The book of abstracts

The 3rd International Conference on Heating, Ventilating and Air Conditioning

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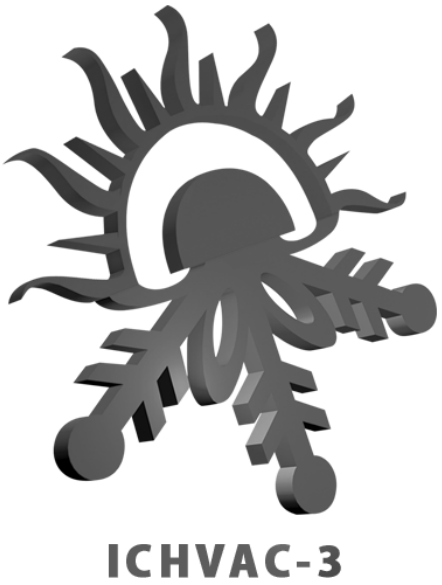
Tehran-Iran



(400 word abstracts)

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Building and Housing Research Center

The Iranian Construction Engineering Organization

University of Tehran

The Iranian e-Community of Mechanical Engineers

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Turkish Society of HVAC & Sanitary Engineers (TTMD)

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Preface:

The 3rd International Conference on Heating, Ventilating and Air Conditioning (ICHVAC-3) will be held by Building and Housing Research Centre, Iranian Construction Engineering Organization, Tehran university and the Iranian e-Community of mechanical engineers in close partnership with United Nations Environment Program (UNEP) and Turkish Society of HVAC & Sanitary Engineers (TTMD) as a reach forum to exchange ideas and achievements of academic scholars, industrial professionals, consulting engineers, contractors and manufacturers.

With increasing population growth, there is an essential need for comfortable conditions at home, work place and vehicles too. This results in much more energy consumption, especially in building sector, whereas much of energy is consumed through heating or cooling process of the buildings. To survive in these conditions, the manufacturers of equipments, designers and practitioner in building industry are made satisfy the emerging needs by producing optimized and low consumption products. Based on this viewpoint, there is special attention toward modification of energy consumption for HVAC systems.

Total number of 142 papers were submitted to the conference website. Each paper was reviews at least by three reviewers. Finally, 53 papers are approved for oral presentation and other 32 for poster presentation. Without significant support of members of conferences scientific committee and our reviewers, this job almost very hard to be done. It is our absolute duty to acknowledge sincerely all of them.

There will be one keynote lecturer to present the one of the newest achievement and improvements. Several specific sessions including:

- Joint session of UNEP and GIZ on Future new refrigerant
- Technological and economical comparison of reciprocating and absorption cooling systems
- Presentation of professional and industrial issues and challenges

Through educational workshops, with respect to experiences of two past conferences and received feedbacks of audiences in order to eliminate the parallel and similar workshops and make better opportunity for whom interested in, there are totally 12 selected workshops with different concepts.

These workshops will be presented by professional academics, specialists and industrialists, too.

As an innovate step, the conference's industrial committee is established, through which industrial professionals are invited. They would try to reinforce technical base of the conference by offering valuable experiences and ideas. The findings of this committee activities and results will be presented through discrete meeting, too.

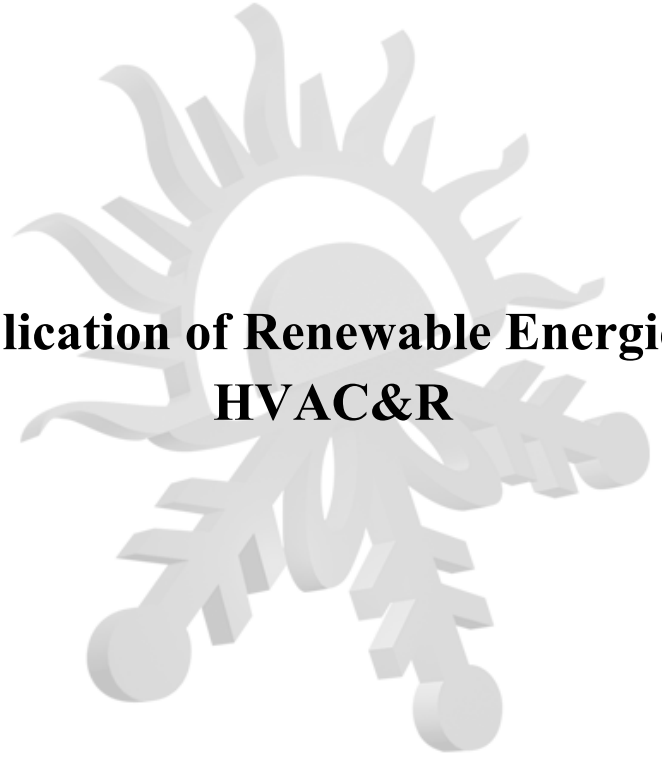
Like last conference (ICHVAC-2), through this conference in order to identify the superior ideas and encourage fostering ideas and also commercialize "heating, cooling and air conditioning subjects", the doctoral thesis, M.S. dissertations and B.S. projects would be then appreciated. Also in parallel with establishing the conference, there is an exhibition through which many of consultant engineers, contractors and manufactures of heating, cooling and air conditioning equipments are present.

Finally, it is worthy to acknowledge all of the authors, reviewers, invited lecturers, workshop conductors, university professors and our other colleagues…
I request the god, the success and honor for our country.

Mohammad Ali Akhavan (Prof. Mechanical Engineering)
Conference Chairman

Abstract Index

Application of Renewable Energies in HVAC&R



Review of Low Energy and Solar Cooling Technologies for Buildings

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ABSTRACT

The need to accomplish a safe and comfortable environment is one of the main obsessions of the human race. Nowadays research at the development of technologies that can cause reductions in energy consumption and energy costs without lowering the desired level of comfort conditions has heightened. Optional cooling technologies are being developed that can be used in residential and commercial buildings, in a wide range of weather conditions. These include night cooling with ventilation, evaporative cooling, desiccant cooling, slab cooling etc. The design of buildings with low energy cooling technologies has some problems, and needs advanced modeling and control techniques for efficient operation. One of the other methods of reducing energy consumption is ground cooling. Ground cooling is based on the heat-loss dissipation from a building to the ground, which has a lower temperature than the ambient in the summer. This dissipation can be achieved in two ways: direct contact of a main part of the building with the ground or by blowing air that has initially been passed through an earth-to-air heat exchanger into the building. In intermediate seasons in hot dry climates, processes like evaporative cooling can suggest energy conservation opportunities. However in summertime, low energy cooling technologies cannot alone afford the total cooling request of domestic dwellings, thus active cooling systems are required.

For this reason vapour compression, cooling systems are usually used which are expensive, and its production depends absolutely on fossil fuel. In such climates, one of the sources plentifully available is solar energy, which could be used to power an active solar cooling system based on the absorption cycle. Solar absorption machines have some problems. One of them is that they are expensive relative vapour compression machines, and are not readily available in the small capacity range suitable for domestic cooling applications. Reducing the use of conventional vapour compression air-conditioning systems will also reduce their effect on global warming and ozone layer depletion. The jointing of the building envelope with an absorption system should offer better control of the inner environment. The goal of this paper is to examine solar cooling and low energy cooling technologies. A brief review of various cooling systems is presented, including solar sorption cooling, solar mechanical systems, solar related air conditioning, and other low energy cooling technologies. The relative efficiencies and applications of the various technologies are presented. These technologies can be utilized to reduce both the energy consumption and environmental impact of mechanical cooling systems.

Keywords: Low energy, Solar Cooling, Sorption Cooling, Air conditioning.

Designing a Passive Solar System in Bandar -e- Lengeh

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ABSTRACT

By reviewing the efficiency features and high quality of static solar energy systems, This study aims at emphasizing the importance of benefiting passive solar energy system as a solution to reduce fossil fuel energy consumption and to create buildings which are self-sufficient in terms of cooling and heating. Subsequently, through case studies of the application of such systems, the study investigates to determine the appropriate and efficient type of solar energy systems. In addition, the researcher attempts to improve the selected type for a designed residential case in the town of Bandar-e- Lengeh, with a hot and humid climate, by taking some innovative measures. The measures are taken in order to achieve the most efficient and optimal system based on the said native and local climatic conditions.

