DEVELOPMENT OF CORRELATION BETWEEN SICK BUILDING SYNDROME AND MICRO-CLIMATE

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DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

It has been identified that the incorporation of vegetation in built-environments is a sustainable solution for reducing the energy demand for thermal comfort and air quality in tropical climate and reducing building related stress to improve the human condition. Even though a considerable amount of research has been carried out in order to identify the effect of vegetation on built-environment, hardly any guideline can be found in such incorporation. This study is aimed at the development of guidelines for incorporation of vegetation in built-environments in national scale.

In order to achieve this objective incorporation of vegetation in both indoor and outdoor was studied separately. Initially the effect of the indoor plant on indoor environment was studied in order to quantify the amount of plants to be kept inside a room. This quantification was carried out based on the CO_2 absorption capacity. An equation was developed to determine the amount of leaf area per space, using absorption rate and ventilation rate as parameters. The need for a database of CO_2 absorption rates for varying species was identified consequently.

Framework criteria to develop such database were also identified based on theory, literature review, and experiments. Experiments were carried out in a large-scale chamber with and without plants, and varying several conditions. The identified framework criteria are indoor temperature and relative humidity, lighting source and combinations, orientation of windows, leaf area density per window length, existing CO_2 concentration and night time CO_2 emission. The opinion survey was carried out to identify the public preference towards keeping indoor plants. Majority of the respondents preferred to have indoor plants majorly due to the visual comfort provided by the plants.

Subsequently, incorporation of vegetation in outdoor micro-climates was studied. An experimental study was carried out to measure temperature, relative humidity, CO_2, NO_2, and $PM_{2.5}$ concentrations in five residential buildings selected based on their micro-climatic features. A parametric study was also carried out using CFD based software, 'ENVI-met' in order to identify strategies to design and plan garden vegetation for residential buildings. The computer models were validated for wind

speed, temperature, CO_2 concentration and wall surface temperatures using field measured data.

It was identified that locating vegetation in northern and southern sides of the building provides the highest beneficial effect on atmospheric temperature and CO_2 concentration where locating vegetation in eastern and western sides provides the highest beneficial effect on wall temperature. It was also identified that the effect of vegetation in the ground level diminishes after a certain height. Thus it was concluded the necessity of the vertical greenery systems in high-rises.

Air pollutant concentration may vary based on vertical elevation. Therefore, a separate study was conducted to evaluate vertical dispersion profiles of several air pollutants. A declining trend of several air pollutants were observed with the building height. A stagnation of air pollutant in street canyons and dense building arrangement was observed. A higher level of air pollution was observed in such arrangements than in locations surrounded by vegetation and water bodies.

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