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Name : ABDUL BASIT ALI AHMED ALMHAFDY

Title : OPTIMIZATION OF COURTYARDS DESIGN FACTORS IN THE HOT HUMID CLIMATE: ENERGY AND THERMAL ASSESSMENT

Supervisor : ASSOC. PROF. AR. DR. NORHATI IBRAHIM **(MS)**
PROF. DR. SABARINAH SHEIKH AHMAD **(CS)**

Courtyards are regarded as a microclimate modifier, and their application has become popular in various forms of public buildings. This thesis reviews design factors of courtyards in hospitals in Malaysia, and assesses the resulting thermal performance of the courtyard space and energy performance of the attached built volume. The study took a sequential approach whereby knowledge gained from each phase of research,served to inform the direction for the next phase of the study. It began with the initialinquiry on what are the courtyard characteristics applied in hospitals in Malaysia. Data were gathered through field survey, followed by a typology analysis involving 34 courtyards in 19 government hospitals. The survey revealed extensive use of OEnclosure Courtyard (OEC) and U-Enclosure Courtyard (UEC), and that although the spaces inside the surveyed courtyards appeared as appealing, activities inside these courtyards were rather limited. This led to the next research inquiry on the thermal condition inside the courtyard and the adjacent rooms / built volumes. A field measurement was conducted on a case study hospital, where the thermal condition in the OEC and UEC were collected, analysed and compared. The findings indicate UEC as the better design option. Consequently, the UEC configuration was chosen for further investigation through a parametric analysis using the Integrated Environment Solution <Virtual Environment> (IES<VE>) simulation software. Mean radiant temperature (MRT) in the courtyard and the energy consumption of the attached built volume were the criteria of thermal performance. In the final phase of the research, the results from the parametric analysis were used for dual purposes -(1) to ascertain the thermal condition inside the courtyard through Computational Fluid Dynamic (CFD) analysis, and (2) formulation of an energy performance prediction equation, constructed using Structural Equation Modelling (SEM) technique. The structure model shows that eight predictors, i.e., Area, Length, Width, Height, Cantileveredroof, Orientation, Flow-in and Flow-out, can explain 97% of variations in energy. The significant finding of the thesis is the proposed preliminary Energy Estimation Formula (EEF) for UEC in the tropical climate that could benefit architects, designers and clients with deep concerns for a responsive design resolution.