H16 – HOW TO DETERMINE THE DAY WITH THE HIGHEST OUTDOOR CLIMATE LOAD AS A FUNCTION OF THE FAÇADE ORIENTATION IN BISTRA & VOLTRA

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

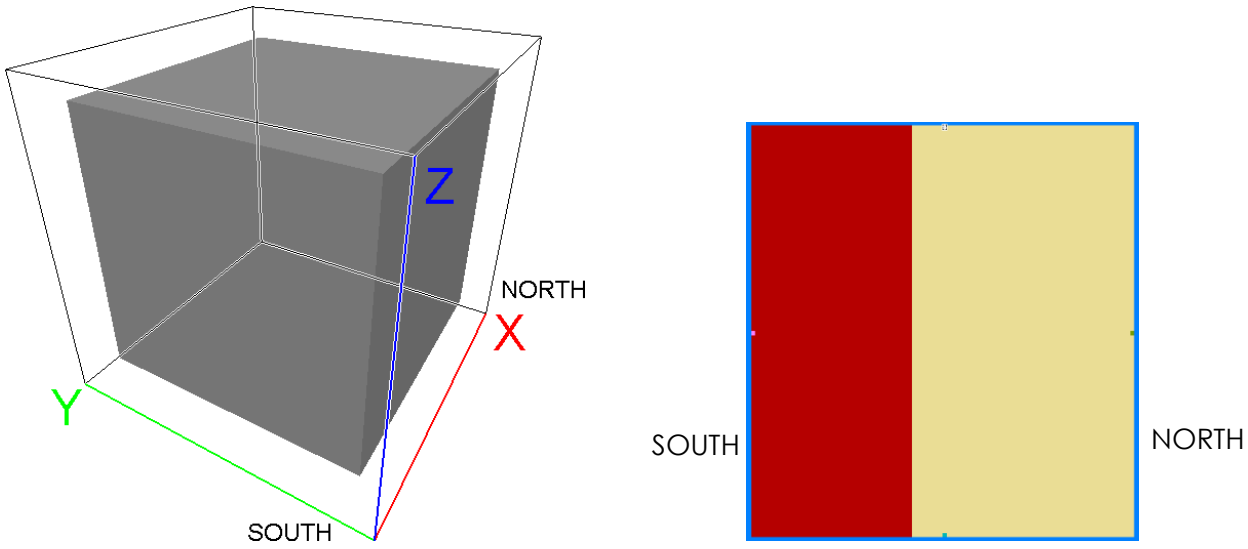

Figure 1 Simulated black cube in VOLTRA and surface in BISTRA

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 : λ = 0.040 W/mK, ρ = 50 kg/m3, c = 1000 J/kgK
- outdoors climate of New Haven: reference year files USA_CT_New.Haven_TMY3.epw
- global heat transfer coefficient he = 13.5 W/m^{2}K
- orientation as shown in Figure 1 - calculation duration = 1 year, calculation time step Δt = 30 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.

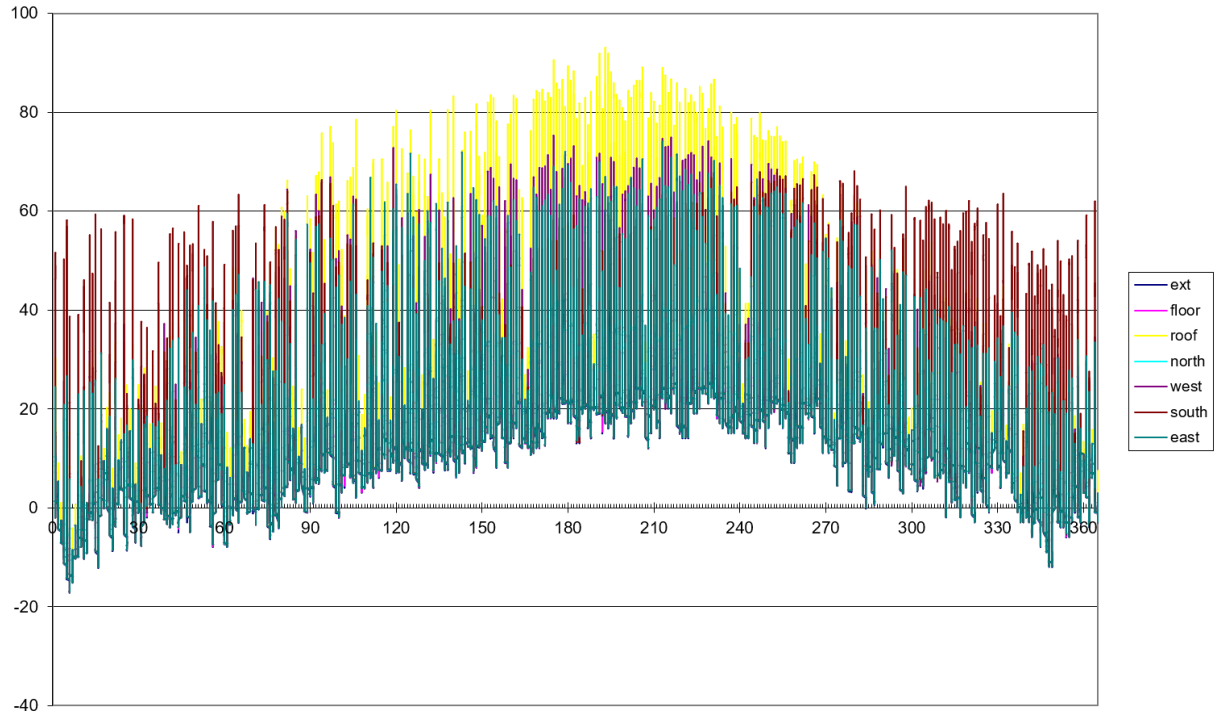

Figure 2 Temperature of outdoors and 6 surfaces

		maxima	**33**	**40.4**	**92.9**	**44.5**	**75.3**	**68.4**	**74.1**
index	day-nr	time	ext	floor	roof	north	west	south	east
0	1	0000:00:00:00	-2	-2	-2	-2	-2	-2	-2
1	1	0000:00:30:00	1.1	0.5	0.6	0.6	0.6	0.6	0.6
2	1	0000:01:00:00	1.1	1.4	1.4	1.4	1.4	1.4	1.4
3	1	0000:01:30:00	1	0.8	0.8	0.8	0.8	0.8	0.8
4	1	0000:02:00:00	0.9	1	1	1	1	1	1
5	1	0000:02:30:00	0.9	0.8	0.8	0.8	0.8	0.8	0.8
6	1	0000:03:00:00	0.9	0.9	1	1	1	1	1

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 New Haven (USA_CT_New.Haven_TMY3.epw)

- floor surface day 213 1 August
- roof surface day 193 12 July
- north surface day 191 10 July
- west surface day 175 24 June
- south surface day 253 10 September
- east surface day 213 1 August

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