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Design and Modification in Air Curtain

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Abstract: ***Air curtain setup can easily separate outs the two temperature zones. While doing so the loss of conditioned air from the room to the outside environment takes place. In an ac room when we put the air curtain on wall at entrance of room and kept the door open. The same amount of air from conditioned room loss to the outside to keep the external hot air away from the room. So to reduce the effect of that air loss from conditioned room either we have to go for recirculated type air curtain or go for changes in the air nozzle angle at exit. While making recirculated type system the setup becomes costly and complex, so next option is suitable in use. In this paper, we have to make a change in nozzle angle by 10 degree inward side of room and compare the result with 0 degree angle. From the setup and testing result we get the data that effectiveness of air curtained room can be increases slightly compared to 0 degree angle.***

Keywords: ***Air curtain, Scroll casing, Effectiveness, Swirling, humidity***

I. INTRODUCTION

Use of the air curtain is most specially required at the place where continuous door opening of air conditioned room is occur. Such as in cold storage industry, ice factory, manufacturing industry etc. In an air conditioned room when continuous transfer of man or material is done from in and out through the room, the load on the air conditioner is increase. This happen because when door is open outside air gets infiltrated with inside conditioned air and that's why again temperature and condition of air inside the room again increases, so finally to keep it in control and cool work of air conditioner increases. That will directly affect the effectiveness of air conditioner.

So to keep this things in control the device developed was air curtain. It was first invented in 1904 by Van Kennel.[3] It consists of fan or impeller unit connected to two way shaft motor. This whole assembly produces a jet of air forming a barrier to heat, moisture, dust, odours, insects etc. This unit is placed above the door at entrance which blowing the air jet vertically downwards, in this study of paper we give new idea about changing nozzle angle at air outlet side.

When the nozzle angle is vertical that is very straight then it creates the air barrier but doing so conditioned air from room is loss out to outside air. That is why our aim to keep that loss of conditioned air as less as possible to increase the effectiveness of air conditioner. Thus here we keep the angle 10 degree inwards of air blowing out and check the temperature of both sides to calculate the effectiveness and compare with standard straight angle effectiveness values.[3] While designing air curtain for air conditioned room along with door height, width the another factor to be consider is nozzle angle or air exit angle at outward and also velocity of the air is also major factor.[1]

II. LITERATURE REVIEW

Grzegorz Krajewski etal :- He done experimental test to verify turbulence model by using CFD analysis for designing air curtain in fire safety. He had done the attempt for checking CFD methods possibilities for analysing parameters. He suggests that air curtain can be used for smoke free zones division at the time of fire. A.M .Foster etal :- He shown that proper adjustment in jet velocity and angle will help to increase the effectiveness of air curtain. He made an analytical model so that optimum jet velocity can be identified for obtaining effectiveness between 0.37 and 0.7. He concludes that when air curtain size extends beyond the door width effectiveness will further increase up to 0.79.

Kai Siren etal ;- He provided new perspective for dimensioning air curtain for building envelope and ventilation system. He suggests that against wind induced breakthrough tight building envelope with small discharge angle and high jet momentum flux gives more tolerance. He concluded jet discharge angle has more influence on air jet for resisting breakthrough. The pressure difference across the building is major factor in dimensioning air curtain.[6]

Zhikun cao etal :- He done the analytical and experimental study with SVM algorithm and CLTF model respectively for determining cooling loss. He built CLTF model for studying flow and transfer of heat for air curtain in open vertical refrigerated display cases. He predict the cooling loss is reduced by this method is 19.6% and experimental validation gave result up to 17.1%. He also concluded that air curtain performance in refrigerated display case depends on air supply temperature, air supply velocity and variation baffle position.[5]

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III. DESIGN CONSIDERATION

There are two major considerations while designing the air curtain

A. External parameters

The most important external factors which are to be considered while designing the air curtain are as follows:

1) *Type of application* – commercial (to maintain the humidity in air conditioned room during summer season.)
2) *Door height* – normal door height of 7 feet is assumed while designing the air curtain.
3) *Door width* - 3 feet door width is considered.
4) *Temperature difference* – outside temperature is assumed to be 36 to 40 degree Celsius. And inside room temperature is assumed to be 22 to 26 degree Celsius.

B. Design parameters

According to the various external factors and design requirements, the following parameters are calculated.

