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A Passive Solar Building Response to Selective Components of Solar Irradiance

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Solar radiation provides the most significant natural energy in buildings. Due to atmospheric interference, solar radiation received at the earth surface consists of direct beam and global irradiance, where diffuse can be further broken down into short and long wave irradiance. Although each of these components occur simultaneously, their individual influence on the indoor condition of a building differs. The aim of this study is to analyze the influence of the various components of solar irradiance on the indoor temperature, relative humidity and illuminance level of a passive solar building in Alice in the Eastern Cape. To this effect, a SOLYS 2 dual Axis Sun tracker system, comprising of a set of four radiometers were used to measure the various solar radiation components. These include direct beam, diffuse, tilted and downward long wave irradiance. The indoor temperature and relative humidity was measured by HMP 60 temperature relative humidity probe. A Li-210R Photometric sensor was used to measure the indoor illuminance. Preliminary results show that on a typical sunny day, the indoor temperature and relative humidity have a linear and inverse response, respectively, to the various solar irradiance components. A minimum response time of 1 hour was observed between the indoor temperature and diffuse irradiance. While a 30-minute response time between the indoor relative humidity and direct beam irradiance was noticed. Relative to other solar radiation components, it was found that the indoor temperature is statistically predicted best by a linear combination of global, tilted and downward longwave irradiance. Whereas, a combination of direct beam, diffuse, as well as downward longwave irradiance are suitable to predict indoor relative humidity. A meticulously developed model to predict the indoor conditions of the building will also be discussed with particular emphasis on the sensitivity of the model to the various irradiance components.

Apply to be
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Level for award
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PhD

Main supervisor (name and email)
and his / her institution

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