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Sun shading devices


Human tends to stay under the shade rather than exposing to solar radiation. In order to block solar radiation, buildings are designed with shading devices. To determine which kind of shading devices to use, it is essential to know the position of the sun at different time and the time we need shading.


We can know the position of the sun relative to the centre of the Earth using sun path diagram. Sun path diagram is origentated by cutting the earth half and by using the centre as point of reference to see, The altitude and bearing will become circles and lines respectively. Each point in the sun path diagram is in relation to the position of the sun. Hence, using these information, we can know what time we need to shade.
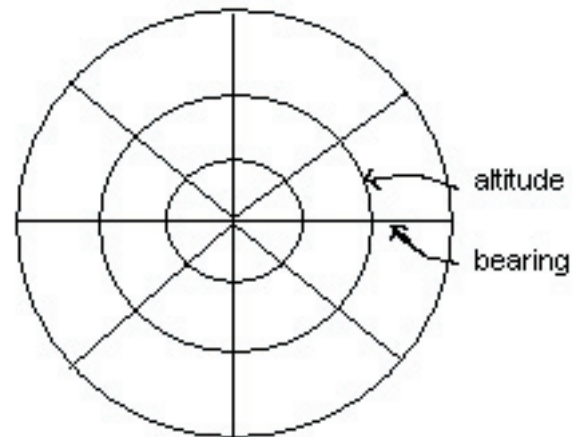
However, it is not necessary to block all solar radiation. we only need to block the solar radiation when the temperature is too hight that would make us feel uncomfortable. Different zone may have different temperature range. Taking Hong Kong as an example, a place which is exposed to solar radiation with temperature higher than 27 degree will need shading. The period of time when there is solar radiation with temperature too high that we feel ucomfortable is called overheating period. Overheating period can be found by obtaining data. The area in sun path diagram which represents overheating period will need shading devices to block the sunlight. This region is called shading mask.

Overheating period is not determined by sun angles alone. It is determined by air temperature. Air temperature can be affected by the thermal conduction of the air. When the sun rises in the east, it takes time for the solar radiation to heat up the air to 27 degree. On the other way, when the sun set in the west in the afternoon, since the air has already been heated up, the air temperature remains above 27 degree for a longer period of time. As a result, the overheating period is shorter before noon when compare with afternoon. This explains the reason why the shading mask is not symmetrical about the north-south axis.
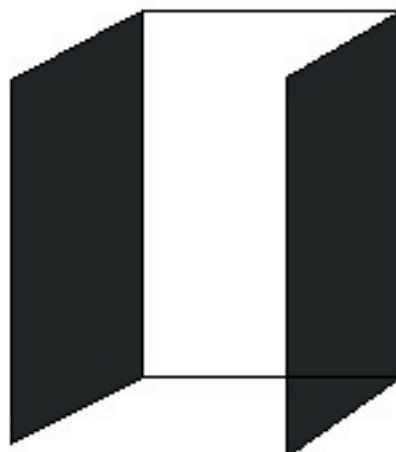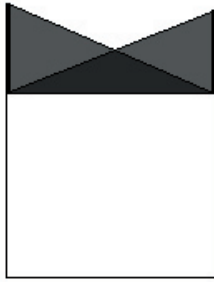
There are mainly two types of shading devices, horizontal element, which is to to place on top of the window and vertical elements on two sides.

front view

front view

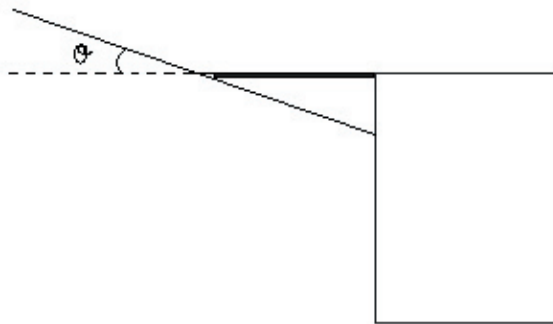Altitude will give shade in an arc-shaped.



top view

top view

top view

top view

of window while bearing will give a wedge-shaped.

The length of the horizontal shading devices can be determined by the altitude of sun's position. It is shown in the below diagram

In contrast, the length of vertical shading devices is based on bearing of sun's position.



side view

side view of the window.



top view

top view of the window.

To determine the length of the shading devices, we have to find the altitude and bearing on the sun path diagram which covers the shading mask. This is done by simply placing the window's edge on the equator of the sun path diagram facingn one direction. As a result, only half of the shading mask could be seen.

