

1. Introduction

2D and 3D transient simulations may require considerable computer calculation time, and therefore, instead of a whole year period, only a short period (typically one or a few days) with an extreme outdoors climate load is considered.

For a cube in VOLTRA and a surface in BISTRA the surface temperature variation over time is simulated during a whole year for a given outdoor climate. From the results the day with the highest outdoor climate load is derived as a function of the orientation.

2. Simulation

VOLTRA data [sensor_6_orientations.vtr](#)

BISTRA data [sensor_4_orientations.bst](#)

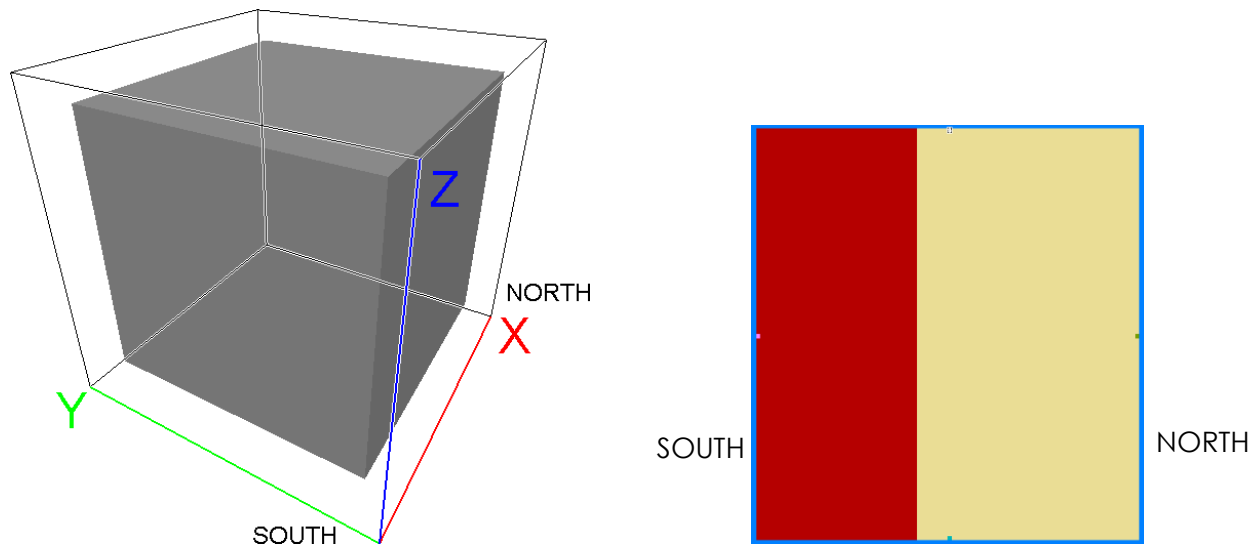


Figure 1 Simulated black cube in VOLTRA and surface in BISTRA

Figure 1 shows a cube (1m^3) and a surface (1m^2). The following data are assumed:

- dark surface: solar absorption factor = 0.9 (-)
- light insulation material : $\lambda = 0.040 \text{ W/mK}$, $\rho = 50 \text{ kg/m}^3$, $c = 1000 \text{ J/kgK}$
- outdoors climate of Brussels: reference year files [BEL_Brussels.064510_IWEC.epw](#)
- global heat transfer coefficient $h_e = 13.5 \text{ W/m}^2\text{K}$
- orientation as shown in Figure 1 - calculation duration = 1 year, calculation time step $\Delta t = 30 \text{ min}$.

Running the simulation, the temperature in the centre of each surface is reported each time step.

3. Determination of the day with the highest load

EXCEL files [sensor 6 orientations VOLTRA.xls](#)
[sensor 4 orientations BISTRA.xls](#)

The results generated in the report output are copied into a spreadsheet. (Alternatively, the automatically created Report.csv file can be used.) Figure 2 presents the outdoor temperature together with the temperatures measured on the six cube surfaces.

