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Design of HVAC System for Multiplex using Double Heat Recovery Wheel and Improving Indoor Air Quality

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Abstract: ***The project work includes the proposed HVAC system design and also the heat load Calculation in HRW software there after improving IAQ for the coming new Multiplex in Hyderabad. The proposed air conditioning structure should be placed in building basement. The Design of air-conditioning incorporates heat load estimation, Selection of chillers, pumps, Air handling units (AHU'S), type of recovery wheel, TFA units.The task work incorporates heat load estimation of the working through Hourly Analysis Program (HAP) and furthermore the load calculations in HRW programming for energy consumption, channel outlining through Mc Quay pipe seizer, pipe measuring through Mc Quay pipe estimate, drafting of air-conditioning framework, designing of recovery wheel, equipment selection, the difference between the tonnage of HAP and HRW software's in the theater spaces of the multiplex and also maintaining IAQ by providing treated fresh air units in areas of theater spaces.***
Keywords*: Heat recovery wheel, Air conditioning, Treated fresh air, Chiller pumps*

I. INTRODUCTION

The term HVAC which abbreviates to Heating, Ventilating and Air Conditioning, has a wider scope in the zones of commercial, residential and hospital buildings.

The role major of HVAC is to provide comfort heating, comfort cooling and ventilation or heating and cooling applications in residential as well as commercial areas. It includes study of wide range of equipment's from small scale domestic application to the large scale industrial applications.

HVAC system configuration is a sub train of mechanical building, in light of the Principles likes thermodynamics, liquid mechanics, and heat exchange. Refrigeration is sometimes added to the field's shortened form as HVAC&R, or ventilating is dropped as in HACR (Such as the assignment of HACR-evaluated circuit breakers).

II. HEAT RECOVERY WHEEL

Recovery wheel transfers only the sensible heat, while energy recovery Wheel transfer heat and also moisture from air streams. As the recovery wheels transfer the greater amount of heat, which results in high effectiveness values and mean Pressure drops in HVAC system.

The transfer of heat between the air streams is accomplished by the rotating exchangers as desired for the comfortness. Typically the rotating speeds of recovery wheel are in order of 20-30 RPM (revolution per Minute). For the maximization of moisture transfer the wheel uses thick desiccant coatings fully surrounded to wheel. By decreasing the rotational speed of the recovery wheel by ($< 1RPM$), eliminates as much moisture as possible from the moist air stream as required.

HRW and ERW are produced in various sizes and are manufactured with a wide range of materials. The core part of the wheel is known as the wheel matrix, permits heat and moisture exchange between the two air streams. Aluminium is the general framework material as it offers high conductivity and capacitance. The extra lattice materials, for example, pottery, tempered steel, plastics can likewise utilize.

The viability of heat and energy exchangers is completely reliant on the heat/mass exchange territory which implies more noteworthy surface region, the more prominent adequacy in heat exchange.

A. Working Of Heat Recovery Wheel

In the operation of HRW and ERW the two air streams flow through the wheel in counter flow pattern so that the maximum possible heat and moisture transfer.

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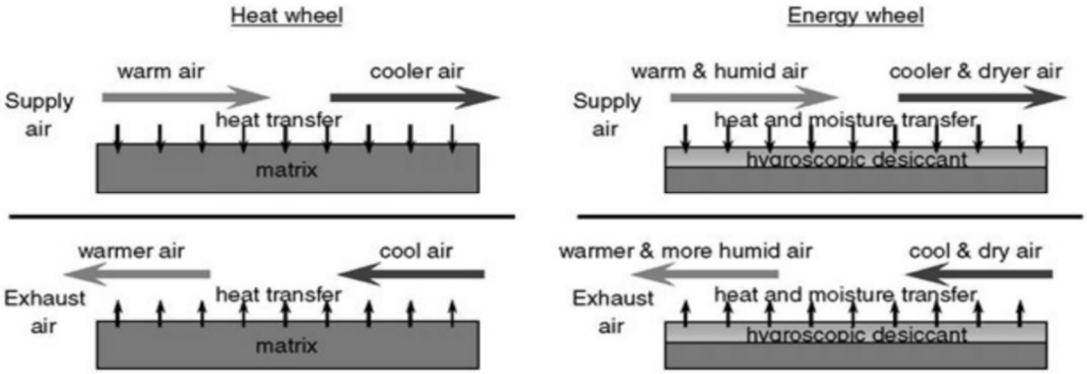


