

EXPERIMENTAL VALIDATION OF THE PROGRAM VOLTRA FOR 3D TRANSIENT HEAT TRANSFER



Introduction

Two experimental validations of the program VOLTRA for simulating 3D transient heat transfer were done on a small glazed wooden box.

In the first **indoors** experiment the transient heat transfer due to a sudden internal power source was investigated.

In the second experiment the box was put **outdoors**, allowing **validating the solar processor** module in **VOLTRA**.

The experimental validations were done in the framework of the SBO project IWT 050154 research program “Heat, air and moisture performance engineering. A whole building approach.”

Box description



removable roof

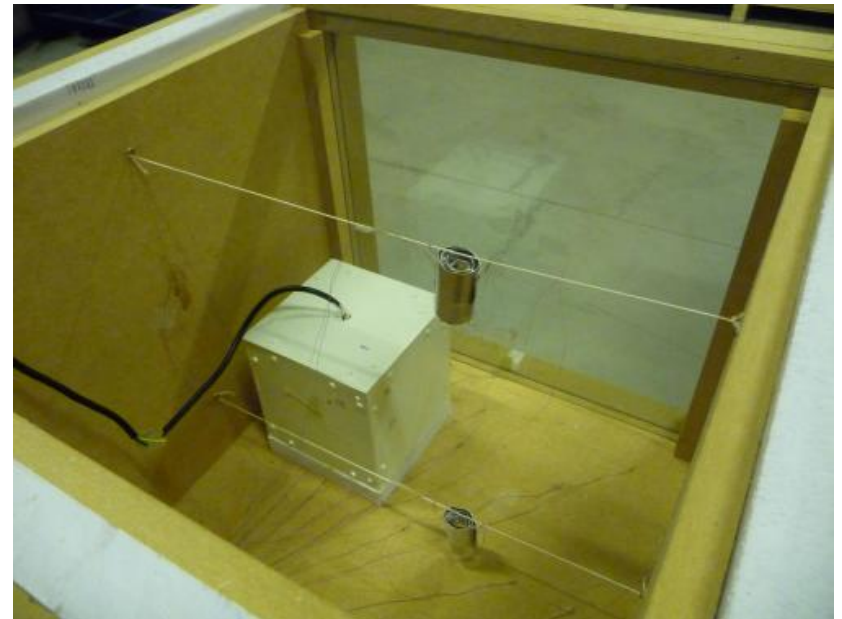
box double glazing (MDF spacer)

box wall (materials: MDF, XPS)

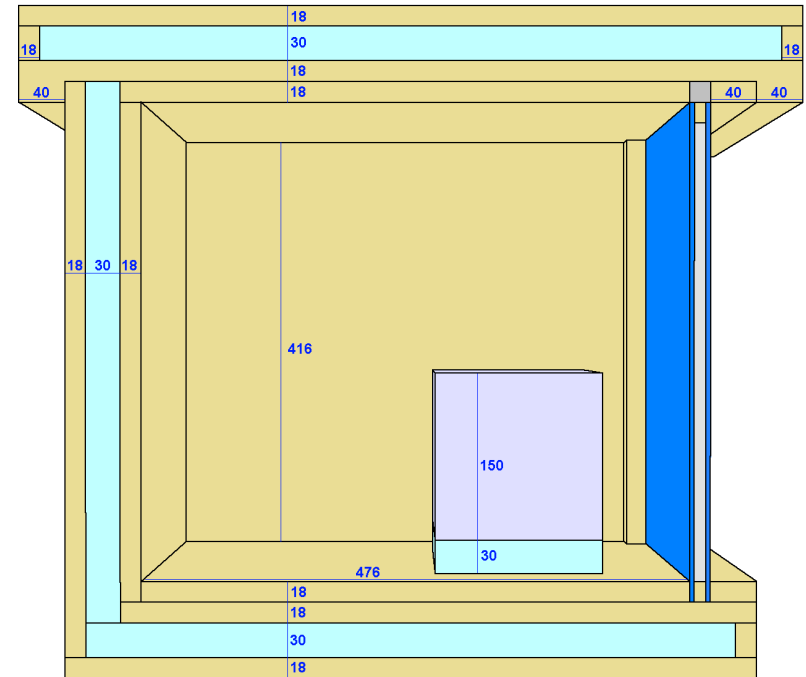
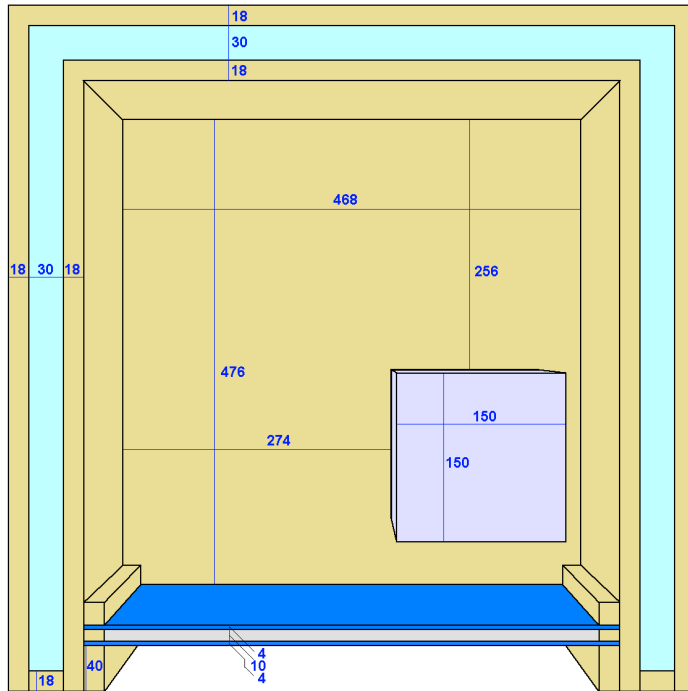
copper box (containing a 60 W lamp)