Key words: Hot and Humid Climate, Self-sufficient Building, Bandar Lengeh, Passive Solar Energy System

Experimental Investigation of Ejector Operation and Thermodynamic Modeling of Solar Ejector Refrigeration Cycle

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ABSTRACT

In this paper, performance of an ejector refrigeration cycle was experimentally and theoretically investigated. Then, thermodynamic performance of a solar ejector refrigeration cycle was simulated. The system consists of a solar collector subsystem and ejector refrigeration subsystem. The major components in the refrigeration cycle are an ejector, a condenser, a generator, an evaporator, an expansion device and a pump. The vapor from the low temperature evaporator is sucked into the high velocity vapor stream in the ejector. The high velocity vapor stream goes through a converging-diverging nozzle in the ejector resulting in the vapor being sucked from the low temperature evaporator. The suction occurs, as the pressure is low at the narrowest section of the ejector. The stream from the evaporator reaches a subsonic velocity. Mixing occurs at the end of the converging section. After mixing, the combined stream becomes a transient supersonic stream, and the velocity of the combined fluid must be high enough to increase the pressure after deceleration in the diffuser to a suitable condensing pressure. After the pressure build-up, the stream from the ejector goes to the condenser, and heat is rejected to the environment. After the condenser, one part of the fluid is pumped to the generator, and the rest goes to the evaporator, reaching the evaporating pressure through the expansion device.
The solar radiation that reaches the solar collector is transformed to heat. This heat is partly absorbed by thermal fluid and the surrounding equipment and partly lost to the environment. The entrainment ratio and operating parameters at the exit of the ejector could be calculated according to area ratio of the ejector and inlet conditions (pressures and temperatures). The ejector modeling was carried out using constant-pressure mixing theory in the constant-area section. The simulated performance of the system was in good agreement with the test results. Then, performance of the solar ejector refrigeration cycle was thermodynamically investigated. R11 was used as the working fluid in the experiment and R12, R123, R500, R152a, R134a used in the modeling. The effects of the operating parameters on the coefficient off performance (COP), exergy destructions and second law efficiency were studied. Among the studied working fluids, R152a gives higher first law efficiency. When boiler and evaporator temperatures increase, the coefficient of performance goes up.

Keywords: ejector, solar ejector refrigeration cycle, exergy

Heat Ventilation of Building by Using Geothermal Energy with Two-Phased Closed Thermosyphon

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ABSTRACT

Nowadays, energy supplying systems around the world face formidable challenges that are taxing conventional strategies. Fresh approaches are needed to address persistent problems of the past and provide industry with an energy resource appropriate to the needs of a modern, information-based global economy. Using fossil energy, apart from being a costly process, has resulted in devastating problems such as the release of green house gases that causes unprecedented global warming. Besides, limited access to fossil energy has forced scientists to consequently think of a renewable and green source of energy as a replacement. Geothermal energy is among the most important of all renewable energy resources that are accessible in cold regions of the world at a low cost. In this paper, a two phased closed thermosyphon is used to inspect the heat ventilation in a building as a case study. Firstly, the global statistics are displayed to demonstrate the growing rate of using geothermal energy. Secondly, a mathematical model is utilized to make a comparison between conventional domestic warming systems and geothermal energy showing that using geothermal energy finally results in a tangible decrease in heating expenditures. To this aim, a FORTRAN code is written to optimize dimensions of thermosyphon and monitor the effects of different factors such as length and diameter on its efficiency and outgoing working fluid temperature. Outcomes demonstrate that an increase in the length of evaporator and condenser sections declines the outgoing working fluid temperature of thermosyphon whereas altering the length of adiabatic section leaves little changes on it.

Keywords: Geothermal energy, Heat pumps, Thermosyphon, Two-phased closed, Simulation

Improvement of Heating for the Solar Passive Two Sided-Roof Greenhouse

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ABSTRACT

An agricultural solar passive greenhouse is a building where plants are grown. In this structure, solar radiation transfers from its transparent covers; and then is absorbed by the things inside the building. The two sided-roof greenhouse is a traditional type. It has been proven that the traditional greenhouses have very poor thermal performance with a typical U-value for the single-glazed envelope of about 6.2 W/m2 K, resulting in high-energy use for heating, cooling or ventilation. In order to overcome this problem, in recent years, closed greenhouses have been investigated to reduce the summer ventilation and winter heating losses. In this case, the heat transfer phenomenon within the solar passive greenhouse treats like to air natural convection into the enclosures.
The several analytical and numerical approaches and techniques were conducted to obtain thermal characteristics of the greenhouses, by researches. Also selection and optimization greenhouses based on the energy conservation have been performed. It is seen that literature about exergy performance of a greenhouse is surprisingly scarce. The exergy analysis based on second law of thermodynamics calculates exergy destruction of processes and has an important role in energy conversion systems. The optimal design criteria for thermal systems by minimizing their entropy generation have recently been a topic of great interest, especially in the fields related to geometry of a duct, natural convection in enclosure has gained attraction of many researchers. In the minimized entropy generation places, the sunbeams are directly absorbed by the plants.
The present study has been focused on the finite-volume solution of a two sided-roof greenhouse in the air natural convection for finding its optimum dimensions using the total entropy generation minimization. In this work, an explicit forth-order Runge-Kutta integration algorithm was applied to find the steady state conditions. In addition, an artificial compressibility technique was applied to couple the continuity to the momentum equations. The greenhouse was assumed like a two-dimensional enclosure. The boundary conditions were considered as the constant temperature, the adiabatic and the constant heat flux at the bottom, the lateral and the top surfaces, respectively. The solutions were obtained for variations of the heat flux, the plant's growth temperatures and the ambient temperature. The results showed that the exergy destruction is minimized when the ratio of h_{Roof} / h limits to 0.5. Furthermore, it was seen that with increasing the greenhouse aspect ratio (L/H), then the total entropy generation into it decreases.

Keywords: Entropy; Finite-volume method; Greenhouse; Natural convection; Solar energy

A Comparison among Solar Collectors Test Standards

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ABSTRACT

Depleting fossil fuels resources and environment pollution have caused humankind to find new energy resources. Solar energy is one of the best alternative energy sources and its industry is developing continuously. Fortunately, Iran is a country, which has a good potential for using this kind of energy because of its geographic situation and high level of solar radiation.
Solar collectors are the most important part of a solar system, as they called heart of the solar system. So, producing an efficient solar collector is of prime importance. Efficient product helps fewer investments and more rates of return (ROR), which is very important in the solar energy economy. The road to achieve an efficient product is verifying it with standards and codes.
In the present article, first, various types of solar collectors have been introduced briefly. Following this, three common solar collectors testing standards are introduced and compared. Three standards, which have been studied, are ISO 9806-1, EN 12975-2 and ASHRAE 93, which are International, European and American solar collector testing standards, respectively. Comparison has been made among parameters, allowable limits and testing methods mentioned in each standard. According to the study, there are some similarities in defining steady state conditions but tolerances and allowable limits are somehow different in each standard. Moreover, testing methods of some parameters are also different in some cases. The results have been summarized in tables in the article. As a result of studying and comparing the most common standards, a test plan has been suggested for testing solar collectors, based on the ISO international solar testing collector standard. As the authors are aware, at the time of writing this article, there is no solar collector testing laboratory in Iran and it is hoped that this article would be a step toward developing such laboratories in the country.

Keywords: Collector, Solar water heater, Test, Standard

A Comparison among Solar Water Heaters Test Standards

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ABSTRACT

Nowadays, the energy used for heating or cooling the buildings makes up some 40 percent of the total energy consumption. This fact not only squanders our fossil fuel resources but also leads to the pollution of the environment. Therefore, in the recent years, making use of renewable energies in the heating and cooling of the buildings has caught the attention of engineers and architectures. There are various methods for using these renewable energies, but heating water using solar water heaters may be the easiest and most economical method.

Solar water heating systems are divided into two types of open loop systems and close loop systems, each of the systems have various types, which are introduced in the first part of this paper.

Following this, three standards, which are common for testing solar water heaters in the world, are reviewed.

The three compared standards are ISO 9459-2, EN 12976-2 and ASHRAE 95. The result of this comparison is summarized in a table in the article. The table contains similarities and differences among parameters. Allowable limits for each parameter during the test are also compared.

Considering that Institute of Standards and Industrial Research of Iran (ISIRI) complies with the International Standard Organization (ISO) documents, therefore this standard is more common in Iran and discussed in more detail. According to comparison of three mentioned standards, and comprehensiveness of ISO 9459 standard for testing the performance of solar water heaters, and also considering the facilities and procedures applicable for test, a test rig plan for different types of solar water heaters is presented based on ISO 9459-2 standard. As the authors are aware, at the time of writing this article there is no solar water heater testing laboratory in Iran and it is hoped that this article would be a step toward developing such laboratories in the country.

Keywords: Solar water heater, Collector, Test, Standard

CPC-Trough—Compound Parabolic Collector for Cost Efficient Low Temperature Applications

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ABSTRACT

The high-performance CPC-Trough Collector has been developed for the utility scale generation of low temperature solar steam and hot water for low temperature process heat applications including solar air conditioning. With an optical concentration of 7.5:1, operating temperatures over 130 ^{o}C may be reached. This novel design has included a FEM validation and is compatible with the standard reflectors and evacuated tubes in the market. The peak efficiencies of 35% with unshielded and more than 45% with evacuated tube receivers were obtained. This CPC collector requires intermittent tracking i.e tilt adjustment is only once in a week for more than 8 hours collection in summer and 6-7 hours in winter seasons.

