Determination of Appropriate Position of Desert Cooler in Living Room by Using CFD, ANSYS and Simulation

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Abstract- **There has been plenty of research work carried out related to evaporative cooling However, very few studies are done on suitable positioning of desert cooler in room to attain minimum temperature . The following research is based on systematic literature review of 2 papers which were published on desert cooler in the top journals from 2002-2015. The published authors have researched desert cooling literatures in the way that would help research academicians to take a closer look at the growth and development of this technique. This papers aims to review the recent development concerning evaporative cooling technologies that could potentially provide sufficient cooling effort, and lower energy consumption. The authors have reviewed various journal papers and suggested different schemes of classification. The review covers working principle, performance of desert cooler with respect to various position. The study focusing on best position of desert cooler in living room , benefits in terms of temperature drop, In addition, certain gap areas are identified that would help researchers in future.**

Index Terms- Evaporative Cooling, desert cooler, thermal resistance , Method of Cooling, Environmental Aspects.

INTRODUCTION

The comfort of building occupants. The cooling potential for evaporative cooling is dependent on the wet bulb depression that is the difference between dry bulb temperature and wet bulb temperature. Desert cooler involves converting sensible heat to latent heat by evaporating water to remove heat from the air. Energy for evaporation of water is provided by the sensible heat in air. Desert coolers lower the temperature of air using the process of the cooling and Dehumidification. Desert cooler is the addition of water vapour into air, which causes lowering the temperature of the air. The energy needed to evaporate the water is taken from the air in the form of the sensible heat, which affects the temperature of the air, and converted into the latent heat. This conversion of sensible heat to the latent heat is known as adiabatic process because it occurs at a constant enthalpy value. Evaporative cooling technique is very old and easy method of cooling. Humans have been using this technique for their comfort and convenience. In many old monument we can find this type of cooling technique but because of systems inefficiency and some constraints we are not using this technique so in this paper focus is made to understand the system working and improve its efficiency by using the changing of position of desert cooler and also make a study how to design desert cooler for a particular region. Some of the researchers have worked on the desert cooler whose findings are reported in the ensuing paragraphs.

METHODOLOGY

A simple two-dimensional model of a room was analyzed using CFD-ansys, a commercial computational fluid dynamics software package, to examine airflow and temperature distribution under different circumstances. The model was set in summer conditions in which cooling were necessary. In both cases, the position of the cooler changed yielding a large matrix of results.The CFD package, CFD-ACE+, was set up to use three modules to

resolve the flow and temperature distributions of the model: flow, heat transfer, and turbulence. Each of these three modules has its own set of governing equations and is discussed in its respective section below. While the equations presented apply directly to the two-dimensional cases.

1.3 Objective of the study

The main objectives of this paper are as follows:-

- Compare the temperature variation by position of cooler.
- Determine the suitable position of cooler for more human comfort.
- Increase the evaporative efficiency as more as possible.

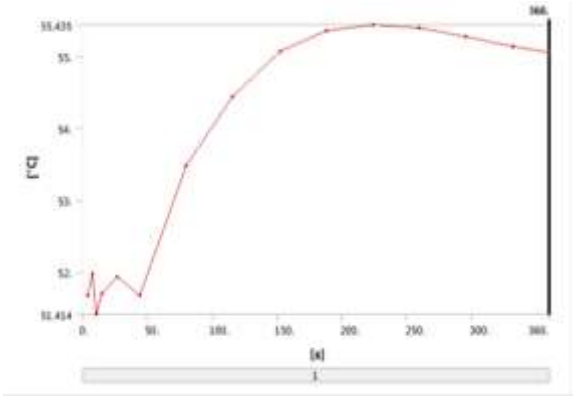
1.4 Results & Analysis

The two different cases were investigated in 2 dimensional analysis . For case 1, cooler was placed inside the room and in case 2, cooler was placed outside the room. The data collected includes the temperatures at the monitor point and temperatures distribution at all node in the model room at the end of the 360 seconds. simulation computations were done by using ANSYS and CFD.