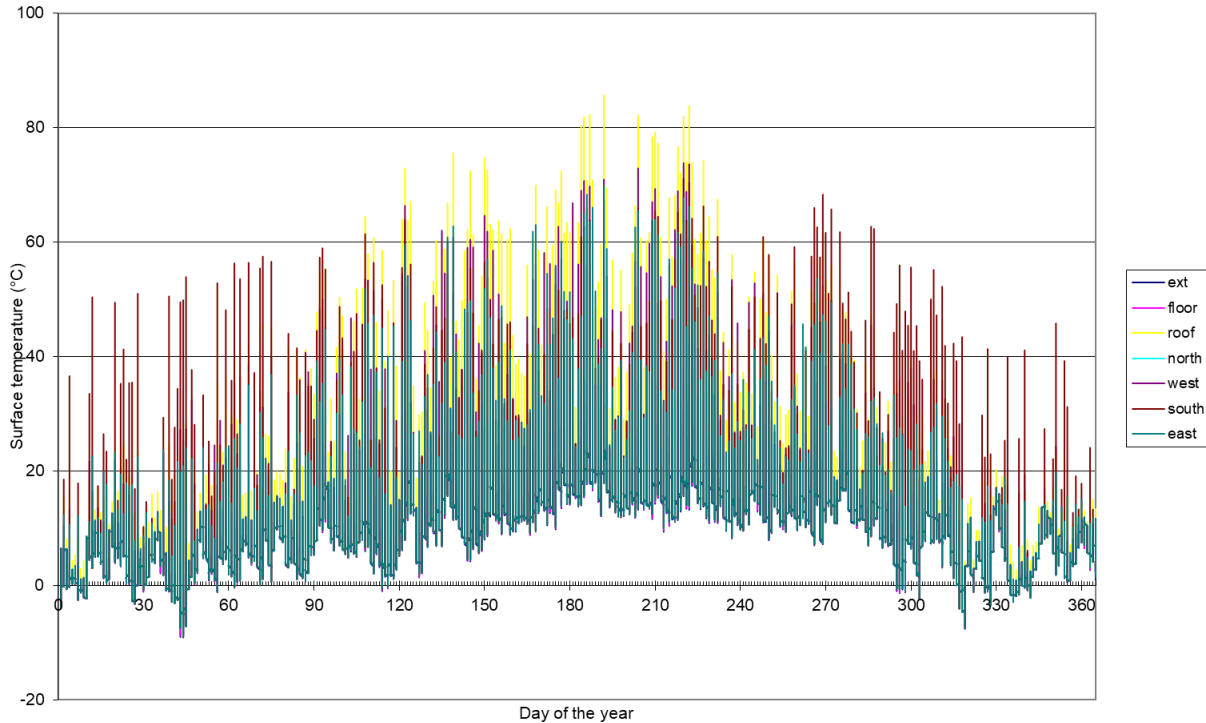


Figure 2 Temperature of outdoors and 6 surfaces

		maxima	34.9	41.2	85.7	44.2	73.8	73.6	69.8
index	day-nr	time	ext	floor	roof	north	west	south	east
0	1	0000:00:00:00	6.4	6.5	6.5	6.5	6.5	6.5	6.5
1	1	0000:00:30:00	1	2	2	2	2	2	2
2	1	0000:01:00:00	1	0.6	0.6	0.6	0.6	0.6	0.6
3	1	0000:01:30:00	-0.2	0.6	0.6	0.6	0.6	0.6	0.6
4	1	0000:02:00:00	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
5	1	0000:02:30:00	-2.2	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
6	1	0000:03:00:00	-3	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8

Figure 3 Spreadsheet with temperature of outdoors and 6 surfaces

Searching for the highest temperature for each surface results in the day number for which the highest climate load occurs for Brussels ([BEL_Brussels.064510_IWEC.epw](#))

- floor surface day 222 10 August
- roof surface day 192 11 July
- north surface day 223 11 August
- west surface day 220 8 August
- south surface day 222 10 August
- east surface day 192 11 July

The data files mentioned can easily be adapted to derive these day numbers for other climate data.