copper plate

datalogger space



Box description



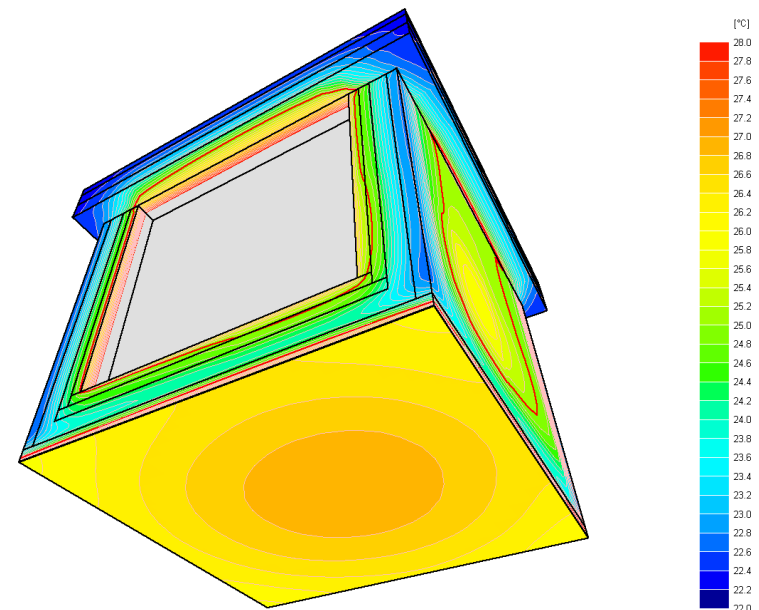
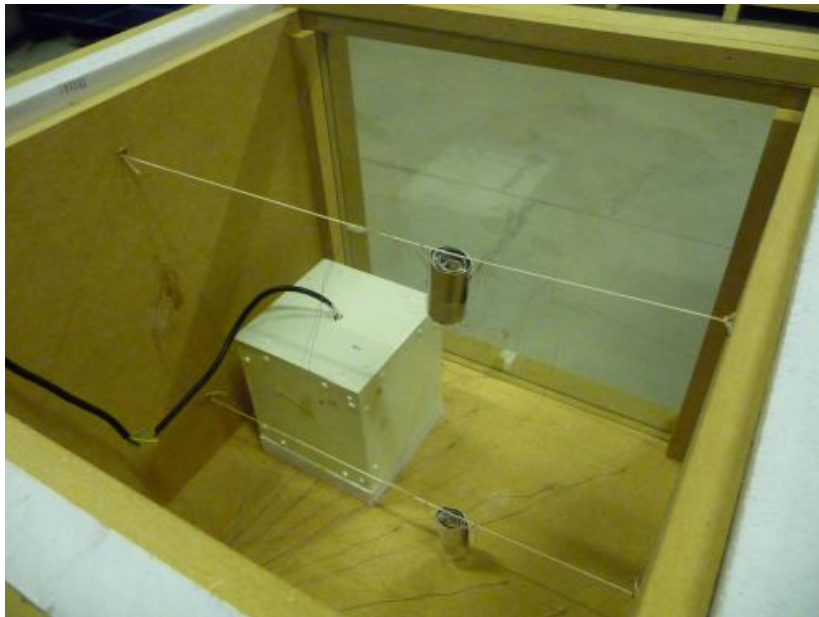
Internal power experiment

3 boundary conditions fully determine the heat transfer in the box

The **laboratory temperature**. The air temperature and the mean wall surface temperatures are assumed to be the same.

