



Factors Influencing Thermal Comfort and Occupant Well-Being in Naturally Ventilated Buildings and Their Level of Impact

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Thermal comfort in naturally ventilated buildings plays a crucial role in determining indoor environmental quality. It directly affects occupant health, productivity, and overall well-being, especially in warm-humid climates such as Sri Lanka where buildings rely substantially on natural ventilation. This study investigates the relative influence of environmental, building design, and occupant-related factors on thermal comfort in naturally ventilated office buildings. Furthermore, it examines associated Sick Building Syndrome (SBS) symptoms and perceived productivity impacts. A mixed-methods approach was adopted. First, a large-scale questionnaire survey of the general public ($n = 375$) was conducted to prioritize thermal comfort factors using Relative Importance Index analysis. This was followed by detailed occupant surveys in two naturally ventilated office buildings in Galle, Sri Lanka: the Department of Buildings ($n = 25$) and the Road Development Authority ($n = 20$), to assess actual indoor comfort conditions, health symptoms, and perceived productivity. Thermal comfort was evaluated using the Predicted Mean Vote (PMV) model, supported by statistical analysis of occupant responses. Results of the first survey show that air temperature is the most influential environmental factor for thermal comfort, followed by radiant temperature, air velocity, and relative humidity. Key building design factors include room size, building materials, and window size with their placement. Moreover, occupant density, clothing level, and activity level are occupant-related factors that significantly affect perceived comfort. Results of the second survey show both buildings exhibited warmer-than-neutral conditions ($PMV \approx 1.1-1.2$), comfort levels between uncomfortable and neutral, and a high prevalence of SBS symptoms (DoB = 72%, RDA = 50%). Occupants also reported notable impacts of indoor environmental conditions on work performance, indicating an association between thermal comfort and productivity, although causality cannot be conclusively established. The findings highlight the need for targeted thermal comfort improvements through optimized natural ventilation, improved building envelope design, and occupant-centered control strategies to enhance health, comfort, and productivity in naturally ventilated buildings in Sri Lanka and similar climatic regions.

Keywords: Naturally ventilated buildings, Occupant well-being, Sick Building Syndrome (SBS), Thermal comfort, Workplace productivity