A Review on Urban Heat Islands Researches

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ABSTRACT

This paper reviews researches that dealing with reducing energy saving improvement in residential sector about Urban Heat Reduction (HIR). Temperature difference between an urban and its surrounding and rural due to many external parameters makes it a heat island. Some ideas like using light roofs and pavements, shading trees and vegetation affect urban temperature. These energy saving plans will have two effects direct and indirect. Direct effect will be, reducing cooling energy needs of individual households by lowering sunlight heat absorption. And indirect effect will be, hole city temperature reduction due to these policies which impose lowering temperature difference between ambient temperature and households' inside temperature. Consequently, energy saving, utility cost reduction and environmental pollution reduction will result. These researches performed for big cities and it would be a great idea to be used in construction policies for big cities like Tehran. The HIR strategy has three main steps for evaluation three main strategies, which are light color replacement of roofs and pavements, planting trees to shade buildings, and also for wind shielding. Steps are as below based on methodology illustrated in Figure 3 for both direct and indirect effects.

1. Calculating amount of cooling and heating energy and related costs.
2. Calculating amount of smog reduction and related costs.
3. Calculating costs for reroofing, repaving and planting trees.

Keywords: Heat Island Reduction, Residential sector energy demand, Shading trees, Vegetation

Design of Combined Heating Systems (Solar Heating - Floor Heating) for Industrial Halls in Iran Climate

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ABSTRACT

Solar energy is one of the sources of free, clean and free of harmful environmental effects that from the past with different methods have been used by human. Energy crisis in recent years caused that the countries with the energy problems are treated differently that, among in these approaches, the replacement of fossil energy with solar energy to reduce energy consumption and saving, controlling supply, energy demand and reduce polluting emissions has been greatly welcomed. In our country according to the subsidies and increasing energy prices, use of solar energy in heating system to provide hot water consumption, heating of building air or industrial halls as a good solution for saving energy and reducing costs, can be used.

For this purpose, in this study, Calculation and design of a complete heating system using solar energy for heating of industrial halls in the climate of Iran has been done. Since, the working temperature of floor heating systems compared to other systems is less, the possibility of using solar heating systems make easier. Therefore, in this research, the floor heating system due to adaptability with the solar heating system is chosen.

Keywords: Solar heating, floor heating, industrial halls, Iran climate

Experimental Investigation of Dual Purpose Solar Collector in Air Conditioning Systems

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ABSTRACT

Dual purpose solar collector (DPSC) is an air and water collector joint with each other to a single collector. This collector can attain the high temperature with high heat delivery with a 50% reduction in space and cost. In the collector two fluids (water and air) flow simultaneously. The DPC is a flat plate collector, which is made of two sections, one for water heating and the other for air heating. The basic elements in making up a conventional water flat plate collector are the tubes fixed to the absorber plate through which the liquid heated flows with the conjunction of the air heater, which consists of an absorber plate with a sheet of metals in a V-shaped that is connected to the same absorber plate. The liquid collector part is consisted of parallel pipe and connected into two main inlet and outlet ports for reduction of pressure drop. The air heater section is designed in a triangle shape and is connected to the water absorber plate from the top and the insulated plate in the bottom. The air and liquid parts are completely sealed. The DPSC was oriented south-facing and exposed to solar radiation at Dezful, Iran (latitude 32°22′, longitude 48°24′) and angle between the collector and the horizontal line was chosen to be 20°. Experimental data indicate that high temperature and high performance can be obtained using dual purpose solar collector (DPSC) compared to a single water or air collector.

Keywords: Air heater, Dual purpose solar collector, Thermal Efficiency, Water heater.

Monthly Mean Clearness Index for Few Iranian Cities

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ABSTRACT

Designing, Modeling, and performance analysis of solar energy systems, depends on solar radiation data. Accurate data for many cities and locations in Iran is not available. Therefore, estimation of such data for solar applications is inevitable. Clearness index ($\overline{K_T}$) is a measure of solar radiation attenuation at a location due to geographic-atmospheric parameters. It is defined as the ratio of solar insolation on a horizontal surface to the insolation on the same surface if there was no atmosphere. In this paper, a model for prediction of clearness index of many cities of Iran is presented. The model is based on linear regression. $\overline{K_T}$ is assumed to be a function of sunshine duration, relative humidity, precipitation, and ambient temperature. Data collected over a period of thirty years (1975-2005), in the time interval of 60 minutes were released by I.R.I. Meteorological Organization. The model predicts the data favorably and more accurately compared with the prediction of other models. The main reason for accuracy of the proposed model is that the data used for extraction of correlation in the present work covers the period of 1975-2005 whereas all previously proposed models were based on data for much shorter period. Among The cities investigated, Yazd with 0.647 has the highest $\overline{K_T}$ and Ramsar with 0.388 the lowest one.

Keywords: Clearness Index, Iran, Monthly Mean, Solar energy

Numerical Simulation of the HVAC System in a Solar Restaurant Using TRNSYS

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ABSTRACT

Todays, according to the new style of human's society, the quality of indoor air in different industries such as food, chemical, pharmacy and electronics is more important than before. Therefore, suitable ventilation of restaurants is important due to hygiene and also to provide comfortable situation. In this paper, the commercial program TRNSYS is used to simulate the HVAC system of a restaurant. Numerical simulation is a low cost and trustable method to achieve optimum solutions. Evaluating the comfort design conditions and building a solar restaurant in the meteorological condition of Kerman is presented in this paper. The simulated restaurant has three parts; a kitchen, a storage room and a dining room with 675m^3 total space and the total area of windows is 10m^2. The comfort temperature in the presence of humans is 25°C and 16°C in other situations. The results show the possibility of building a restaurant with employing solar HVAC system in Kerman. Solar collectors in winter for providing warm water and solar-driven refrigeration system as a cooling system in summer are used in this restaurant. In other words, in winter, solar energy can provide some of the heating load needed in a building and in summer, by using solar-driven refrigeration system, the electricity for cooling a building can be decreased. The use of solar-driven refrigeration system can decrease the consumption of electricity almost 30%.Since in solar systems, the results have been affected extremely from different parameters such as air temperature and the gradient of that in a day, solar intensity, the clearness index parameter, the latitude and some others, the results of this paper cannot be able to compare with the results of previous references with different investigated meteorological conditions, however, by varying different effective parameters, the accuracy of the results are checked. Furthermore, the results show that increasing the mass flow rate, increases the total consumption of energy. Consequently, to decrease energy dissipation, the leakage of the air should be limited.

Keywords: Hygiene ventilation, Numerical simulation, TRNSYS

Experimental Investigation on the Performance of the Solar Air Conditioner in Hot and Humid Climate

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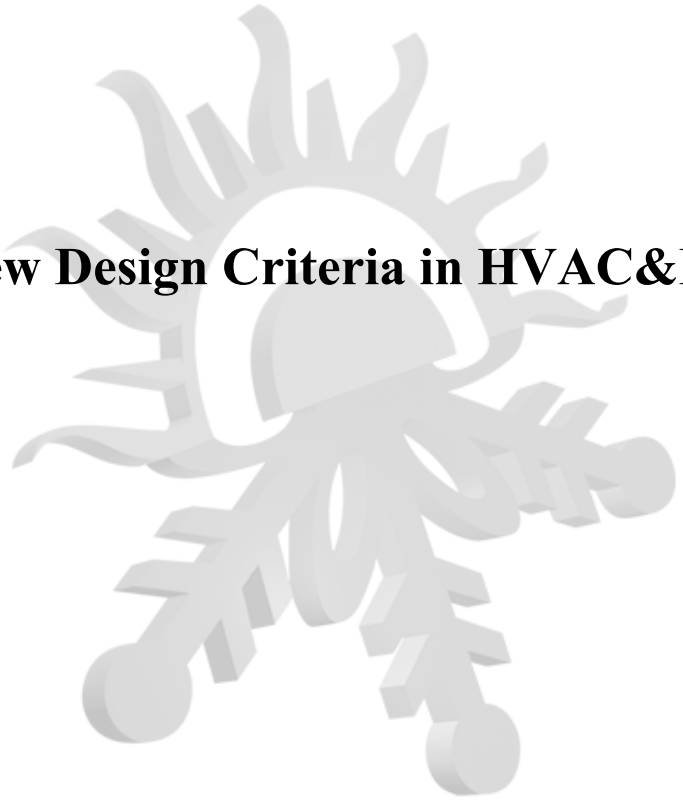
ABSTRACT

According to the high consumption of energy in recent years, employing renewable energy is more important than before and due to the high amount of energy consumption in buildings, using renewable energy and as a result decrease the consumption of electricity is valuable. Providing heating in winter and also generating cooling in summer are some examples of the use of solar energy in buildings. Todays, using air conditioners in hot and humid climate is a common way for generating desirable air. A big problem of these air conditioners is the high consumption of electricity; however, employing solar refrigeration systems can solve this problem. The most difference between the solar refrigeration systems and common air conditioners is the use of ejector and solar collectors in the solar refrigeration systems. Ejector can able to make a zone with low pressure and low temperature and as a result can generate cooling in the system.