The **copper plate temperature** assumed as homogeneous.
The numerically predicted temperature gradient is only 1 °C.

The **power of the bulb** used: 0 W for $t = 0$, and 56 W for $t > 0$.

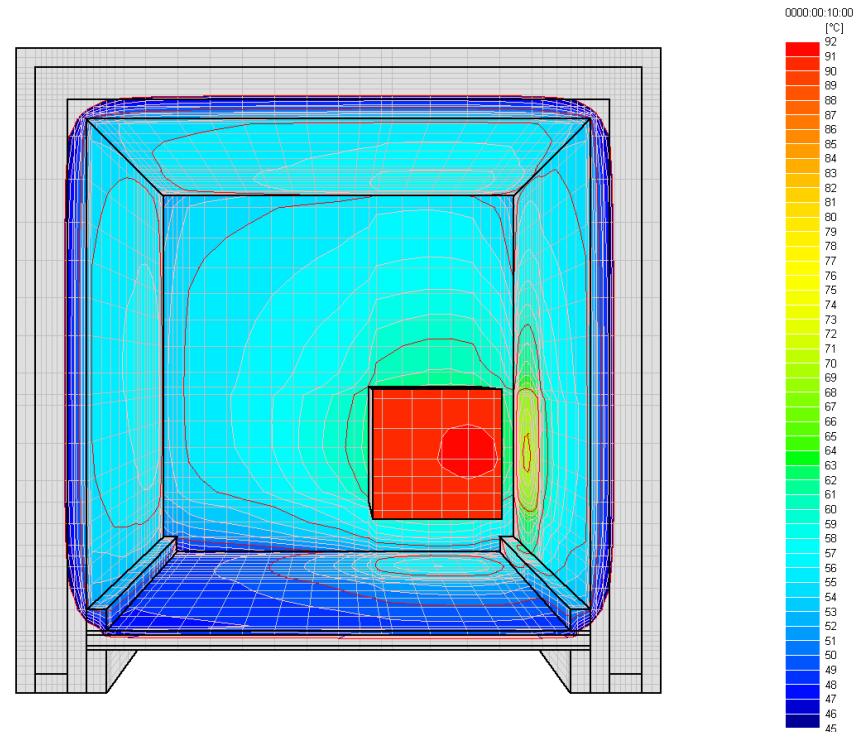
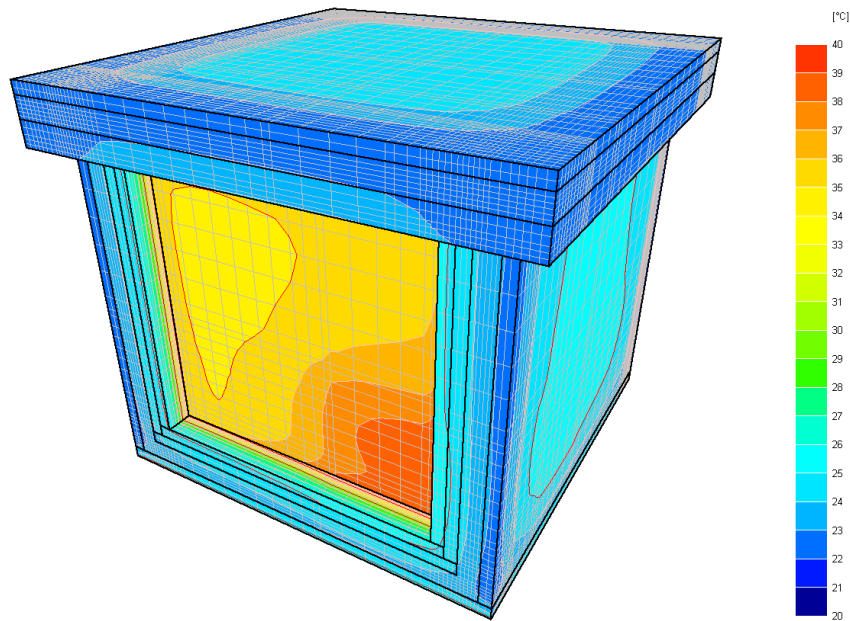