1) Outer dia. Of impeller – 120mm
2) No. of vanes required – 25
3) Length of impeller – 145 mm
4) Impeller Vane thickness – 3 mm
5) Shaft diameter – 10 mm
6) Dia. Of scroll casing – 150 mm
7) Thickness of casing – 2 mm

IV. WORKING PRINCIPLE

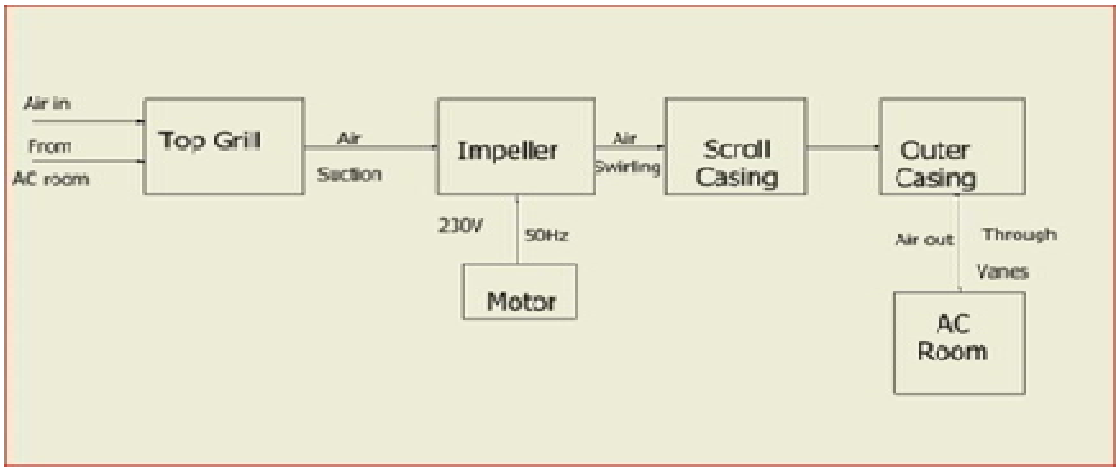

Fig 1. Block diagram for working of air curtain

Once the power is on, air is brought into the unit through the intake, enters the fan housing and is accelerated by the fan. This fast moving air goes into the plenum, which allows for an even distribution of air along the full length of the discharge nozzle. Aero foil shaped vanes in the nozzle create a uniform air stream with minimal turbulence.

For efficient air curtain performance, the angle of the discharge nozzle must be set correctly. An air curtain nozzle should be inward with some angle. The air discharged through the nozzle creates the jet stream to the floor. So that approximately 80% of the air returns to the inward side of the door and 20% goes in the opposite direction.[2]

V. COMPONENTS

There are five main components in an air curtain assembly unit which are as follows

A. Impeller

Impeller is a main component in air curtain. This is coupled to the motor shaft and it runs with motor speed. When air is sucked inside the casing it moves over the impeller and impeller provides swirling motion to the air.

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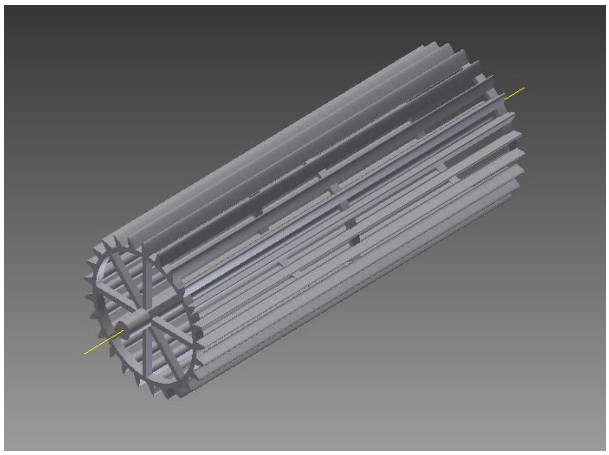

Fig. 2. Air curtain impeller

B. Motor

Motor is used to rotate the impeller.

C. Scroll casing

It surrounds the impeller to guide the moving air and provides swirling motion to the air.

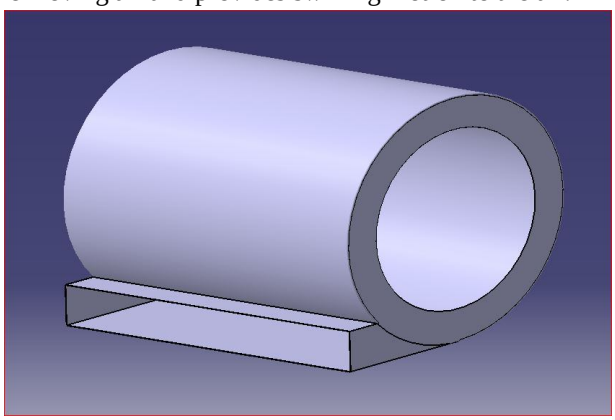

Fig.3. Scroll casing for air circulation

D. Air directional vanes

It is a member which guides the air coming out from scroll casing and directs the air according to the angle.

E. Outer casing

All parts are surrounded by outer casing. Grills are provided on upper side of this casing for entering air. This casing also consist the required angle for outgoing air.