In this paper, experimental investigation on the performances of solar air conditioner in the meteorological condition of Qeshm, Iran with hot and humid climate is presented. The area of the tested room is $20m^2$ and the capacity of both solar air conditioner and common air conditioners is 12000 Btu/h. The results show that when solar air conditioner is used almost 30% of the annual consumption of electricity is decreased in comparison with general air conditioners. Furthermore, the consumption of power in solar air conditioner is equal to 66% of the consumption of power in the general air conditioners. In the solar-driven refrigeration systems, the current of electricity is almost 4A; however, it is double in the common air conditioners. Note that solar collectors, which absorb solar energy, can provide hot water in almost 80 °C. In the end, according to the achieved results of this paper, the capability of the solar air conditioner has been proved in hot and humid climate.

Keywords: Solar air conditioner, Ejectors, Solar cooling

New Design Criteria in HVAC&R



HVAC Calculation and Energy Consumption Control Using TABESH Software

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ABSTRACT

Energy storage is one of the most important issues in the world and in our country (IRAN). There are different approaches of optimum usage of energy. One of the major problems of developing countries especial Iran is high consumption of energy in commercial and residential buildings. This high consumption of energy can cause unfavorably economical and environmental effects. Since energy consumption of building allocates 40 percent of total produced energy by country. According to prior studies and experiences, accurate calculations and control of the thermal and cooling flaxes of the building is one of the important approaches of energy conservation in building industry. Accurate calculations require efficient software that conforms to 19th principle of national building regulations (conservation of energy consumption).

The aim of this paper is to introduce briefly Tabesh software that has been designed in order to integrate calculations and control mechanical building establishments. Other applications of this software include eliminating of approximate and over design contents(as a result of software calculations), reduction of energy consumption in buildings and expansion of applying novel technology in order to acquire accurate calculations in engineer society. All of these applications support the claim that Tabesh software causes energy conservation in building industry. This software has been registered by informatics supreme council and has been confirmed by organization of optimization of country's fuel consumption and organization of energy exploitation of Iran (Saba).

- calculation of thermal and cooling flaxes of project for all time of day and determination of peak hour for each room
- all menus are bilingual
- investigation of usage double glazed windows
- investigation of effect of isolation on thermal and cooling flaxes
- calculation of annual energy consumption
- calculation of hot water consumption of project
- representation of energy label for buildings
- compatibility with standards of housing organization

Keywords: Software, Energy consumption, Tabesh

Performance of Evaporative Coolers in Iran and a New Design to Enhance the Cooling Efficiency

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ABSTRACT

Evaporative cooling is a very old recognized technique for air conditioning. This simple system is widely used in most area with hot and dry weather to create a comfortable indoor environment. In Iran, most of the existing evaporative coolers are based on the fifty years old design with almost no change since their early production. The existing coolers are not efficient, especially in hot days of summer. The aim of this article is to evaluate the performance of the evaporative coolers in Iran, address their problems and to mention the need for a better design. In addition, a new design is proposed to enhance the cooling efficiency.

The efficiency of the existing coolers was determined by measuring the temperature and humidity of the ambient air in the vicinity of the cooler as well as the cooler vent at different conditions. The ambient temperature was in the range of 30-40°C with a relative humidity of 6-20%. The results related that the vent temperature was 5-6^{o}C higher than the temperature predicted by theory. The cooling yield was calculated to be about 70%. The major problem in the evaporative coolers is their low evaporation rate from the surface of the chaff. The reason is the short contact time between air and water. This prevents the cooler to reach the ultimate temperature. The new design is based on increasing the speed of evaporation by spraying water in air. The cooling efficiency of the new design was obtained to be about 95% and the temperature differed from the theoretical temperature only by less than one degree, hence a increase of 30-40% in the cooling efficiency. This design was patented in Iran.

Keywords: Evaporative cooler, Spraying, Cooling efficiency

Analysis and Comparison of R-290 as a Replacement of R-22 in Compression Refrigeration Cycle

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ABSTRACT

Propane (R290) can be introduced in many of today's R-22 applications. No other single component refrigerant has such similar thermodynamic behavior to R-22. The commercial simulator Hysys- (version 3.2) was used to obtain thermodynamic properties of the process streams of R-290, R-22 in the compression refrigeration cycle. The results of comparison will show that R-290 is the best refrigerant for replacement of R-22.

Keywords: Compression Refrigeration Cycle, R-290, R-22, Coefficient of Performance

Heat Transfer in Finned Tube Coils

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ABSTRACT

Finned tube heat exchangers, in general called coils, are used widely in heating, ventilation and air conditioning applications. Improvement in heat transfer and mechanical characteristics of these heat exchangers, will increase efficiency and reduce energy consumption in the whole vapor compression system, consequently the initial and installation cost decreases, in addition smaller footprint of the HVAC and Refrigeration equipment will save valuable building spaces. Fluid flow inside tubes have been studied in the past decades and reliable data and well established correlations are available, on the other hand, Limited correlations are available for heat transfer and pressure drop of the passing fluid over the coil surface, which derived from experiment. Up to now, mechanical and thermal analysis of a finned tube heat exchanger, mainly restricted to empirical and semi empirical methods. Optimal design of a coil, disregarding other parameters, achieves by compromising a balance between heat transfer performance and acceptable pressure drop across the coil. In most cases, increasing heat transfer results in an increase in the pressure drop, to a point increasing fluid velocity over the coil, will enhance heat transfer, but after that point, the small gain from heat transfer augmentation is surpassed with extra power consumption in fan to overcome the additional pressure drop.

In this study, thermal character of a finned tube heat exchanger modeled, and impact of geometric parameters on overall performance of the coil was studied. In order to validate the procedure, the results were compared with experimental data measured from a coil manufactured by Sanaye Sarmaafarin Iran Co. In conclusion, good correspondence between analytical and experimental results exists. Therefore, the method can be used to find optimal design of a finned tube heat exchanger.

Keywords: Outdoor design condition, HVAC, Coincident Temperatures, Thermal load

Numerical Analysis of a Trombe Wall Performance in Unsteady State Condition

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ABSTRACT

In this article, performance of a Trombe wall system and the flow establish into the room in an unsteady state condition has been investigated. The aim here is that the effect of the system on interior room when the system starts until the system reaches a steady state investigates and also computed the amount of hours that energy stored in the wall transfers into the room in the absence of solar radiation. For Started system assumed that all velocities are zero and room has the minimum temperature in winter (T=10^{o}C) and system starts with solar radiation and heat flux received by the wall. The problem is solved implicitly. The number of repeats at each time step based on the error rate determined for velocity and pressure.

Keywords: Trombe Wall, Unsteady State, Implicit Solution.

The Effects of Configuration of the Thermal Insulator Layers in External Walls on Energy Consumption in the Buildings with Non-continuous Heating System

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ABSTRACT

Thermal insulators are frequently utilized in crust opaque components of buildings to save the energy. Another method for energy saving is non-continuous heating method. In this method, when a sample room does not need heating, the heating system will be turned off. The goal of this paper is to investigate the effects of using both thermal insulators and non-continuous on energy consumption and finally the best configuration of the insulator, where the energy consumption becomes minimum, will be found. In the mode that was studied in this paper, the inside air was assumed as a region and the external walls were assumed as four layer model. The soil temperature in the depth of 5 meters is constant and equals to 10 ^{o}C.

Energy equations were considered in an unsteady state for roof, floor and external walls separately. In addition, an energy equation for Inside equipments and another energy equation for energy source in the region were considered. To obtain the mathematical model, the energy equations for all components of the sample model, like walls, roof, floor, inside equipments (suit, table ...) have been written in the form:

The obtained equations were written in the matrix form of the state- space. SIMULINK is available in MATLAB software and was used to solve the state- space equations.

It can be seen from results that when the insulators are located inside, the thermal response of the system is faster and the minimum energy is consumed. The amount of energy savings by changing the insulator configuration highly depends on the outside temperature and the input thermal power. By considering these parameters, the maximum and minimum percentages of energy saving are about 21.8 % and 8 % respectively.

Keywords: Thermal insulators, Non-continuous heating, Configuration

Design of a Two-way, Two-circuit Fridge with the Capability of Using Condition

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ABSTRACT

Fridges are a type of food storages in which different kinds of foods are stored through cooling process. Fridges are usually manufactured in such a way that can only store above-zero or under-zero products but some fridges which are called two-circuit fridges can store both of these products in different sites. Sometimes on certain conditions, the amount of products that require storage in the under-zero condition decreases and in this situation it is necessary that above-zero fridges be designed in a way that if needed, user can change them to under-zero fridges. These fridges are called two-way fridges.
In this paper, a two-way and two-circuit fridge, that has the ability of storage of two products with different temperatures (two-circuit) and the capability of changing the using condition (two-way) is designed. Then The capability of changing the using condition of above-zero sites is investigated from three aspects: Product placement based on standards, Responsiveness of cooling system and its instruments if using condition changes and economic benefit of this fridges in comparison with two-circuit fridges.

