick building would hold its temperature more effectively and lead to more comfortable temperatures, especially in long lasting heat periods.
With the overhang of the brick building (3) being declared as a distinct air volume, the inside air temperature is influenced by the outside processes disconnected from the other air volume, and thus has a different temperature variation compared to the building it is attached to. With a lower surface to volume ratio, it has more possibilities to cool down and consequently has an overall lower inside air temperature compared to the other building (2).
This study shows ENVI-met's capability to analyze the behaviors of different materials and their influence on the inside of the buildings.

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