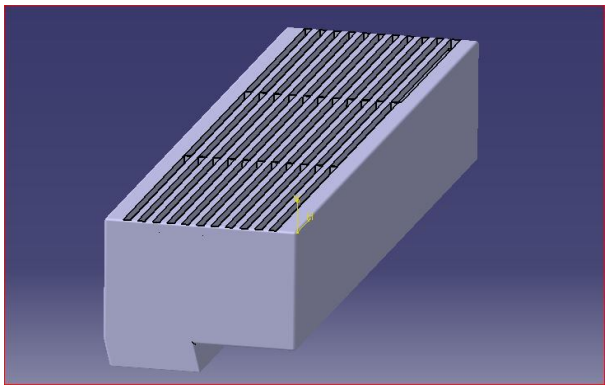

Fig.4. Outer casing with 10 degree inward angle

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VI. CONCLUSION

From the review of various papers we conclude that air curtain is a very useful device for separate out two different temperature zones. Also we conclude that it works more efficiently when it is placed at proper position. The concept of changing angle of nozzle outlet with 10 degree inward is the precise angle at which effectiveness of air curtain is increased and it is useful in improving the effectiveness of air conditioned room. The various design considerations while designing the air curtain also affect the performance of it. From the study of various papers we conclude that infiltration of conditioned air is minimum with outside air when the nozzle angle is few degree inward. When nozzle angle is 10 degree then it improves the effectiveness as compare to straight angle.

VII. ACKNOWLEDGMENT

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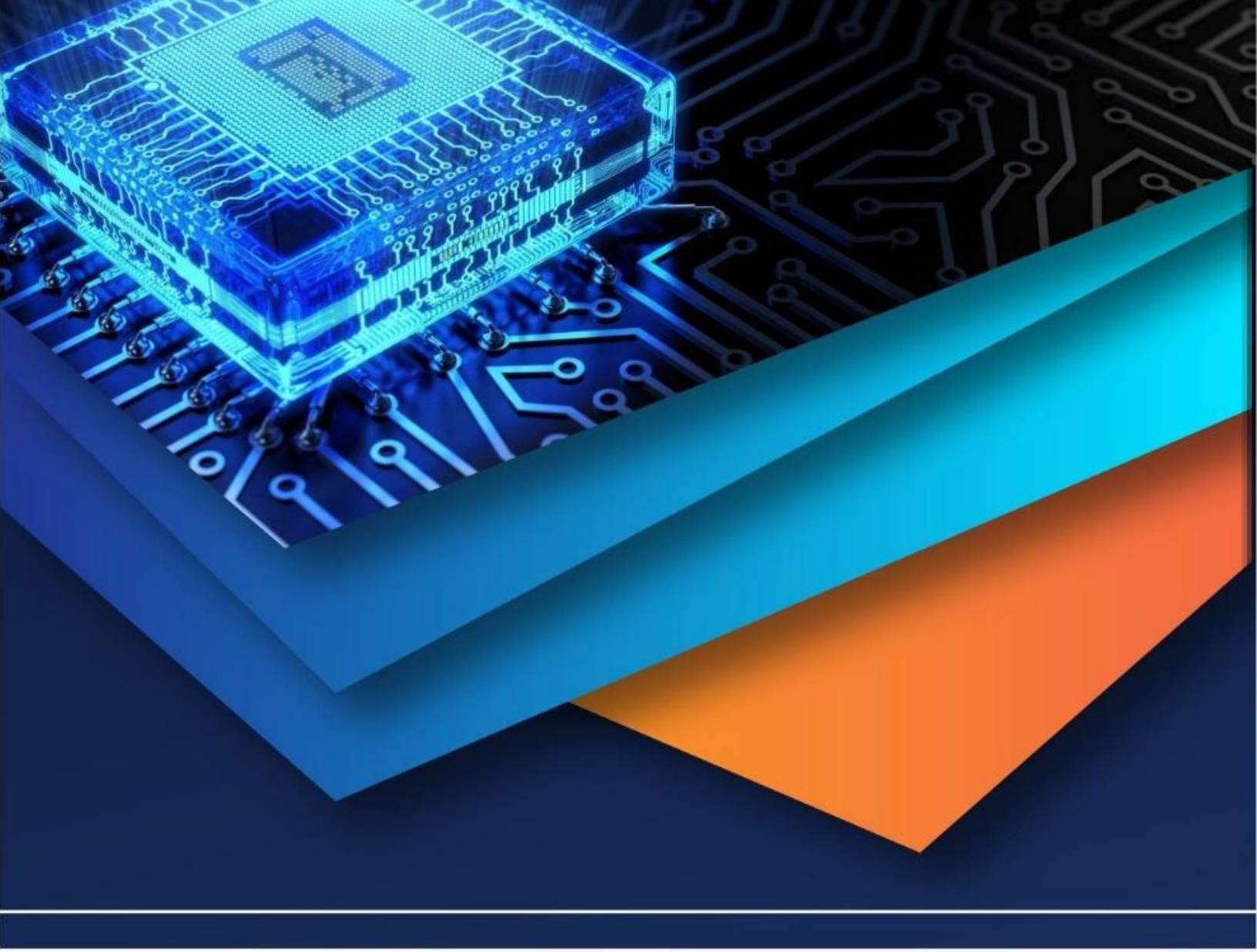

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