

## Arch-753-001 Building Performance Simulation

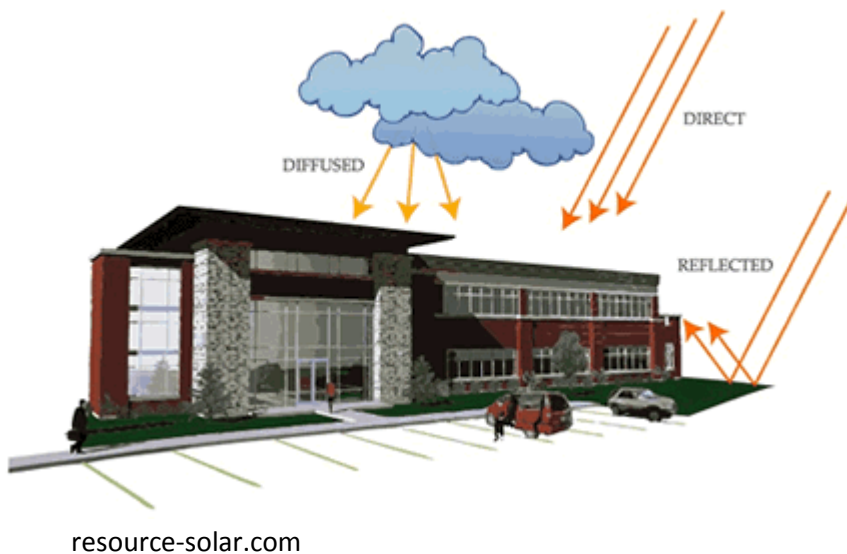
### Different Types of Solar Radiation

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### Radiation Range

Solar radiation which passes through the atmosphere, is made of both a direct component from the sun and a diffused component which has been created by the reflections off the clouds and moisture vapor in the air and other particulates within the sky. The incident solar radiation is measured and calculated from the model geometry and also hourly recording of direct beam and diffuse horizontal values which are available from currently loaded weather data files.



### Direct Beam Radiation

The amount of solar radiation measured when the sensor is pointed directly toward the sun. The peak point of this value is in February in which the earth's orbit brings us closest location to the sun, so the theoretical value of direct beam radiation would be maximum.

This component of solar radiation in the weather data file format, is defined as value in  $\text{W/m}^2$  and is measured by means of measuring the imaginary surface directly facing the sun. In other words, this measurement surface follows and tracks the sun path as sun moves through the sky, consequently, the direction of incident radiation will be always normal (straight on) to it.

## **Direct Horizontal Radiation**

Direct horizontal radiation is not the same with direct radiation is , as in that, the incident solar radiation is measured on a flat horizontal place. While, in direct horizontal radiation can be explained by the cosine of the angle of incidental radiation at which the beam strikes the horizontal surface. Consequently it can be calculated as the following:

## **Diffuse Horizontal Radiation**

This component is also given in  $W/m^2$  and is can be interpreted as the energy from the entire sky dome that falls on a horizontal surface, MINUS direct beam radiation effects after it hits the horizontal.

The diffuse horizontal component is also given in  $W/m^2$  and is taken as the energy from the entire sky dome that falls on a horizontal surface, minus the effects of direct beam radiation as it hits the horizontal. This should not be neglected that as the radiation from low in the sky near the horizon strikes the flat measurement surface at mostly grazing incident. This means that diffuse horizontal radiation contributes much less to the measurement than light from the Zenith, with strikes the surface at or near normal solar radiation incident. As the diffuse horizontal radiation values are measured assuming that there is no surrounding barriers and obstruction to cover or make vague any part of sky, these are usually measured at the top of the tall buildings or on a pole in a field.

## **Global Horizontal Radiation**

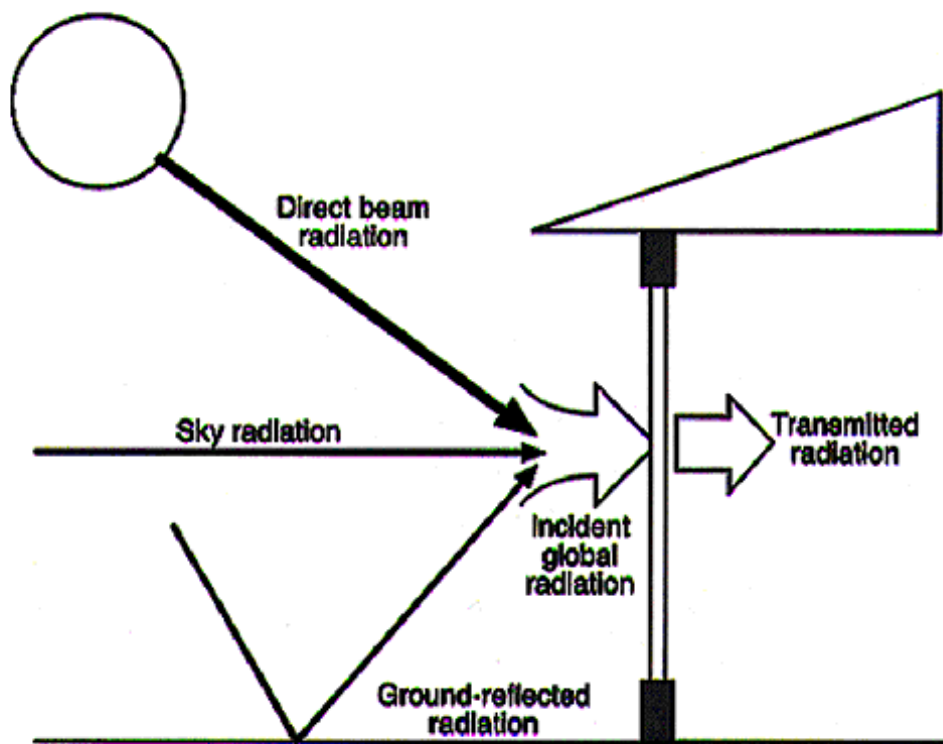
The other type of radiation data is the global horizontal radiation, as a total amount of both the direct and the diffuse components as measured incident on a flat horizontal plane. (naturalfrequency.com)The radiation falling on a surface, measured and recorded is called global horizontal radiation. "In theory it is composed of all the diffuse radiation from the total sky vault plus the direct radiation from the sun times the cosine of the angle of incidence." The peak point of this value is in summer when the sun locates at the highest height and also in a perpendicular position towards the horizontal surface. (Climate consultant help, 2015)

## **Global Radiation**

As it is not possible for a single surface to be horizontal( collecting diffuse horizontal) and normal to the direct radiation ( collecting direct beam) at the same time, as a result there is also a global radiation which obviously differs from the global horizontal radiation. As stated above this value does not represent a real physical quantity, though for sum of the available radiation (specially for the low sun angles) for the vertical and other non-horizontal surfaces is considerably a better indication.

## **Tilted Surface Radiation**

The total amount of direct, diffuse and reflected solar radiation received on the surface in a hour is tilted surface radiation. This value is measured from the horizontal (flat =  $0^\circ$ , vertical =  $90^\circ$ ). The default reflectance for ground is for grass which is about 20% and is subject to be changed by the user. (units in  $Wh/m.sq$  or  $Btuh/sq.ft$ ) (Climate consultant help, 2015)



<http://rredc.nrel.gov/sol>