Keywords: two-circuit fridge, two-way site, product arrangement, refrigeration instrument

Role of Geometric Parameters on Inhaled Air Quality of a Room with Personal Displacement Ventilation (PDV) System

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ABSTRACT

As an alternative to the mixing and displacement ventilation systems, personalized ventilation systems intend to influence only the immediate surroundings of the person operating the system. Personal displacement ventilation (PDV) is a new ventilation concept that combines the positive features of displacement ventilation with those of personalized ventilation. PDV is expected to create a controlled environment around an occupant. To do so, one of the most important facts is to decrease the pollution concentration of inhaled air. In this study, air-particle flow in a full-scale 3dimentional room with furniture and an occupant has been numerically modeled by Fluent 6.3, using Eulerian approach and standard k-ε turbulence model. For modeling pollutant source, a UDF has been applied.
Generally, inlet-outlet position, source location, obstacle situation, air change rate and pollutant density, which are parameters that influence the particle concentration distribution and ventilation efficiency have been investigated by the researches, but in the most of these studies, only one parameter is investigated individually. In this study, the effect of two main geometric parameters, which are inlet-outlet position and source location simultaneously on the inhaled air quality and ventilation efficiency, are investigated by modeling nine cases with different geometries.
For evaluation of ventilation efficiency and inhaled air quality quantitatively, different scales have been introduced in the literature such as age of air, removal efficiency, relative ventilation efficiency, IACS, SVE1, SVE2 and SVE3, SVE4, SVE5 and SVE6. In this research, we define NSIAQ, a new scale of inhaled air quality, for evaluation of different cases. The results show a considerable effect of these parameters on indoor air quality and inhaled air quality.

Keywords: Personal displacement ventilation (PDV), Standard k-ε turbulence model, Eulerian approach, Geometric parameters, Pollutant concentration

3D Numerical Simulation of Temperature Distribution Inside a Room with Floor Cooling

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ABSTRACT

Natural convection in enclosures is extensively investigated due to its importance in many applications, such as heat transfer through double glazing windows, buildings, electronic cooling devices, geophysical applications, etc. Two configurations that have been extensively explored in the literature are the differentially heated enclosures and the Rayleigh–Benard problems. In the present work, a different kind of problem is investigated, namely the cross thermal boundary conditions. Three dimensional analyses were performed for an enclosure cooled from below with one vertical wall heated, and the other connecting walls were assumed to be adiabatic. The thermal condition at the ceiling is varied from an adiabatic one to a different degree of heating. The objective of this study is to simulate the comfort provided by floor cooling in a room. For comfort requirements, the interest is on determining the rate of heat transfer and the temperature distribution in the room. Furthermore, the problem is academically interesting for understanding the fundamentals of natural convection.
The flow may be stratified for two specific conditions of the ceiling, namely, adiabatic or heated. The degree of stratification depends on the Rayleigh number. For a cold ceiling, there is a possibility of descending traversal recirculations. The strength of these recirculations increases near the adiabatic wall and with the increase in the Rayleigh number. A descending flow at the top corners and at the central plane along the adiabatic wall is evident for Ra = 10^7. It is found that the average rate of heat transfer from the floor is almost constant and not a strong function of the Rayleigh number. The rate of heat transfer from the heated wall and ceiling increases as the Rayleigh number increases. In general, sharp thermal gradients develop near the floor for the entire range of the investigated parameters. In addition, the flow exhibits three dimensionality, where transverse recirculations predicted for cold ceiling conditions occur. The predicted results are interesting and have practical applications. For a certain configuration, where strong three-dimensional recirculations were predicted, the flow is three dimensional, hence the two dimensional assumption is not valid.

Keywords: Natural convection, Floor cooling, 3D simulation, Enclosure

Enhancement of Thermal Comfort Conditions and Reduction in Energy Consumption Using Fuzzy Logic

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ABSTRACT

In this study, fuzzy logic has been applied as an effective way to control of nonlinear systems and designing the controller for buildings heating system. For this purpose, the difference between indoor and desirable temperature, relative humidity and temperature variation rate in the building are taken into account as input variables. In order to control of comfort conditions and reduction in energy consumption, output variables are composed of blower input power, the amount of humidifying or getting humidity from air and heating coil performance. To communicate between input and output variables by defining the appropriate membership functions for each variable, fuzzy rule-based is designed. Results have shown that designed fuzzy controller is capable of maintaining the Temperature and humidity in the comfort conditions, So that compared to classical controllers, in addition to reducing energy consumption, efficiency and useful life of the heating system is also increased.

Keywords: fuzzy logic, controller, air conditioning

The Verification of The Payback Time for a Solar Driven Absorption Cooling System Depending on Technological Development and Design Data

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ABSTRACT

In this study a solar driven absorption cooling system is offered for a hotel. Solar energy is only used in absorption chiller. The payback time of the offered system with different scenarios are investigated. Solar collectors and absorption chiller price are the main contributors to the total system price. The effects of the unit prices of the absorption chiller and solar collectors depend on the technology development. However, electricity prices increases day by day due to the increased fuel prices. Also, storage option is taken into account to increase the load factor of the offered system. The effect of the carbon prices are also investigated for the offered system for different ton prices of the carbon. The best and worst scenarios are given with respect to the variation of the prices and load factor. The results show that, the payback time changes 2.18 to 20.3 years. With 2010 prices with 10 $ per ton carbon credit the payback time is calculated 10.1 years. However, the cost of electricity and carbon increases and the offered system payback time could be logical in less than ten years.

Keywords: Absorption chiller, solar energy, carbon credit, payback time

Numerical Study of Buoyancy Driven Natural Convection in Glazing Cavity

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ABSTRACT

Natural convection in closed enclosure is receiving many attentions in papers due to wide usages such as multi-layered walls, multi-pane windows and other air gaps in unventilated spaces. In this type of flow, there are vast variables, which determine that the flow is turbulent or laminar. While laminar flow is relatively simple and well defined, turbulent flow represents one of the most complicated phenomena in the nature. In this article, turbulent free convection flow and heat transfer in vertical glazing is studied using a CFD code based on finite volume method and RANS turbulent model. Boussinesq approximation is used to model natural convection and $k-\varepsilon$ is used for modeling the turbulent effects. For obtaining more accurate solution, turbulent buoyant terms are added to turbulent model and logarithmic wall function is used for modeling of wall laminar and turbulent sub-layers. The test case includes a 2D cavity with variety of aspect ratios which examined in vide range of Rayleigh. Two lateral walls are isothermal and the rests are insulated. First, test cases are studied to find the critical Rayleigh. For doing this, both laminar and turbulent cases is solved to find the flow regime based on the differences between their wall nusselt numbers and then, test cases for aspect ratio of 30 to 100 are studied to explore the effects of aspect ratios on the nusselt number. This study shows that in transition zone between laminar and turbulent regimes, the turbulent results are more accurate than laminar results. Nusselt number correlations are presented for various discrete vertical aspect ratios, with interpolation suggested in between. The correlations presented will make it possible to predict heat transfer in equipment or building sections with internal cavities with a high vertical aspect ratio. These correlations are widely used in building industries. The research was shown that by increasing the aspect ratios, the Nusselt number decreases. In addition, increasing in Rayleigh number causes that the nusselt number increases.

Keywords: glazing cavity, free convection, $k-\varepsilon$

The Effect of Nurse Movement on the Particles Entrapment in Operating Rooms

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ABSTRACT

These days according to previous researches urgent requirement for development the operating rooms for society health preservation has been found special importance and within the developing industry of computer, positive indicators that show a real need to a compare comprehensive study and research about airflow pattern and particle concentration distribution in the operating rooms, in order to predict the distribution and dispersal of particles. Correct determination of indoor airflow and particle concentration distribution results in new standard development for operating rooms. In this research, we are going to consider the effects of a moving nurse on a two dimensional operating room are studied numerically. This article uses the computational fluid dynamics (CFD) method and k-ε RNG turbulent model to investigate the effects of a moving nurse. The results show that airflow pattern and particle distribution in the operating room has been affected considerably from the nurse movement and with velocity increasing are formed larger recirculation zones around the nurses and due to the nurse movements, which are not favorable for the operating room.

Keywords: Operating room, Dynamic mesh, Numeral Modeling, Nurse Movement

Numerical Study of Natural Convection Heat Transfer of Double Skin Façade in Building

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ABSTRACT

In this paper, the effect of outer double skin façade on heating and cooling loads of a building has been investigated numerically. Since the outer face of building has less effect on decreasing cooling load at higher floors in respect to lower floors, it is better to divide the outer face to different parts. In order to modeling of a double façade skin, a two dimensional rectangular cavity has been considered. In this cavity the solar energy is attracted from outer façade (glass). The enclosure contains air with Prandtl number 0.71. One sidewall of enclosure is in contact with outdoor air with temperature T_{out} and another sidewall is in contact with indoor air with temperature T_{in}. The study has been done for Isfahan city. The governing equations including continuity, momentum and energy equations have been solved using the finite volume approach. The study has been carried out for the Raleigh numbers in the range $10^2 \leq Ra \leq 10^6$. Using of the double façade face leads to decrease in energy loss for different months (especially cold months) of the year. When the aspect ratio of the cavity is 10, the minimum value of average Nusselt number occurs for all months of the year. In the other hand, increase in double façade height leads to increase in heat transfer rate and more energy loss.

