OVERALL THERMAL TRANSFER VALUE (OTTV)

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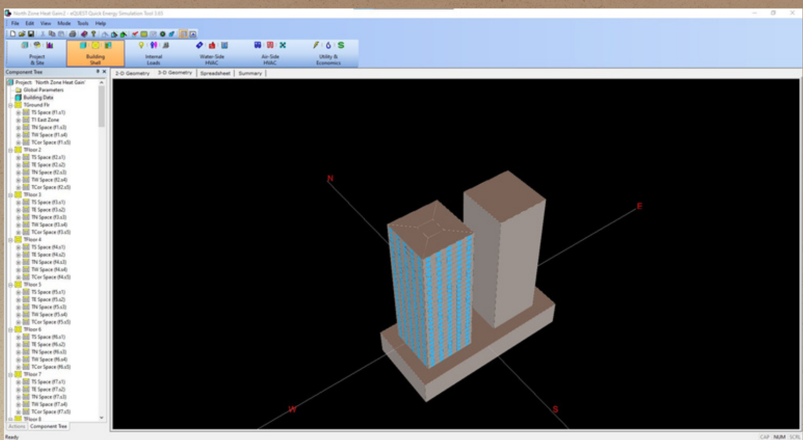
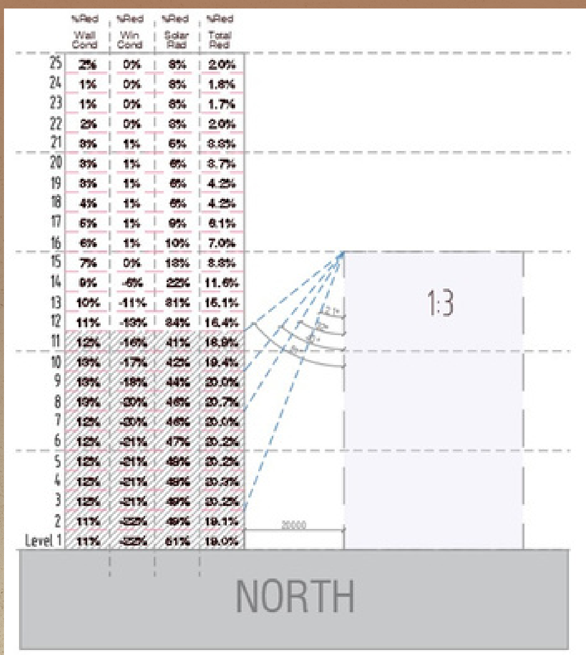
The research team at Universiti Teknologi Malaysia (UTM) has secured funding from GreenRE Sdn. Bhd. for a research project titled "Assessment of Building Envelope Thermal Transmittance under the Effect of Adjacent Shading and Natural Ventilation." The research is scheduled to take place from 15 March 2023 to 14 March 2024, and the project leader is Assoc. Prof. Ar. Dr. Lim Yaik Wah from the Faculty of Built Environment and Surveying, UTM.

The Overall Thermal Transfer Value (OTTV) is a crucial factor outlined in Malaysian Standard (MS) 1525 and is mandated by the Uniform Building By-law (UBBL) Amendment 2012. However, questions have arisen regarding the efficacy of the assumptions underpinning the assessment in contemporary scenarios. The current calculation method, while incorporating shading contributions from conventional shading devices, overlooks shading contributions from adjacent buildings. Additionally, the empirical substantiation of the relative contribution of naturally ventilated spaces to the OTTV or Residential Envelope Transmittance Value (RETV) performance is lacking, raising concerns about its exclusion from the by-law. Thus, the objective of this research is to present empirical studies and methods aimed at enhancing the assessment of OTTV or RETV in Malaysia.

The initial phase involved conducting an inventory of existing multi-block developments and buildings with both air-conditioned and naturally ventilated spaces. This information was then utilized to develop base models for experimentation. Subsequently, dynamic computer simulations were conducted using eQUEST software to assess the annual heat gain through building external envelopes, considering various building ratios. The simulation results were meticulously compared with the OTTV or RETV calculations for validation, leading to the establishment of correlation factors. The anticipated outcome of this research is to contribute valuable insights that will improve the standard OTTV or RETV calculation, specifically addressing the impact of adjacent shading in multi-block developments and naturally ventilated spaces within buildings.





Simulation of the heat gain through building envelope with the effect of adjacent shading

UNRAVELING THE LIFE CYCLE CARBON EMISSIONS OF GREEN OFFICE BUILDING WITH HOTSPOT-ORIENTED REGRESSION

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Buildings contribute to 38% of global energy-related CO_2 emissions, and the trend to develop green buildings with low or net-zero status has gained traction. A regression model focused on hotspots (i.e., high carbon emissions) has been developed for green-certified office buildings, utilizing Life Cycle Assessment (LCA) and Multiple Linear Regression (MLR) methods. We collected on-site data and adopted material-specific parameters contributing to the most embodied carbon (EC) and operational carbon (OC) to enhance the prediction accuracy of regression models from a life cycle perspective.

Based on the data collected and assumptions made, findings reveal that OC emissions constitute a significant portion of a building's 86-97% carbon footprint, with electricity usage as a dominant factor. Embodied carbon, accounting for 3-14% of total life cycle carbon emissions, is mainly influenced by cement and steel usage, emphasizing the importance of sustainable building materials in the green building rating system. The MLR analysis identifies key parameters for EC to offer insights into their impact on carbon emissions. Hotspot-oriented regression equations demonstrate more accurate predictions than basic building parameters (e.g., GFA and number of storeys) for embodied and operational carbon. Material-based regression equations for EC exhibit the lowest margin of error, with a 23.7-42.1% variance between the actual and predicted values, compared to GFA and the number of storeys, which provide lower carbon emissions and incur higher errors in predicting carbon emissions for green buildings. The study underscores the underestimation of carbon emissions when applying basic parameters due to material quality and quantity variations during construction. Considering diverse building designs and lifespans, material-based regression equations are essential for accurate predictions. Basic parameters also fall short in representing energy efficiency factors, such as air-conditioning, water systems, lighting, office space occupancy, and the number of users, impacting utility consumption. The regression equations for both EC and OC are shown below for reference.

$$\sqrt{EC} = -0.01 + 0.73\sqrt{x_1} + 0.28\sqrt{x_2} \qquad Eq\ (1)$$

$$\sqrt{OC} = -0.002 + 0.937\sqrt{x_3} + 0.029\sqrt{x_4} + 0.095\sqrt{x_5} \qquad Eq\ (2)$$