SPACE LOADS AND ENERGY CONSERVATION

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Keywords: Economizer, Energy conservation, Energy recovery, Energy wheel, Heat exchanger, Heat recovery, HVAC, Infiltration, Latent load, Sensible load, Thermal gains

Contents

Summary

Heating and cooling loads determine to a great extend the building thermal performance. Throughout the year, ventilation loads play a significant role on the overall building energy consumption. However, since ventilation is directly related to indoor air quality, thermal comfort and to an extent can also influence acoustical comfort, any efforts to reduce energy consumption for ventilation must ensure that there are no side effects. Energy conservation strategies for the ventilation system need to address specific problems that depend on the requirements introduced by the type, size and characteristics of building and special use spaces. Air-to-air heat and energy recovery devices, water and airside economizers are some of the systems that can be used to optimize ventilation for optimum IAQ and energy consumption. In addition, infiltration must be reduced and that will also improve thermal comfort.

1. Introduction

Indoor conditions are primarily influenced by external climatological parameters (external gains due to solar radiation and heat gains or losses due to the outdoor temperature) through the building envelope, and highly variable internal loads (human activity, lights, equipment) as shown in Figure 1.

The internal gains from occupants and the ventilation (including infiltration) introduce both sensible and latent loads. The sensible heat transfer rate is the result of temperature variations, while the latent load is a result of the moisture variations from the desirable conditions. Solar radiation and internal loads always act as thermal gains to the space. Heat transfer through the building envelope because of temperature difference may represent a heat gain or a heat losse, depending on the direction of the heat flow. Heat gains and losses between the indoor and outdoor environment occur primarily by conduction and also by convection and radiation.

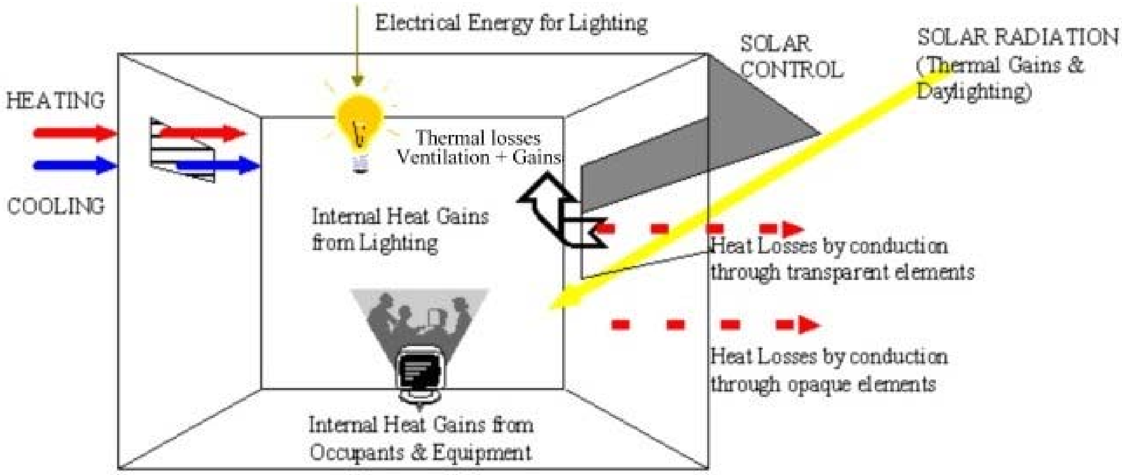

Figure 1: Schematic illustration of space heat and moisture transfer (thermal losses and gains, energy consumption)

The temperature variation of indoor air, for a space enclosed by n surfaces, depends on the surface temperature of the surrounding surfaces, the amount of air that is ventilated into the space, internal heat sources, and solar to air heat flow. This can be expressed by the following thermal balance equation:

$$m\,c\,(dT_a / dt) = \left(\sum_{j=1}^{j=n} Q_{c,j} \right) + Q_{c,v} + Q_{c,i} + Q_{s,r} \qquad (1)$$

where m = mass of internal air [kg], c = specific heat of internal air [J/kg.K], T_a = indoor air temperature [^oC], t = time [s], n = number of surfaces, $Q_{c,j}$ = convected heat flow rate by each surface j [W], $Q_{c,v}$ = heat flow rate exchanged by ventilation [W], $Q_{c,i}$ = convected heat flow rate from internal sources [W], $Q_{s,r}$ = solar to air heat flow rate [W].

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Biographical Sketch

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