PASSIVE TECHNIQUES TO IMPROVE THERMAL COMFORT IN FACTORY BUILDINGS IN SRI LANKA

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By

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DECLARATION

I, Samantha Pradeep Wijewardane, hereby declare that the content of the dissertation is the original work carried out over a period of 15 months at department of Mechanical Engineering and Civil Engineering, University of Moratuwa. Whenever others' work is included in this thesis, it is appropriately acknowledged as a reference.

ABSTRACT

Recent past the electricity prices have boosted to a certain height as to be identified by the industries, a key factor that hindered their competitiveness in international market. As a result, ways of reducing the energy consumption are called for within every segment of manufacturing. This new trend places the active techniques such as air conditioning a less feasible option for achieving thermal comfort within factories involving large workforces. Consequently, there occurs a rising preference for naturally ventilated factory buildings with passive techniques that enhanced the thermal comfort over HVAC controlled buildings as fit to the scenario.

This array of researches was a consequence of above circumstances, which aimed to find the thermal comfort preferences of factory workers and to study and develop passive techniques that reduce or totally eliminate the active means of achieving thermal comfort in factory buildings at the low altitude of the country. The thermal comfort survey formulated accordance with the "adaptive hypothesis" primarily illustrate the comparability of thermal comfort range of Sri Lankan factory workers and ambient temperature span of typical out door conditions at low altitudes. Therefore signify the possibility of adopting the methodology of creating the favorable outdoor thermal environment within the built environment thus show the opportunity to become independent from costly active means such as air conditioning. Further the results were used to compare the validity of various adaptive models and formulas published recently for tropical warm climatic conditions.

On the basis that there are abundant benefits to be gained from an improved understanding of the influence of adaptation on thermal comfort in the built environment, few novel experiments were designed and conducted to understand how workers behave and interact with different intensities of solar radiation and with different air velocities. The experiment that aimed to compare the effects of direct solar radiation on various parts of the body shows that 70% of the participants were uncomfortable when direct radiation fall on the back of their body than front of their body. Other 30% did not notice any significant difference So for existing factories, which are unable to stop the direct solar radiation inside the building, can change their

production lines if possible so that the unavoidable direct sunlight fall front side of the body rather than backside of the body.

Another experiment showed that 80% of the workers thermal comfort improves when walking, than staying in one place. It is believed that the augmentation of the relative velocity (0.6-0.8 ms^{-1}) when walking makes this difference even the metabolic rate is slightly higher when having a leisurely walk. Further it was noticed that the level of thermal comfort starts to reduce when the walking speed exceeds 0.8 ms^{-1}. Moreover, the questionnaire survey shows that about 50% factory workers have the option to have a short walk around, about after 20-25 minutes time period. This may be a good technique for workers to improve the thermal comfort of themselves.

Finally A simple and basic, but pragmatic factory model is presented by integrating the results of both field surveys and questionnaire surveys. The orientations and sizes of the openings with respect to walls and the techniques that uses vegetation as a cooling potential is considered here to give practical guidelines to a factory designer. Computer simulations using programs DEROB-LTH and AIOLOS were used to compare the model that with a common type. Results show the significant improvement with respect to ACH (Air Changes per Hour) in newly designed model.

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