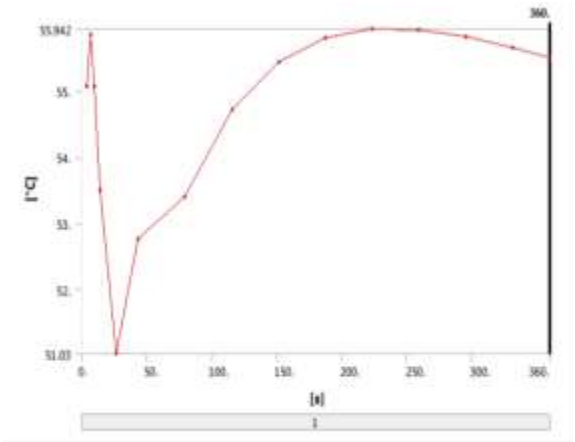
1.4.1 When cooler is inside window all specification of room taken into the consideration and desert cooler as shown in table below.

SPECIFICATION	ROOM	EVAPORATIVE COOLER
Length x	3.8384 m	0.685 m
Length y	4.9203 m	0.475 m
Length z	3.0988 m	1.28 m
Nodes	8327	7974
Elements	3861	3587

by using ansys R 15.0 by putting the all considerd dimension of room and cooler the following graph obtain which represents temperature with respect to time temperature of room increases 0.5°c in 10 sec. After the 10 second, temperature suddenly fall down up to 51.414°c. This is because of particle are coming from surrounding, comes into the contact of cooler hence the temperature is very less at the initial stage. But after 15sec, as soon as they mingle with the rest of room air, temperature starts raising. It takes some time to mingle and heat transfer. In the beginning there is drop in temperature because of air particles do not mix up with the rest of the room air. As soon as mixing takes place, temperature raises and raise in temperature is continue up to 250sec. Almost, room have the same temperature. Further cooling takes place , total temperature difference 4.021°c.



1.4.2 When cooler is placed outside the Window



Following data used in ANSYS R15.0 and CFD main object to determine the temperature variation in room after using these value we got the following graph represents the temperature distribution and heat flux in considered room at the initial stage of test , temperature of room increases 0.942°c in just 10 sec temperature suddenly fall down up to 51.03 °c .the This is because of particle are coming from surrounding, comes into the contact of cooler hence the temperature is very less at the initial stage But just after 25sec, as soon as they mingle with the rest of room air, temperature starts raising. It takes some time to mingle and heat transfer. as soon as mixing takes place , temperature raises and raise in temperature is continue up to 250 sec . all most room have same temperature further cooling takes place , total temperature difference 4.912°c .

1.5 Conclusions & Future Recommendations

As defined in the earlier chapter after following the described methodology following conclusions can be made:-

(1) when the Desert cooler placed inside the window, temperature drop was 4.021 °c while when the desert cooler placed outside the window, drop in temperature was 4.912 °c hence the outside condition is best for positioning desert cooler

(2) when desert cooler placed inside the window the temperature difference and conductivity both factor due to saturation is more while in case second temperature difference and conductivity both is less. hence second condition is good for cooling purpose

(3) when desert cooler placed inside the window the min heat flux after 10 sec was 2000w/m² but when the cooler placed outside the window after 10 sec heat flux was 1300w/m² hence on the point of heat flux second position is best

(4) suitability of positioning when desert cooler placed inside the room it will cover a lot of space of room and there are chances of leakage of water by khus used in it but when cooler placed outside the room it will not cover useful space of room and leakages of water is outside the room hence on the basis of handllation outside condition is best

Areas of interest in future simulations would include changing of desert cooler locations and changing of air injection methods. For example, a pulsed injection with a mean volumetric flow equal to the injection flow rate of a steady flow may offer more mixing and better results. It is important to find out most efficient design through parametric study in CFD for real-life implementation. Heat transfer performance varies with different cross section shape. Study of different cross section like oval, helical shape should be carried out through analytical and CFD.

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