

Assessment of solar radiation on diversely oriented surfaces and optimum tilts for solar absorbers in Malaysian tropical latitude

ABSTRACT

In this paper, the solar radiation on diversely oriented surfaces and optimum tilts for solar absorbers were assessed. The KT solar radiation model was coded in the MATLAB-based environment to compute the monthly solar radiation values. Seven-year data of monthly average daily solar radiation on a horizontal surface in Bangi, Malaysia (latitude = 3°N) were adopted as input in the simulation programme and the results were compared with the local optimum tilt angle at solar noon and other solar radiation model. The contour mappings of solar irradiation at various orientations in 12 months were presented. Results showed that the surface tilted $\leq 20^\circ$ could intercept a relatively high solar intensity, which was less sensitive to the variation of azimuths with average solar insolation deviation of 11.82 %. The monthly optimum tilt angle altered throughout the year, ranging from -24° (in equator direction) to $+22^\circ$ (in north direction). The estimated annual optimum slope, 1.4° facing to the equator, was close to local latitude. Based on the seasonal analysis, the north-facing surface was able to intercept higher daily average solar radiation energy compared to south-facing plane. The optimum angles for seasonal south- and north-facing surfaces were found to be 14.4° and 14.8° , respectively, with a tolerable slope deviation of $\pm 5^\circ$ from the optimal values in the present work.

Keyword: Solar radiation; Orientation; Tilt angle; Optimisation; Malaysia