

Integrated Displacement Ventilation with a Novel Evaporative Cooled Ceiling for Energy Enhancement

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Abstract

The study investigates by modeling the performance of displacement ventilation (DV) aided with a Novel Evaporative Cooled Ceiling, Maisotsenko cycle (M-cycle). The integrated DV and evaporative cooled ceiling system will increase the load removal of the DV air conditioning system beyond the 40 W/m^2 limit with no additional energy consumption. To increase the efficiency of the evaporative cooled ceiling, solid desiccant (SD) dehumidification system regenerated by parabolic solar concentrator thermal source will be used. Predictive mathematical models of the conditioned space, the SD, the solar concentrator system, and the M-cycle will be developed to study the energy performance of the suggested integrated system while utilizing an optimized control strategy for typical offices of the city of Beirut. The control strategy seeks optimal values of supply air flow rate and temperature and the desiccant regeneration temperature while meeting space load, indoor air quality, and thermal comfort requirements. The optimized hybrid system performance will be compared with conventional air conditioning system.