Fig.1 Heat and energy recovery wheel matrix working.

The working of energy wheel differs from heat wheels because the matrix of the wheel is also coated with a desiccant that reserves the moisture content in the moist air. The hygroscopic desiccant coated inside the wheel collects the moisture present in moist air. In HVAC system the recovery wheel is installed in air handling unit (AHU) and then made into two half-moon sections.

The unwanted exhaust air is drawn through the one half-moons and outdoor air through the other half portion of the wheel in counter flow pattern. The wheel is rotated by which the sensible heat is transferred as the metallic substrate collects and stores heat from the warmer air stream. Whereas latent heat is transferred as the desiccant coating in the wheel adsorbs the moisture present in the moist air stream. The air stream which is having higher humidity ratio is collected and later that moisture is released into the air stream which has lower humidity ratio.

III.BUILDING DETAILS

In this undertaking work, the kind of working for which a HVACdesign is planned is multiplex, is a business sort of utilization that is the building which is picked is proposed to be utilized as a shopping centre. The building is proposed to be situated in Hyderabad, India. The introduction of the building is to such an extent that, it's confronting is towards the north-east bearing and the building is given an entire glass segment in space like showrooms. Thus, total wall portion are on the screen spaces where the capacity of ERW is utilized. The building comprises of six floors i.e. a ground floor consists of mall and showrooms, similarly the above three floors are typical floors and then coming to 4th floor which is consists of entertainment zones and restaurant areas, 5th and 6th floors are comprises of theater auditoriums. The total area of the building is about 71124 SFT and it includes different sections The maximum occupancy of this building ranges up to about 2100 persons from which about 1400 persons is occupied in theater and the number of occupants that can be accommodated within each floor is estimated from the ASHRAE standard that specifies about 30 square feet per person. An important consideration in this aspect is, the number of occupants is selected based on the space to be condition and not the total building area.

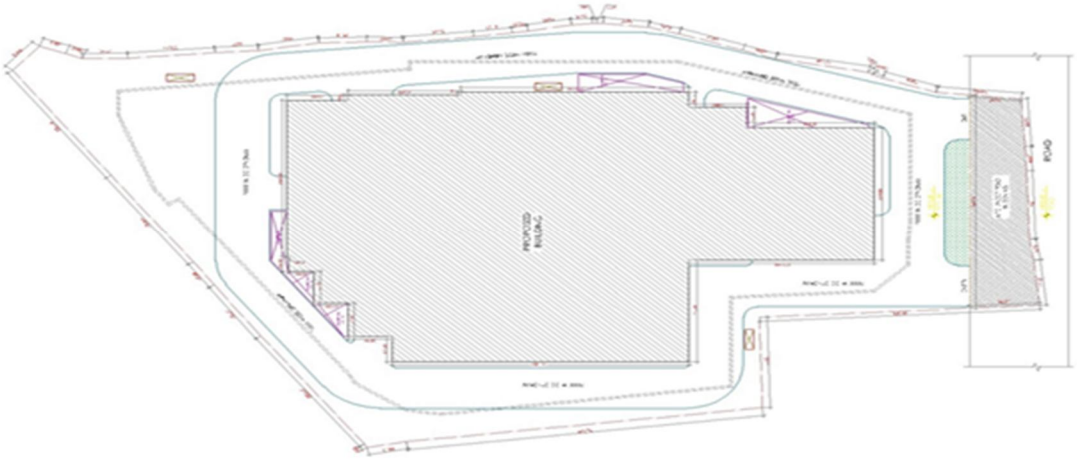


Fig. 2 Building Plan

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IV. CALCULATIONS

A. Heat Load Calculation

The heat load calculation is done using general method, E-20 method, and hourly analysis program (HAP) software. The heat load calculations were also done using heat recovery wheel software. By using recovery wheel 31.5% of heat load is reduced when compared from the calculations of HAP software.

