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Determining the Thermal Performance and Comfort Indices of a Naturally Ventilated Room with Reduced Density Reinforced Concrete Wall Construction over Conventional M-25 Grade Concrete

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Abstract : Purpose: Occupied built-up space can be broadly classified as air-conditioned and naturally ventilated. Regardless of the building type, the objective of all occupied built-up space is to provide a thermally acceptable environment for human occupancy. Considering this aspect, air-conditioned spaces allow a greater degree of flexibility to control and modulate the comfort parameters during the operation phase. However, in the case of naturally ventilated space, a number of design features favoring indoor thermal comfort should be mandatorily conceptualized starting from the design phase. One such primary design feature that requires to be prioritized is, selection of building envelope material, as it decides the flow of energy from outside environment to occupied spaces. Research Methodology: In India and many countries across globe, the standardized material used for building envelope is re-enforced concrete (i.e. M-25 grade concrete). The comfort inside the RC built environment for warm & humid climate (i.e. mid-day temp of 30-35˚C, diurnal variation of 5-8˚C & RH of 70-90%) is unsatisfying to say the least. This study is mainly focused on reviewing the impact of mix design of conventional M25 grade concrete on inside thermal comfort. In this mix design, air entrainment in the range of 2000 to 2100 kg/m3 is introduced to reduce the density of M-25 grade concrete. Thermal performance parameters & indoor comfort indices are analyzed for the proposed mix and compared in relation to the conventional M-25 grade. There are diverse methodologies which govern indoor comfort calculation. In this study, three varied approaches specifically a) Indian Adaptive Thermal comfort model, b) Tropical Summer Index (TSI) c) Air temperature less than 33˚C & RH less than 70% to calculate comfort is adopted. The data required for the thermal comfort study is acquired by field measurement approach (i.e. for the new mix design) and simulation approach by using design builder (i.e. for the conventional concrete grade). Findings: The analysis points that the Tropical Summer Index has a higher degree of stringency in determining the occupant comfort band whereas also providing a leverage in thermally tolerable band over & above other methodologies in the context of the study. Another important finding is the new mix design ensures a 10% reduction in indoor air temperature (IAT) over the outdoor dry bulb temperature (ODBT) during the day. This translates to a significant temperature difference of 6 ˚C IAT and ODBT.

Keywords : Indian adaptive thermal comfort, indoor air temperature, thermal comfort, tropical summer index
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