H5 - How to define the solar data for the solar processor in BISTRA ?

physibel

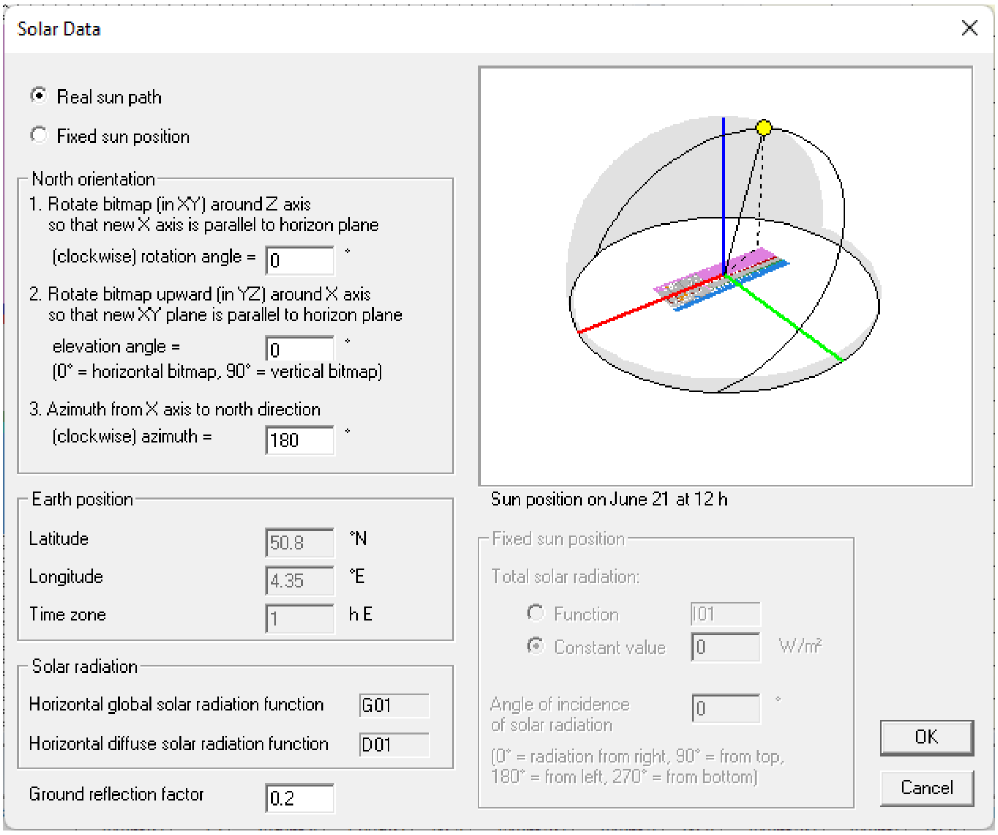
BISTRA

Introduction

BISTRA allows the simulation of solar radiation imposed on the geometrical model defined in the bitmap. Two methods are available:

- Method 1: Real sun path
- Method 2: Fixed sun position

The parameters for both methods (only one of which can be selected for use in a simulation) are defined in the Solar Data dialog box (*Edit → Solar Data...*).
While the exact meaning of all parameters is given in the manual for reference, this Physibel How To aims to clarify the parameters further by providing additional context and practical examples.



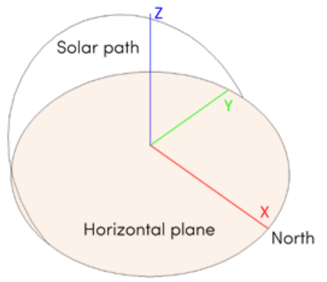
Method 1: Real sun path

When selecting a real sun path to be simulated, 4 categories of parameters need to be defined by the user:

- The "north orientation", meaning the positioning of the 2D bitmap in a 3D celestial coordinate system
- The "earth position", meaning the definition of the location on earth
- The "solar radiation", indicating which functions contain the solar irradiation climate data (on a horizontal surface)
- The ground reflection factor

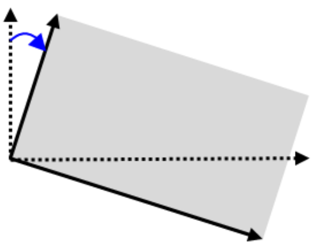
The focus in this How To lies on the first category, i.e. positioning the bitmap, as the other categories are relatively self-explanatory.