B. Heat recovery wheel calculation

This software uses the data from the normal heat load calculations to find the heat load with HRW (heat recovery wheel). For the calculation of heat recovery the supply air CFM of the space and 80% return air CFM with 55% relative humidity is taken.

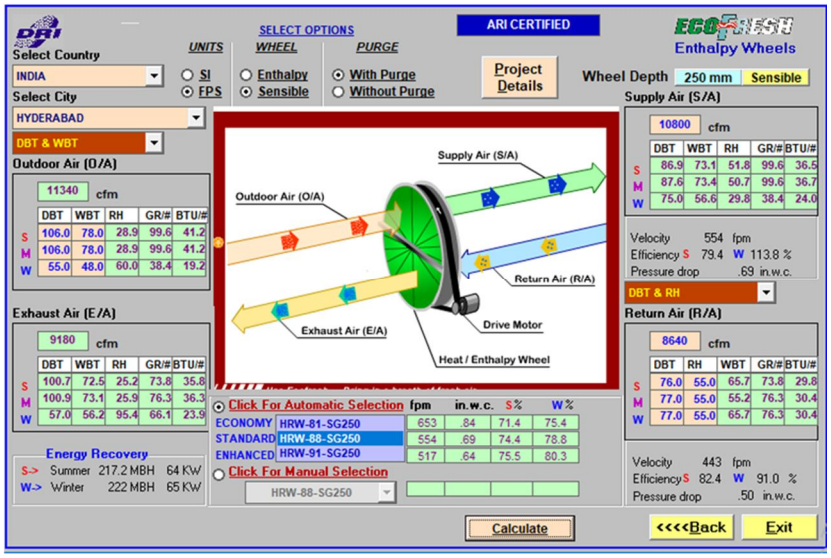


Fig. 3 HRW software (DRI)

C. Comparison of tonnage in HAP and HRW software

TABLE I

OCCUPIEDSPACE SL.NO	HAP (TR)	HRW (TR) KW/3.5
1. SCREEN (1)	27	18.5
2. SCREEN (2)	25	17.1
3. SCREEN (3)	25	17.1
4. SCREEN (4)1	25	17.1
5. SCREEN (5)	29	20
6. SCREEN (6)	19	13.1
TOTAL	150 TR	102.9 TR

From the above table it is obvious that by using recovery wheel 31.5% of energy is recovered. By which in the total energy consumption by chiller plant can be saved Up to 31.5% from the normal designing i.e. without recovery wheel.