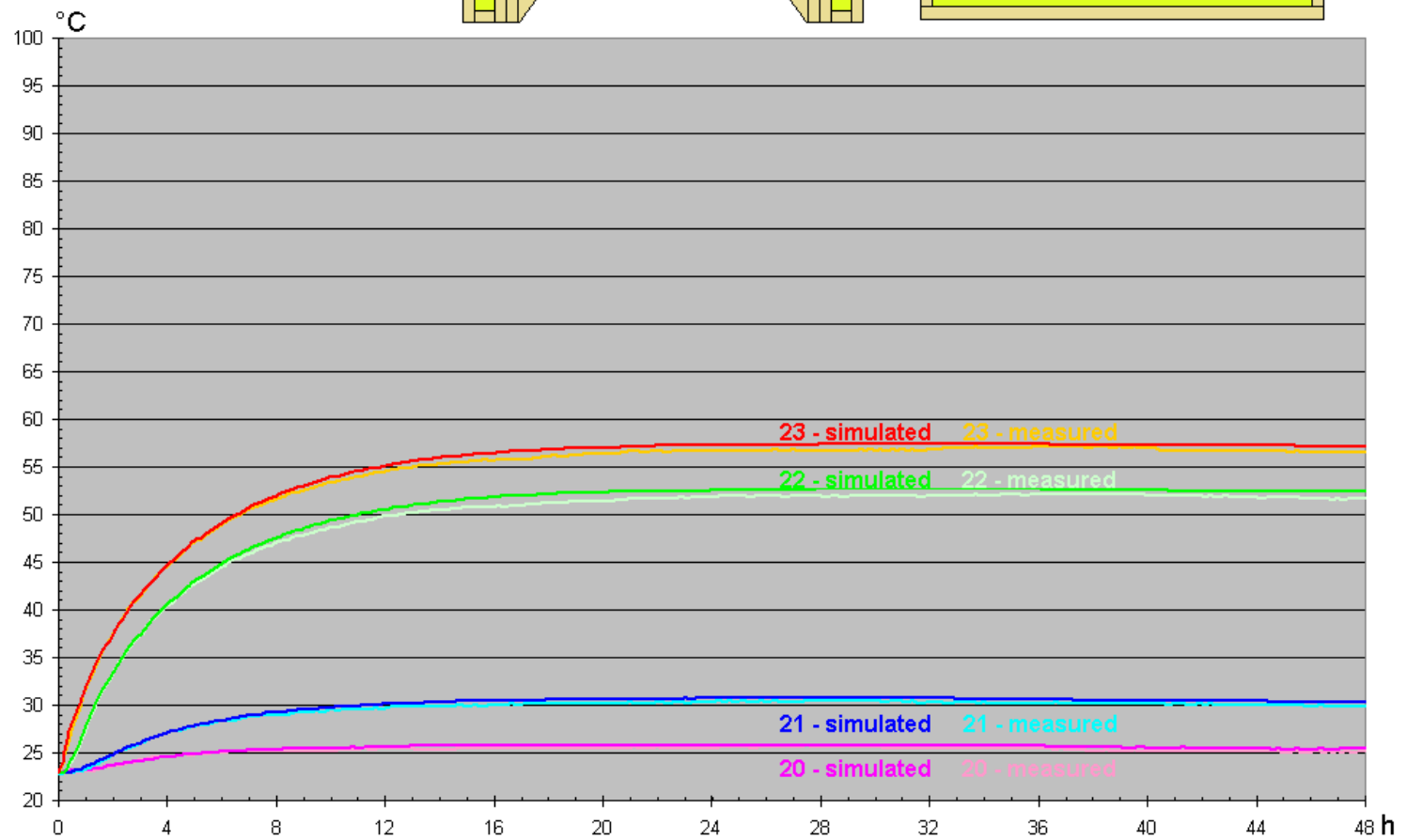
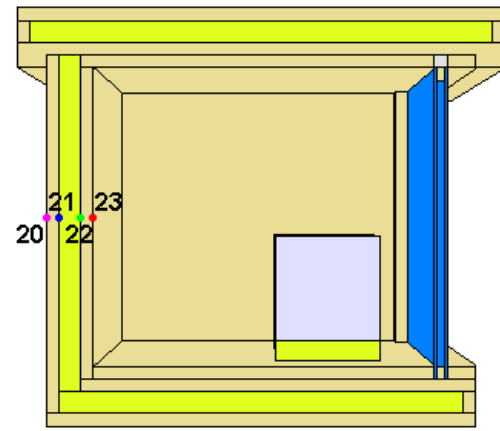
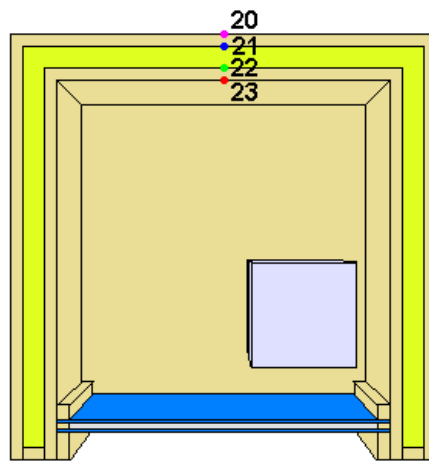
Internal power experiment

VOLTRA transient simulation results.