Keywords: Numerical simulation, double façade face, reduction of heating and cooling loads, natural convection

Electrical Demand Management and Load Curve Reform by Thermal Energy Storage

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ABSTRACT

In this study, cold thermal energy storage (CTES) as a mechanism to manage the electrical energy demand of building cooling equipments is studied. In addition, the effect of applying these systems on the load curve of national power grid is investigated. Case study results showed that the use of cooling systems with tank instead of conventional cooling equipment, without increasing the initial investment, it could replace demands hours from peak hours to non-peak hours. In fact, the TES systems making correction load curve and provide building cooling load. Most optimal mode for the case study, full storage strategy of chilled water with take usage of 16 hours period that was able to transfer 47% of the daily cooling load to non-peak hours, was determined. Economic results demonstrated that investment return period was 2.5 years than the conventional cooling mode. Also the results showed that flexibility of TES systems in design and selection of equipment is very high, so manage and control of electrical demand and Consumption Pattern Reforms, was very effective on hot days and the ability to modify the electrical load curve.

Keywords: cold thermal energy storage (CTES), electrical demand, cooling load

Modelling and Simulation of Vapor Compression Refrigeration Cycle

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ABSTRACT

In this paper, modeling and simulating of vapor-compression refrigeration cycle at steady state condition, was performed. A mathematical model was developed for each components of the system such as compressor, condenser, evaporator and capillary tube using characteristic curves of each component. Integrated modeling and simulation of the cycle was performed using EES software to predict system parameters such as compressor work, cooling effect and coefficient of performance (COP) in various ambient conditions. The simulation results were compared with experimental results obtained from an experimental investigation on a split-type air conditioner. It was found that the experimental and simulation results are in good agreement and the model can predict the performance of the cycle successfully. Average difference between experimental and simulation results for predict COP was 4.5%. Simulation results show that for each 1℃ increase in ambient temperature, COP reduces 3.5%, and for 10% increase in ambient relative humidity, COP increases about 6.5%. Also, by increasing the air volumetric flow rate of condenser about 10%, COP increases about 5%. Effect of increasing condenser area on its heat rejection rate was studied and it was found that increasing the condenser area, increases the heat rejection rate substantially only in a limited range and after that it does not alter.

Keywords: Compression refrigeration cycle, modeling, simulation, split-type air conditioner, coefficient of performance.

Developing a New Applicable Correlation in Order to Estimation the Water Vapor Condensation Rate in Ceiling Cooling Radiant Systems

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ABSTRACT

Ceiling cooling radiant panels are one of the most applicable systems in order to provide the good thermal comfort and by its low energy consumption. In some climates, the water vapor in the air may condense on the cold surface of panels, and it leads falling the water droplets. This is one of the obstacles to develop such systems that limit its application in humid climates. There are some approaches to minimize the rate of condensation. The approaches need information about the exact rate of condensation on the surface. The effective parameters on condensation such as air temperature, air velocity, relative humidity and panel temperature are investigated in this study. Then the effectiveness of each parameter on condensation is evaluated and therefore, relative humidity is announced as the most important parameter in condensation. For a conclusion, a non-differential correlation to calculate the water vapor condensation rate is defined by collecting and regression the all results of numerical solution in various climate conditions. This correlation can be directly used to calculate the design parameters so that there is not any water droplet on the ceiling panels.

Keywords: Ceiling Cooling Radiant systems

Improvement of Heat Transfer in Internal Flow Using Disk Obstacle

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ABSTRACT

In this paper, it has been considered numerically the amount of improvements in internal flow thermal transition by adding a disc shape obstacle, which is embedded perpendicular to the fluid flow. Thermal transition in internal flow of pipelines has vast applications such as heat exchangers, condensers, cooling systems, fluid transport lines and etc. to examine the accuracy of the numerical results; we compare the results extracted from numerical modeling of fluid flow in the pipeline by the condition of laminarity, with analytical results. This examination indicates a fair match. The main feature of this study is in incorporating the disk shape in numerical modeling with vast span of conditions and solving the problem in 3D coordinate. Due to this feature, we observe the effects of adding a disc shape obstacle in condition of Reynolds number among 1000 to 15000 by boundary condition of constant heat flux or constant surface temperature. The results indicates that in the margin of Reynolds number less than 5000, using the obstacle causes the increment of temperature difference in order of 1.5 to 4 times more than the case of non obstacle and also causes the increment of pressure drop in order of 2.6 times more than. So that as the conclusion using the obstacle (especially disc shape) in Reynolds number less than 5000 is penny wise.

Keywords: Heat Transfer, Internal Flow, Disk Obstacle, Numerical Simulation, 3D

Investigation of Effect of Using Several Consecutive Obstacles for Increasing the Heat Transfer in Internal Flow

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ABSTRACT

It has been considered numerically the amount of improvement in internal flow thermal transition by adding several disc shape obstacles, which are embedded perpendicular to the fluid flow. Thermal transition in internal flow of pipelines has vast applications such as heat exchangers, condensers, cooling systems, fluid transport lines and etc. to examine the accuracy of the numerical results; we compare the results extracted from numerical modeling of fluid flow in pipe line by the condition of laminarity, with analytical results. This examination indicates a fair match. The main feature of this study is numerical modeling with vast span of conditions and solving the problem in 3D coordinate. Due to this feature, we observe the effects of adding several disc shape obstacles in condition of Reynolds number among 1000 to 15000 by boundary condition of constant heat flux or constant surface temperature. The results indicates that in margin of Reynolds number less than 5000, using the disc obstacles causes the increment of temperature difference in order of 1.6 to 4.2 times more than the case of non obstacle and also causes the increment of Nusselt number in order of 1.6 to 4.1 times more than.

Keywords: Heat Transfer, Internal Flow, Consecutive Obstacle, Numerical Simulation, 3D

Numerical Investigation of Heat Transfer in Internal Flow With Quadrangular Obstacle

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ABSTRACT

In this paper it has been considered numerically the amount of improvement in internal flow thermal transition by adding a quadrangular shape obstacle which is embedded perpendicular to the fluid flow. Thermal transition in internal flow of pipelines has vast applications such as heat exchangers, condensers, cooling systems, fluid transport lines and etc. to examine the accuracy of the numerical results; we compare the results extracted from numerical modeling of fluid flow in pipe line by the condition of laminarity, with analytical results. This examination indicates a fair match. The main feature of this study is in incorporating the quadrangular shape in numerical modeling with vast span of conditions and solving the problem in 3D coordinate. Due to this feature, we observe the effects of adding a quadrangular shape obstacle in condition of Reynolds number among 1000 to 15000 by boundary condition of constant heat flux or constant surface temperature. The results indicates that in margin of Reynolds number less than 5000, using the obstacle causes the increment of temperature difference in order of 1.3 to 3.5 times more than the case of non obstacle. So that as the conclusion using the quadrangular obstacle is penny, wise in Reynolds number less than 5000.

Keywords: Heat Transfer, Internal Flow, Quadrangular Obstacle, Numerical Simulation, 3D

Implementation of Effective Training Assessment Tool (ETAT) in RAC sector CFC Phase out in India: A case Study"

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ABSTRACT

Every training programme has certain objectives concerned with the transformation in the Individual / organizational behavior and ultimately which leads to the transformation of the Organizational structure. The impact of any training programme is an important parameter for successful implementation of any policies or procedures which have planned to implement for larger geographical areas and concern from Individual to the global impact. Global warming and ozone depletion has major impacts on individual and every organization on the earth. Take the case of Phase out of Ozone Depleting Substances (ODS) such as Chlorofluorocarbons (CFC-12) Refrigerant. India signed the Montreal Protocol in 1992 to phase out ODS. The first activity initiated with large refrigerator manufacturer's such as Kelvinator, Godrej etc. to changeover from CFC-12 to Non ODS. The project started in India with the name ECOFRIG. As per agreement, it was decided not to manufacture CFC based refrigerator from 1st January 2003.

But the major area of concern remain was the service sector, which was having more than 20 millions refrigerators charged with CFC-12 for servicing. To meet this challenge a project started in year 2000 with major focused in south India as HIDECOR. With target to train Refrigerator Engineers involved in maintenance services to end users. The concept behind this was to enable technicians comfortable with new refrigerants and to adopt good service practices. After visualizing and analyzing the impact of training to Refrigeration Technicians the project was renamed as NCCoPP and was implemented in year 2003 nation-wide. Two agencies were involved for providing the training across India i.e. Godrej for their own network technicians and & Regional Management Organization (RMO) Quest Consulting and Training for Micro and Small Enterprises. RMO appointed 15 Training Cells across India. Planning strategy involves each state for each training cell to create geographically and economically viable implementation model. Evaluation of such environmental training program need to assess the ability of training delivery, the goals and objectives in terms of cost incurred and benefits achieved. The analysis of data needs to be compared with the data of other training programme of similar nature at different level including International, National and Local. On the basis of these comparisons, strategy for successful implementation was build and which helped the trainer in the future training programmes, to stop short of completion of the training systems design methodology and evaluation strategy tool was developed for training effectiveness is reneging on our commitment to our future generations. The future demands more precise, reliable training and evaluation strategies, we propose a Effective Training Assessment Tool (ETAT) strategy to be implemented for training effectiveness in the same way that we think of surveillance tests in the plant, we perform training effectiveness evaluations to ensure our programme work effectively.