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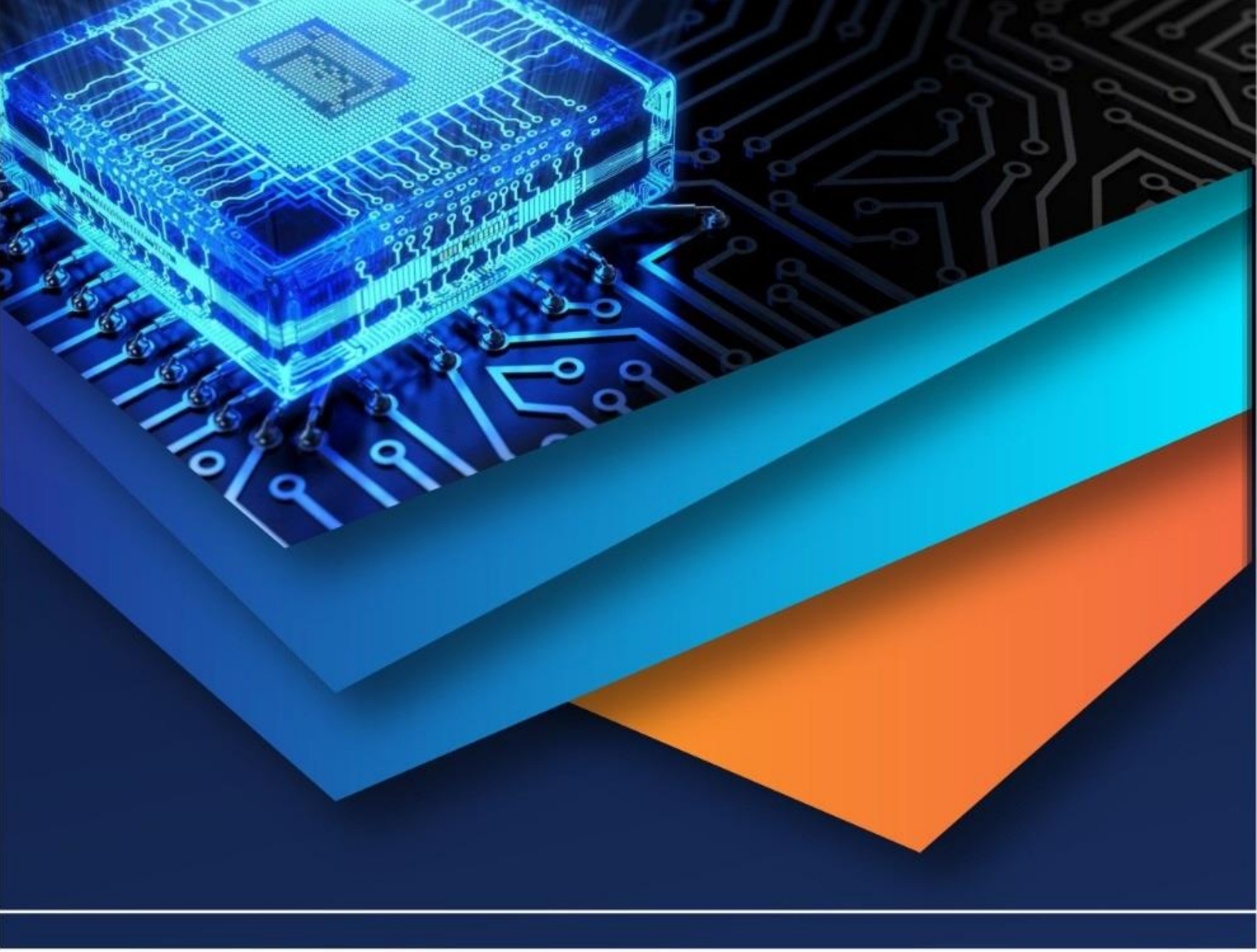
V. CONCLUSIONS

Hence by adding the heat recovery wheel (HRW) in an HVAC allows reduction in system load by (30-60%). The major purpose of this project is to design the HVAC system by using the energy recovery process so that the total amount of energy can be saved up to 31% and also by employing the TFA in HVAC the required supply air will be hygienic for the Occupants. The area of theater auditorium is taken for the energy recovery because of its high Occupancy. The designing is done using chilled water air handling units AHU. The heat load for the six theater auditorium has been compared by using HAP and HRW software heat loads. By which the total tonnage of system is reduced to 31.5% when compared to the HAP calculations. Therefore amount of energy recovered by using HRW in the designing of HVAC system For 6 Theater's space is up to (31.5%) and also the total energy consumption by using HRW than the normal system i.e. without HRW can be save up to 31.5%**.** The System is also designed by installing the TFA units through which the indoor air environment is improved when compare to normal units, also the co_2 levels has been maintained.

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