In the BISTRA manual, a complete description of the mathematical operations necessary to position the bitmap in a horizontal coordinate system is given. The principle behind this explanation is that the bitmap itself has a fixed position in 3D space. Three rotation angles are defined by the user, whereby each rotation is a coordinate system transformation, i.e. a redefinition of the object (in this case the bitmap) in a new coordinate system. After 3 rotations, the bitmap is defined in the horizontal coordinate system XYZ, in which the X axis points to the north, the Y axis points to the west, the Z axis points to the zenith.



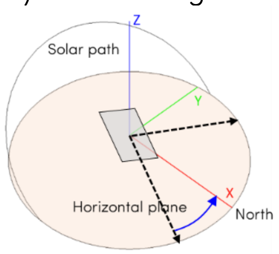
The 3 rotation angles can alternatively be described more colloquially as follows:

- The 1st rotation tilts the bitmap in its plane and is only necessary for slanted bitmaps. For a bitmap representing a horizontal or vertical section view this first rotation is not required (angle = 0°).



e.g. 1st rotation angle +20°

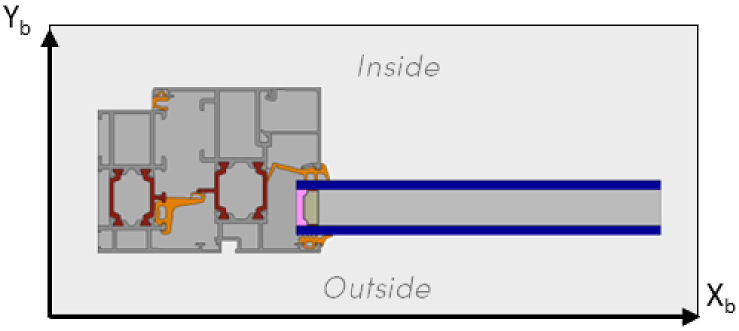
- The 2nd rotation angle represents the elevation angle of the bitmap in the XYZ coordinate system, which is the angle between the normal on the bitmap and the zenith or Z-axis.
For a bitmap representing a horizontal section view the second rotation angle equals 0°.
For a bitmap representing a vertical section view the second rotation angle equals 90°.
- The 3rd rotation angle turns the bitmap to define the model orientation. In case the first rotation angle is equal to 0° (or if the first rotation angle is not equal to 0° and the second rotation angle is 90°), this 3rd rotation angle is equal to the angle from the bitmap X_b axis to the north direction (X axis) or the (clockwise) azimuth angle.



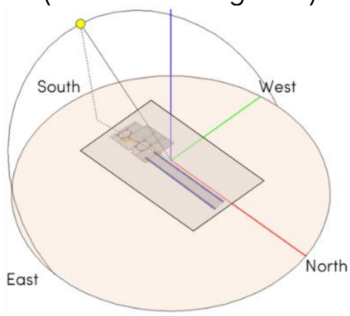
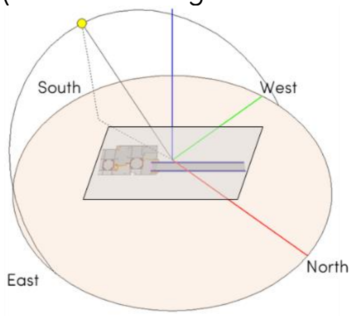
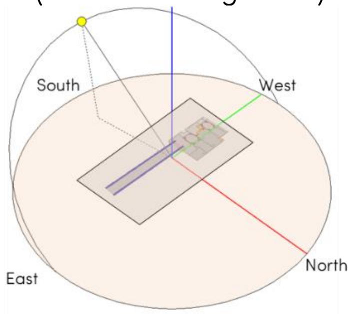
e.g. 3rd rotation angle -20° (1st and 2nd rotation angles 0°)

Three examples are given to illustrate the meaning of the rotation angles.