Exergeoconomic Modeling and Genetic Algorithm Optimization of A Domestic Hybrid Solar Lithium Bromide-Water Absorption Chiller

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ABSTRACT

Exergeoconomic optimization of a dynamic single effect solar LiBr-H_2o absorption chiller system is performed. The absorption chiller system includes evaporator, absorber, generator, solution heat exchanger, pump and expansion valves and the solar system consists of collectors, storage tank and pump. A model based on the energy and exergy analysis is presented for each component of the system. In this study, the hot-water storage tank is considered as a multi-nodded water tank which can be modeled by dividing it into N nodes. Sun radiations heat which is gathered in collectors make the storage tank water to be heated. The required heat in generator of the absorption chiller is supplied by storage tank hot water. When the storage tank temperature drops below the allowable reference temperature, an auxiliary heater boosts the temperature of the hot water from the storage tank temperature to the allowable reference temperature. As solar radiation intensity is not constant in different days and months in the hot seasons of the year, the transient (time dependant) analysis is applied. Exergoeconomics combines exergy analysis with economic constraints to provide the system designer with information, which is not concluded through conventional energy, and economic analysis. So, an economic model of the system is developed. As case study a typical house will be considered in this paper. In order to dynamic simulation of solar system, the base weight of tank is assumed 1500 kg and the base area of collector is assumed 50 m^2. Furthermore, the storage tank is simulated dynamically using 3 nodes. The objective function based on the thermodynamic and exergeoconomic analysis is developed. The proposed single effect solar absorption cycle system includes eight decision variables is considered for optimization. A stochastic/deterministic optimization approach known as genetic algorithm is utilized as an optimization method. This approach is applied to minimize the cost of the system product. The optimized case shows a 5.9% decrease in total capital cost, from 1541 ($/Year) on base case to 1450 ($/Year) in optimized case. Furthermore the exergetic efficiency increases 6.94% from 16.71 to 18.87.The COP of the absorption system is improved 3.14% and finally the objective function –product cost rate- decreases from 3306 ($/Year) to 3172 ($/Year) which means 4.00 percent improvement.

Keywords: Single effect solar LiBr-H_2o absorption cycle, Transient modeling, exergeoconomic , Hot water storage tank, Genetic algorithm

Evaluation the Influence of Thermal Inertia of A Typical Residential Building on Performance of Radiant Hydronic Heating-Cooling Systems a

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ABSTRACT

Radiant cooling and heating systems are becoming more common due to their low energy consumption and high thermal comfort level, therefore observing and analysis of performance of such systems are very important. This paper aimed to analyze the effect of thermal inertia of a typical residential building on performance of radiant heating-cooling panels, using building energy simulation software, EnergyPlus. Two common wall constructions in Iran, namely HI (High Inertia) and LI (Low Inertia), were used to clarify the influence of thermal mass on radiant system performance in energy consumption and thermal comfort viewpoints. Risk of condensation is the main problem by which the usage of radiant cooling systems is restricted. Condensation depends on dew point of zone air, which is highly affected by zone cooling load. In this paper, asymmetric radiation in both heating and cooling mode is analyzed using a code developed by writers. A typical room (8x6x2.7 m) with a $6m^2$ double glazed window facing south, based on ASHRAE-140, is modeled. A $24m^2$ radiant panel is utilized to meet zone heating and cooling demands. Equivalent ρC_p of opaque walls is calculated to specify thermal inertia of each wall construction. HI construction has 2056 kJ/m^3K and LI construction has 524 kJ/m^3K with no considerable difference in thermal resistance. Analysis is done for Tehran climatic conditions using standard format data, TMY2 (Typical Meteorological Year, version2). Fanger comfort criteria are used in both thermal comfort and asymmetric radiation PD (percentage dissatisfied) evaluation. Building with high HI wall construction can save more solar energy in daylight due to higher thermal inertia, and pass it to zone during the night and cause reduction in heating energy consumption in winter. The same reasons can be used to justify the cooling energy consumption reduction in summer with HI wall construction. Simulations resulted in 17.67% reduction in heating, 14.96% in cooling and 16.49% in total energy consumption with HI versus LI construction. Critical matter corresponding to radiant heating systems is asymmetric radiation while results showed that there is no concern in cooling mode. Maximum PD of 35% can reduced to 25% with increase in building thermal inertia; also number of hours that PD, caused by warm ceiling, exceeds 5% is reduced from 31% to 29%.
Furthermore, increasing the thermal inertia of building envelope has significant influence on risk of condensation in radiant cooling systems. Simulations resulted in no condensation in HI case while it happens many times with LI wall construction.

Keywords: radiant heating-cooling, thermal inertia, fanger comfort criteria, asymmetric radiation, condensation.

Predictive Regulatory Adaptive Control on Heating System

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ABSTRACT

Model predictive control (MPC) is a constrained online control method for industrial and process systems. MPC originated in the late seventies and has developed considerably since then. The term model predictive control does not designate a specific control strategy but rather an ample range of control methods, which make explicit use of a model of the process to obtain the control signal by minimizing an objective function. The ideas, appearing in greater or lesser degree in the predictive control family, are basically the explicit use of a model to predict the process output at future time instants (horizon), the calculation of a control sequence minimizing an objective function and the use of a receding strategy, so that at each instant the horizon is displaced towards the future, which involves the application of the first control signal of the sequence calculated at each step. The success of MPC is due to the fact that it is perhaps the most general way of posing the control problem in the time domain. The use a finite horizon strategy allows the explicit handling of process and operational constraints by the MPC. The significance of the basic idea implicit in the MPC has been recognized a long time ago in the literature as a tractable scheme for solving stochastic multi period optimization problems under the term receding horizon. In this paper, we designed a regulatory predictive control for a building heating system under inputs and outputs variations. The heating system formulated by simplified ARIMA model.

Keywords: Model predictive control, receding horizon, building heating system, ARIMA model.

Numerical Study of Cooling Tower under Various Climates and Its Performance Improvement Using Indirect Evaporative Heat Exchanger

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ABSTRACT

In this paper, performance of the cooling tower is studied for different climatic regions of Iran. First, a complete mathematical model of cooling tower, which contains spray, fill and rain zones is developed. The results are validated by experimental measurements. Then, the important characteristics of the cooling towers consist of the Range and the Approach is obtained for each climatic area. It is found that these characteristics strongly dependent on outdoor conditions. Due to low humidity and high dry-bulb temperature of air in central areas of Iran, Range value is significantly increased. In contrast, the higher the humidity, the lower Range is obtained. In such areas, wet cooling towers cannot lonely respond to cooling requirement and based on air wet bulb temperature value can be accompanied with an appropriate auxiliary system such as indirect evaporative cooling (IEC). In the second part of this paper, Numerical model of hybrid cooling tower (wet cooling tower with indirect evaporative heat exchanger) is developed and its effect on approach value is considered. As can be seen, inlet air to tower has higher cooling potential because of decreasing air humidity passing through the heat exchanger. With this combination, using wet cooling tower in humid areas becomes possible.

Keywords: Numerical simulation, Cooling tower, Indirect evaporative heat exchanger, Different climatic conditions

Sustainability through Seismic Mitigation in HVAC Systems

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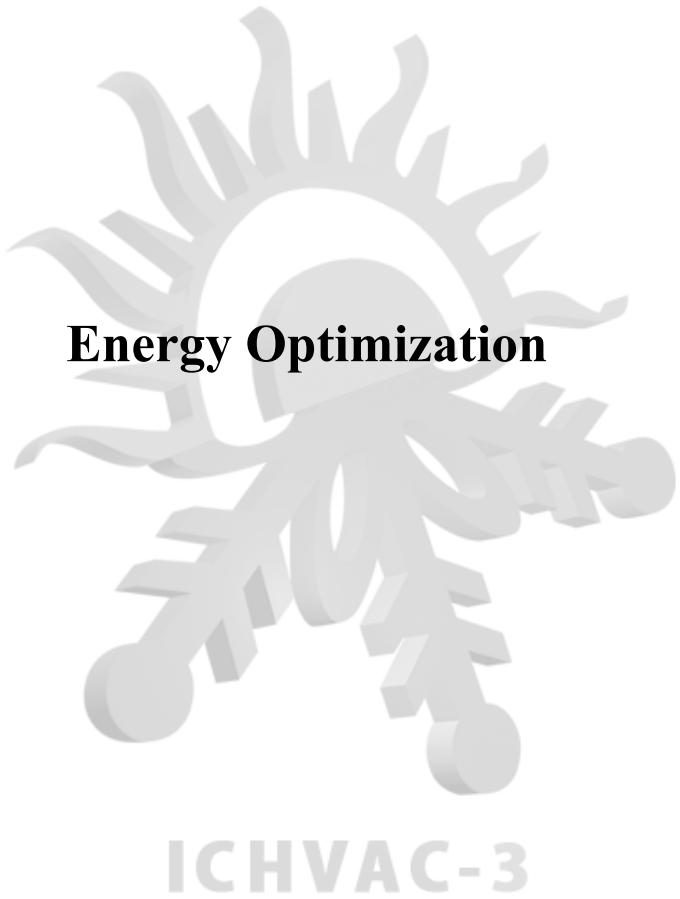
ABSTRACT

Earthquakes are non-predictable natural disasters. No human being is able to foresee a coming earthquake and escape from its consequences. What we can do on the other hand is to observe the results of happened earthquakes, collect empirical data and analyze these for estimating seismic forces subject to future earthquakes. This will be the basis for seismic protection of our buildings and facilities. Today civil engineers can design buildings depending on expected seismic forces. However, an unacceptable mistake is to neglect the importance of seismic restraint for non-structural systems. This is crucial especially for fire sprinkler pipes, fuel lines, emergency and energy systems, etc.

