Chapter 4
Daylight Calculation Methods for Residential Spaces in Warm-Humid Climates:
A Case Study From Chennai

Kamaraj Kalaimathy
https://orcid.org/0000-0001-8349-2255
SRM Institute of Science and Technology, India

Chathana Thagavel
https://orcid.org/0009-0005-0886-9987
Periyar Maniammai Institute of Science and Technology, India

Sofiya M. Karunanithi
https://orcid.org/0000-0002-7641-6913
SRM Institute of Science and Technology, India

ABSTRACT

Daylighting is valued in commercial and industrial settings but disregarded in residences. Thus, the study uses a ground-floor of a residence in Chennai, a warm, humid climate zone, to learn daylight calculating methodologies and metrics. The study assesses daylight performance using a BRE protractor, an Illuminance meter, and Design Builder simulation. Daylight Factor is used to evaluate all procedures in overcast skies. Differences in daylight factor, window-wall ratio (WWR), uniformity ratios, and Illuminance values are examined by comparing these methodologies. Variations in kitchen window size are examined to determine the best WWR for Daylight without glare. For efficient daylighting, maintain 0.4 to 0.7 uniformity

DOI: 10.4018/979-8-3373-0174-7.ch004

ratio and 20–30% WWR. The report also discusses DF's limits and supports Useful Daylight Illuminance (UDI) for greater performance utilising actual annual climate-based figures. Thus, this study improves daylight performance understanding for energy-efficient residences.

1. INTRODUCTION

Light for the whole range of human visual adaption comes from daylight. Space efficiency can be increased by giving daylighting of a building attention (Lechner, 2009). Daylight has an impact on the spatial layout that ensures occupant comfort while saving fossil fuel during the day. It is a sustainable passive building approach, where more daylight improves physical health, visual comfort, and energy efficiency (Ahmad et al., 2022). Day-light changes from one place to another based on the climate, rotation of the earth, cloud cover based on diffe-rent times and seasons. So, in order to conserve energy we should integrate daylight but also use energy conserving intelligent artificial light systems (Ahuja, 1997). Daylight is also influenced by Building Envelope (Lar-tigue et al., 2013), Orientation (Mangkuto et al., 2016), Window-Wall ratio (Sun et al., 2019), External Obst-ruction (Ibrahim et al., 2009), Reflectance (Du & Sharples, 2011), Shading Device (De Luca et al., 2022), Size of the window (Sedaghatnia et al., 2021), setback (Kumar & Kranthi, 2017), latitude and longitude (Xue et al., 2019), Shape (Du & Sharples, 2010) and Form (Xiao et al., 2023), Climate (Wittkopf et al., 2006). The buil-ding will produce glare if these elements are ignored and sunshine penetration is not controlled (Sabry et al., 2014). So, inorder to conserve energy moving away from using non- renewable sources of energy to alternative sources and using building intelligent systems (Ahuja, 1997) for energy conservation can help bring daylight and save energy. Thus, these days, Daylighting calculation is vital for architectural designs. Though daylight study has been considered important for various commercial, institutional, Industrial spaces, least importance has been given to residential spaces. So this study focuses on daylighting performance in a residential space. Evaluation of daylighting is possible for a number of parameters, such as illumination, uniformity ratio, glare, and luminosity. Every one of these factors affects daylighting performance significantly. A significant part is played by various methods and measures for assessing these factors. Various methods include Empirical met-hod, Experimental method, Simulation method, Questionnaire survey, various validation algorithms (Mandala & Ritva Santoso, 2018). Such methods help in determining the daylighting performance of the building. Day-light is studied through metrics such as Daylight Factor, Spatial Daylight Autonomy, Continuous Daylight Autonomy (Boubekri & Lee, 2017; Cantin & Dubois, 2011; Xue et al., 2016). Each of these has its own limi-tations. In this study,