SUMMARY OF PERFORMANCE ANALYSIS OF CEILING FANS

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STATEMENT OF PROBLEM

Continuous change in Architectural aspects and constructional techniques and strategies have, in most cases, hindered the use of one of the most appropriate passive cooling techniques suitable for tropical climates - "The Ventilation". Furthermore, heavy urbanization and congestion have increased the local dry bulb temperature considerably.

The absence of proper natural ventilating methods has led to the immense use of free fans (or simply fans) almost in all types of buildings in Sri Lanka in order to achieve the necessary thermal comfort levels. One can also find different models and brands of free fans with different manufacturing features in the market (e.g. blade angles, blade forms, motors etc.)

Therefore, methods of expressing the performance and characteristics of these free fans have to be established, reviewed and promoted. The electricity consumption for these fans in the domestic and commercial sectors being non negligible and establishment and review of testing procedures could play an important role in energy conservation policy making. Unfortunately, the flow filed in the vicinity of the fan is complex for which no precise analysis is available at present.

STATE OF THE ART

In a tropical country like Sri Lanka, relatively high circulation velocities are required to achieve thermal comfort levels. (1.2 ~ 1.5 m/s). The current of air provided by free fan is often adequate for this purpose. Moreover uniform mixing and hence steady temperature conditions are maintained due to the circulation of air provided by free fan.

A free fan is one that rotates in a common unrestricted air space. Desk, wall pedestal and ceiling fans falls into this category. The present study concentrates only on ceiling fans.

This type of fans suck air from behind and blows out with a higher velocity. This action is provided by the roaring blades of the fan, which are designed with a specific shape and orientation and give optimum performance. In general ceiling fan applications two distrint blade profiles are utilized to achieve optimum flow conditions.

They are cambered blades and flat blades with trailing end Flaps (shapely bend blades). Although the latter is easy to manufacture it inherits a higher drag force due to possible flow separation.

Unlike inducted fans a free fan discharge a jet of air possessing a free boundary. The surrounding air in contact with the jet stream. This process of entrainment continuous as the air streams moves further away from the fan resulting an increase in the volume flow rate in the same direction.

However, this entrainment ceases at a certain point further away from this point onwards there is a net loss of air through the jet boundary.

When the fan operates in a confined space the air will continue to re-circulate through the rotating blades. It is noted that the fan is fed by air that has returned to the inlet side if the fan by the medium of converging jet. When the jet is powerful enough to reach the floor the stream is reflected and this feature results in a relatively wide stream of reverse flow.

Performance of ceiling fans are characterized either by efficiency of the fan or by the service factor of the fan, The efficiency of the fan is the ratio between fluid power and electrical input where as the service factor is the ratio of the delivered volume flow rate at specified distance and the electrical power input. In SLS standard the service factor is used to evaluate the fan performance.

METHODOLOGY

When considering SLS standard there are several; shortcomings which could be identified in defining the criterion.

* Free boundary has not been identified for volume flow circulation

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* The distance between the measuring plane and floor is not sufficient to neglect the reflective effects.

* Since volume flow rate carries with the distance from the fans as well as the fan diameter the fixed distance measuring plane criteria is not suitable for comparison.

The axial velocity is measured at different points on a radial grid using a hot wire anemometer at different planes parallel to the plane of the fan rotor. The static pressure difference across the rotor is also recorded using a differential manometer. These readings enable us to evaluate the fan service factor or the fan efficiency mentioned above provided the input electrical power is also recorded. The contours of the equi-velocity is also established to visualize the personal comfort zone and the fan duty capabili

PERSPECTIVE

It is intended present a FEM model to simulate flow and pressure fields in order to compare with test results and to analyse the effect of vari parameters influencing the fan performance suc blade angle, profile etc.

REFERENCE

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