[Box Internal Power Exp Internal View.avi](#)

VOLTRA steady state simulation results.





Outdoors experiment

In Heverlee, from 24 until 28 September 2008.

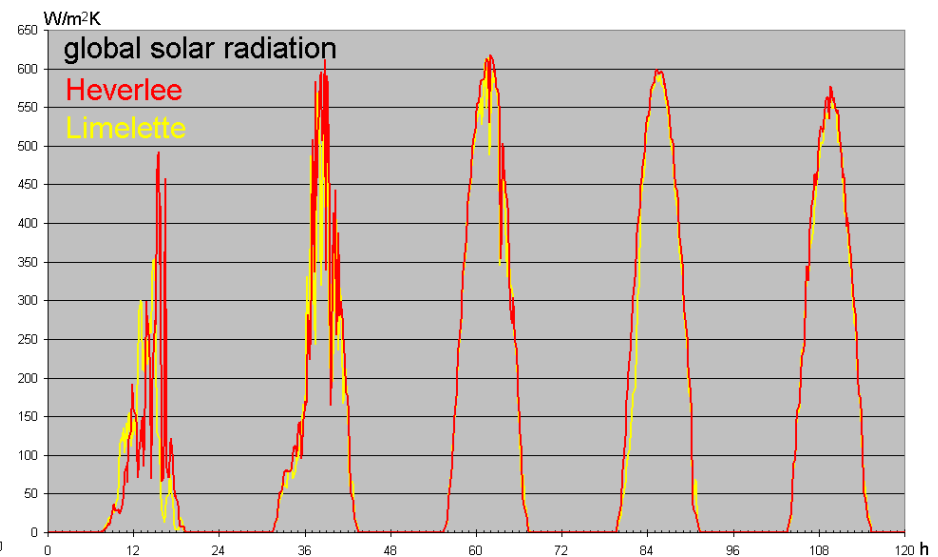
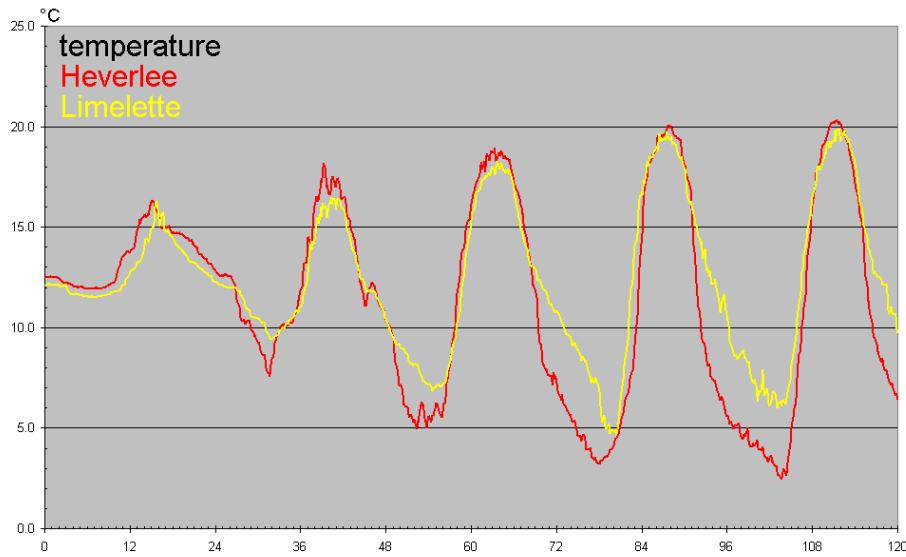
The box is oriented to the South East (39.5° from South).

Some buildings and trees in the environment obstruct the diffuse solar radiation. In the simulation they were entered as a horizon of 7° high in all directions, with a supplement up to 13° from -65° (South-East-East) to $+25^\circ$ (South-South-West).



Outdoors experiment

The climate station in Heverlee doesn't record the horizontal diffuse solar radiation, neither the infrared sky radiation. Therefore these data were taken from the climate station in Limelette (about 20 km south of Heverlee). This method is justified by the agreement between the air temperature courses and the horizontal global solar radiation courses at both sites.



Outdoors experiment

VOLTRA transient simulation results.

[box_outdoors_28_sept_front_view.avi](#)