Example 1: Horizontal section of a window frame

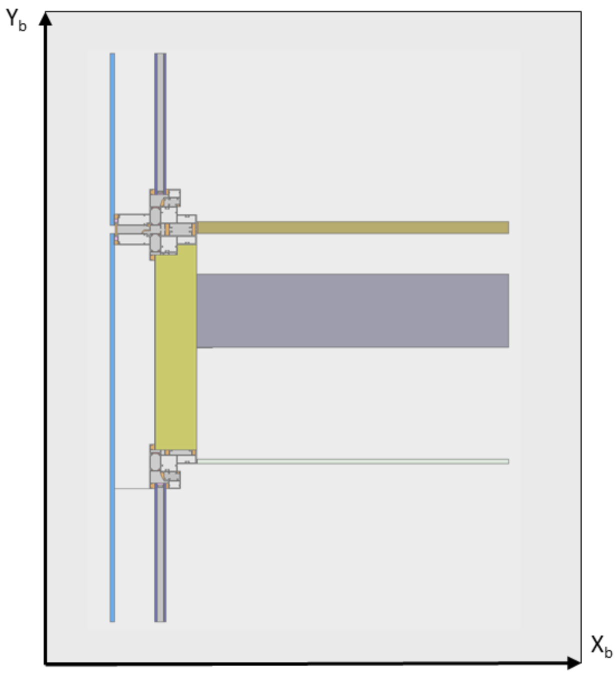


Since this is a horizontal section, the first rotation and second rotation angles both equal 0°. The third rotation angle thus determines the azimuth of the model. When the 3^{rd} angle equals 0°, the bitmap positive X-axis points north, so the window faces east. When the 3^{rd} angle equals 270°, the clockwise angle between the bitmap positive X-axis and the north is 270°, so the window faces south.

First rotation angle 0° Second rotation angle 0° Third rotation angle 0° (window facing east)	First rotation angle 0° Second rotation angle 0° Third rotation angle 45° (window facing north-east)	First rotation angle 0° Second rotation angle 0° Third rotation angle 270° (window facing south)
		

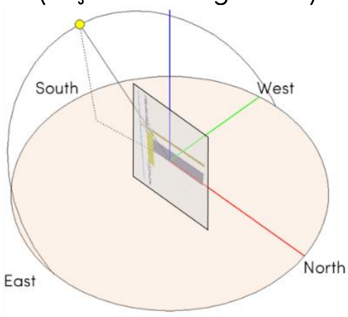
(Sun position of 21/6, 13h, for illustration)

Example 2: Vertical section of a curtain wall

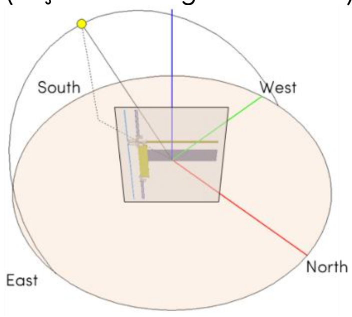


Since this is a vertical section, the first rotation angle equals 0° and the second rotation angle equals 90°. The third rotation angle thus determines the azimuth of the model. When the 3rd angle equals 0°, the bitmap positive X-axis points north, so the façade faces south. When the 3rd angle equals 270°, the clockwise angle between the bitmap positive X-axis and the north is 270°, so the façade faces west.

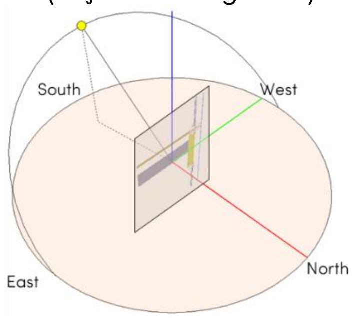
First rotation angle 0°
Second rotation angle 90°
Third rotation angle 0°
(façade facing south)



First rotation angle 0°
Second rotation angle 90°
Third rotation angle 45°
(façade facing south-east)



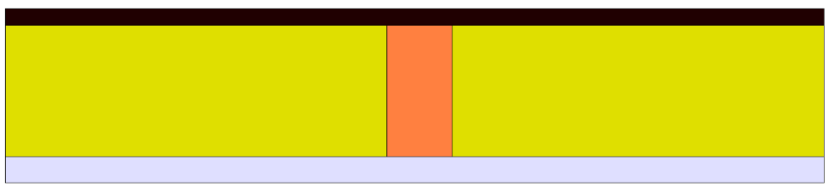
First rotation angle 0°
Second rotation angle 90°
Third rotation angle 270°
(façade facing west)

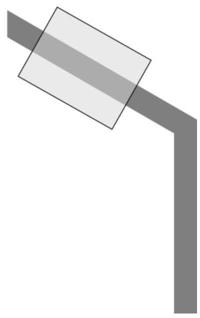


(Sun position of 8/9, 13h, for illustration)