Taking north east direction as an example, the minimum bearing that covers the shading mask is 18 degree.
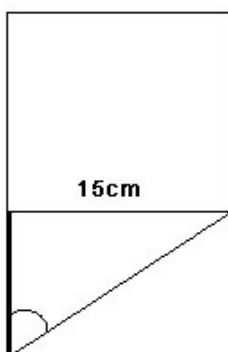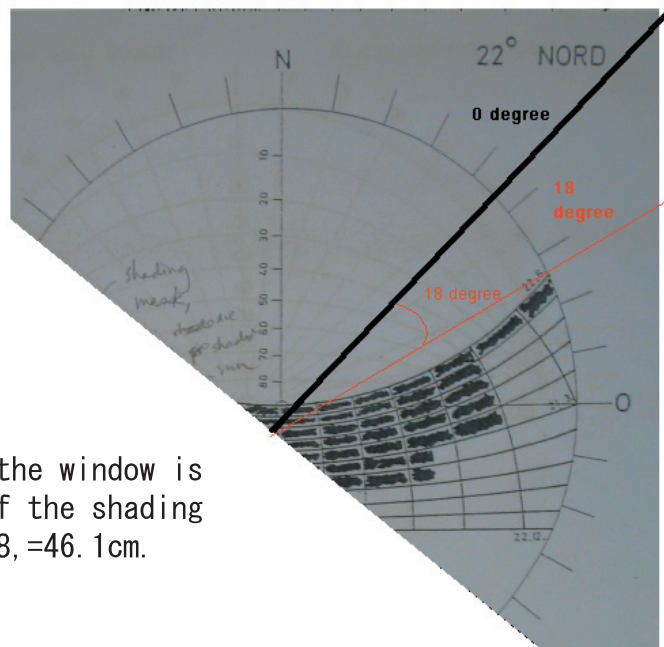




15cm

18 degree

top view

Since the width of the window is 15 cm, the length of the shading devices is 15/tan 18, =46.1cm.

There is an alternatives. Instead of using veritcal element, we can use horizontal element. Using altitude of 25 degree, the length of horizontal shading devices is 10/tan25 =21.4cm.
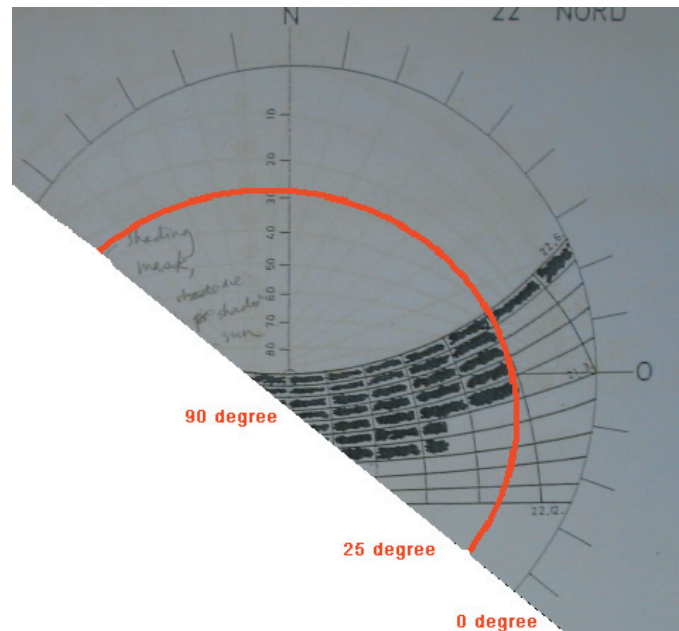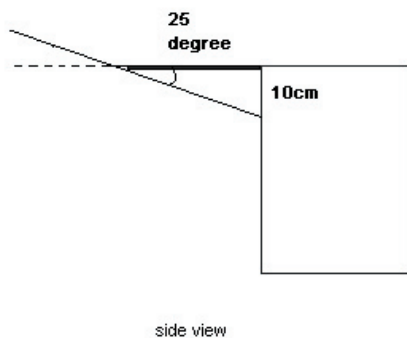


In most cases, the shading mask might not be in either arc-shaped or wedge shaped. It might need a combination of both in order to block the solar radiation. For example, when the window is facing north, it needs two vertical shading devices to block the sunlight. At noon, it needs a horizontal shading devices.

There are many alternatives, but we should consider whether it is practical or not. In our case, vertical element with 46.1 cm is too far from the window. the element would face a lot of problems. For example, it cannot be supported and hence it will easily break. In some extreme cases, e.g. windows facing west direction, the bearing is 0 degree at 5 o' clock. The sun is infinitely far and the horizontal element is infi nitely long. Hence, it would block the view and accumulate hot air inside the louvers. To solve this problem, we may use some movable elements. For the window facing west direction, the resident could put on the shading devices in overheating period.Hence, at the rest of the time, the view will not be blocked.

There are disadvantages in using movable elements. Movable elements help to shade the solar radiation when there is need, but it will completely block the view when it is put on. Moreover, movable element is more expensive. To decide which kind of element to use, we have to choose whether view or blocking solar radiation is more important.

It is essential to take human' s comfort as consideration. Whether we feel comforatable if we live inside helps to determine which kind of shading devices to use. Careful consideration of blocking solar radiation helps to save up electrical energy used by air conditioner.