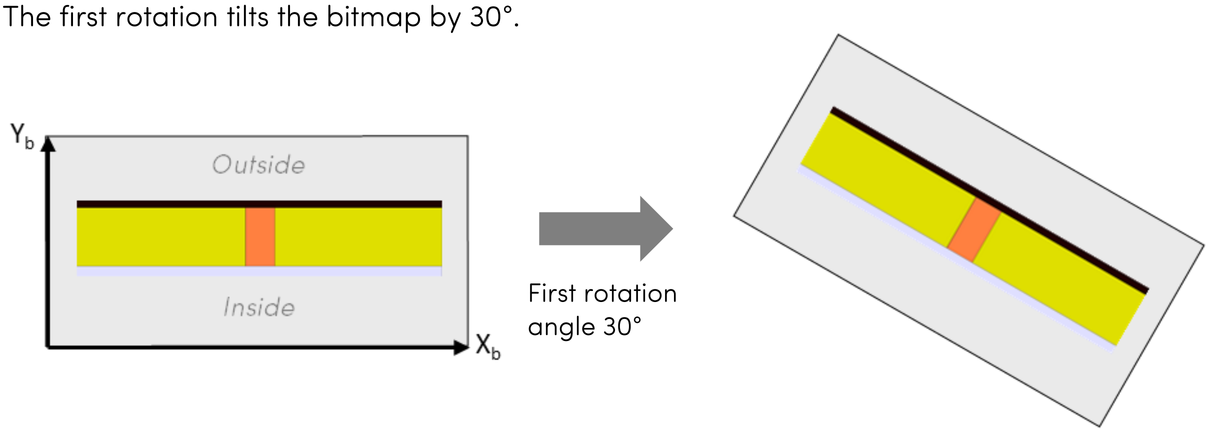
<u>Example 3: Slanted section of a pitched roof</u>

Below the bitmap of a slanted section of a pitched roof (30° slope) and a sketch illustrating where the bitmap is situated in vertical section of a pitched roof and a wall.





The first rotation tilts the bitmap by 30°.

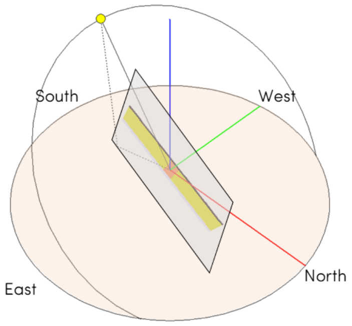


After the first rotation, the model can be viewed as a vertical section and the second rotation angle thus equals 90°. The third rotation angle determines the azimuth of the model. When the 3rd angle equals 0°, the bitmap positive X-axis points north, so the roof faces north.

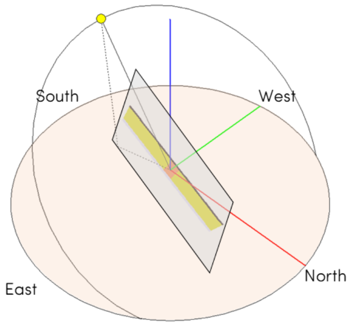
When the 3rd angle equals 180°, the clockwise angle between the bitmap positive X-axis and the north is 180°, so the roof faces south.

Note that the first and third rotation angles are coupled, i.e. a 1st rotation angle of -30° and a 3rd rotation angle of 180° results in the same bitmap position as a 1st rotation angle of 30° and a 3rd rotation angle of 0°.

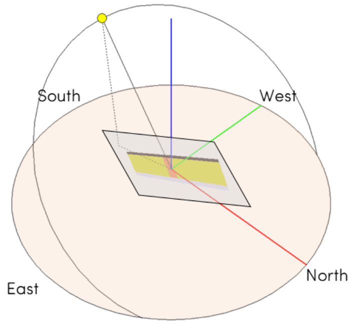
First rotation angle 30°
Second rotation angle 90°
Third rotation angle 0°
(roof facing north)



First rotation angle -30°
Second rotation angle 90°
Third rotation angle 180°
(façade facing north)



First rotation angle 30°
Second rotation angle 90°
Third rotation angle 180°
(façade facing south)



(Sun position of 21/6, 13h, for illustration)

Method 2: Fixed sun position

Alternatively to simulating a real sun path, the user can decide to implement a simplified way of imposing solar radiation. In this second method, a fixed sun position is assumed.
While the amount of solar radiation can vary over time (defined in function I01), the direction of the incoming total solar radiation is always fixed.

For the first 2 examples previously discussed, the bottom and left border of the bitmap could be selected, respectively, to simulate solar radiation which is always perpendicular to the external surface of the façade.