Seismic protection of mechanical and electrical systems in buildings is crucial for human life and for avoiding costs of damages. It is a matter of non-structural seismic engineering design, which must be done by professionals per accepted building codes. This paper starts with basic information on earthquakes and their damaging effects on HVAC systems. It gives necessary knowledge on earthquake standards to clarify when and how to do seismic protection. Professional experiences from a wide perspective are also included in this paper.

Keywords: Earthquake, Seismic, Safety, Mitigation, Sustainability

Energy Optimization



Study of Building Paints in Different Regions of Iran and Comparison with Mineral Coating for Energy Saving

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ABSTRACT

Limited energy resources need to economize on its consumption. The use of appropriate building paints to avoid wasting energy in different industries and buildings, making compulsory. In this regard, the effect of paints in the buildings and their importance in saving energy makes it necessary. In this study, varieties of paints in different regions of our country have been examined. Also in this regard, the effects of various agents on the paints of the building such as the weather conditions, absorption coefficient, reducing the heating and cooling load has been studied. For this purpose, plan of a building with the same geometrical and physical properties in different regions of Iran for different paints by Carrier software has been modeled and for comparison, heating and cooling loads were calculated for selected samples. Effect of paint in different climatic conditions was studied and compares paints and paints' coated with mineral micro-particles in temperate climate to achieve the optimal conditions in terms of energy consumption. The results showed that adding of mineral particles to paint decreases the absorption coefficient and ultimately reduced the amount of transferred heat loads.

Keywords: Optimization of energy consumption, Paint, Mineral micro particles.

Noticeable Role of Removing Sediment Warm Water Facilities for Optimizing Energy Usage and Unique Feature of Central Heating Smart Control for Identifying and Attenuating Sedimentation Process

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ABSTRACT

Among different parts of central heating facilities, thermal exchanger is the first to blame for sedimentation. Sediments formed on internal walls of the system act as an energy insulator, which prevents optimum heat transfer in the heart of the system leading to waste of energy. Performance attenuation, more energy waste, erosion of system parts and mainly costly maintenance services and environmental pollution are the main results of sedimentation in a central heating system. This deficit is more important in the household system where there is no system for removing sediments. By surveying more than 1000 central eating system, the study found that the failing to control sedimentation process in the system is the main cause for waste of energy in the system. The fact is clearer when we observe 35% saving in consumed energy by equipping a central heating system with smart control system. Thus, it is reasonable to say that through timely sediment removal in central heating system and boiler, noticeable profits achieve with trivial cost.

Though removing sediment have proved to be highly effective on lessening fuel and power consumption in central heating system, its benefits may not be visible in short run. First noticeable one is though attenuation environmental pollutants. However, promised positive results are only feasible through implementation of timely and effective removal of sediment process. By focusing on facts and analyzing household central heating system, the study tries to survey effect of removing sediments of central heating system on optimizing energy consumption and lessening environment pollutants emission. Removing sediment is feasible by applying a smart sedimentation control system.

Keywords: Energy Consumption Optimization, Desedimentation Domestic Hot Water Heat Exchanger, Lessening Environmental Pollutants Production, Central Heating Intelligent Controller

Investigation and Optimization of Gas Heater with Closed Combustion Chamber

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ABSTRACT

In ordinary gas heaters, the air within the room is directly used in combustion. This research studies certain types of gas heaters that receive required air from outside of the space to be warmed. These heaters are constructed as single-layer and two-layer heaters. In the two-layer heather two coaxial pipes are devised; one to provide air for combustion and another to expel waste gases produced in combustion. Single-layer and two-layer heaters have been tested in various conditions, and input and output speed and temperature in the different circumstances have been measured and, based on these measurements, the consumed gas flow, specifications of the flow from inside of the heather and the thermal efficiency of the heater were calculated. Based on the results obtained, it is possible to modify the structure of an ordinary heater and develop another type to provide air from outside of the space to be warmed. This arrangement allows adjusting the extra air required and minimizing hazards. As the extra air is reduced, the temperature of the products of combustion rises considerably and the heat transfer rate increases, consequently. If coaxial pipes are employed, a portion of the heat of the combustion products is restored but the airflow to the heater will face difficulty because the floating force of the warm air acts in the opposite direction. This defect can be removed by using separate pipes that allow sufficient airflow towards the heater. If this scheme is employed an air damper should be added to the mechanism to control input air.

Keywords: Gas Heater, Optimization

Influence of Glassy Façade Staircase on Annual Energy Consumption in Current Residential Buildings of Tehran

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ABSTRACT

In this paper, Glassy Façade Staircase (GFS) is investigated in Tehran. The GFS means an outside surface of staircase covering with glasses. Since GFS is common façade in residential buildings, a comprehensive study on GFS can be extremely essential in decreasing heating and cooling loads. Performance of GFS is similar to double skin façade. Direction of building and type of glass are the most important parameters in the analysis of GFS. In this research, Energy plus software is employed for simulation of building with GFS. The simulated building composes of four floors with two apartments in each floor. Furthermore, it is assumed that the building is attached to beside buildings. Width and depth of GFS are 2.5 meter and 5 meter, respectively. Three types of glass, including clear, absorptive and reflective glasses and also four main directions are taken into account in the simulated building. In addition, the TMY2 weather data is utilized. The Simulations are carried out in two different conditions, including winter and summer in which winter condition commences from October 23 to April 21 and summer condition commences from April 21 to October 23.
In summer and winter conditions, room temperature is fixed at 25^{0C} and 23^{0C}, respectively and consequently, the cooling and heating loads are calculated. It is remarkable that cooling load is calculated in two different conditions, including no opening in GFS and two openings in GFS. Results show that GFS with clear glass in the south direction optimizes the annual load. Although the heat transfer coefficient of clear glass is much greater than the heat transfer coefficient of the insulated wall, the results of this study illustrate that GFS with clear glass in the south direction utilizing solar energy and a performance like a double skin façade leads to better efficiency in decreasing of energy consumption compared with insulated wall.

Keywords: Glassy Façade Staircase (GFS), Natural Convection, Energy Plus

Identification and Evaluation of New Technologies in Energy Saving in HVAC Industry and Reform of Residential Consumption Patterns in the Country

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ABSTRACT

At the beginning of this article, we look at the energy situation in the country, regarding the energy consumption, especially in the residential sector and its effects on various factors of social, economic and cultural; to discuss the need for attention and action on energy efficiency in domestic and optimization of energy supply and demand will pay. In this study, we focus on strategies for optimizing energy consumption and new technologies use in building heating and cooling systems in this sector. Thus, nine new technologies in order to optimize energy consumption in residential heating and cooling systems were investigated and then each of the issues, in relation to different cases is discussed. Finally, results, solutions and opportunities ahead for the use of innovative technologies and improvement in the residential consumption patterns are presented. The output of this study can potentially make the recognition and potential savings in residential applications due to methodical solutions and new technologies and changing consumer behavior in this section, be used.

Keywords: Energy management, Building energy saving, Reform of residential consumption patterns, New technologies in energy saving

Outdoor Design Conditions for Optimal HVAC System Design in Iran

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ABSTRACT

Outdoor design Conditions are Climate data, which show characteristic weather parameters at a specific location used for heating, ventilation and air conditioning purposes. Calculating thermal load is the corner stone of HVAC system design; the outdoor design conditions must be known prior thermal load calculation. As the living comfort standards improves, the energy consumption in building HVAC system increases. To save energy especially in building heating and cooling, the first step is to correct these data. In this research outdoor design conditions for major cities in Iran determined from Statistical methods according to the ASHREA standard. Data presented here can be used in designing of building HVAC and cold room systems. There are no generally accepted outdoor design conditions in Iran; in addition recent studies are not according to the ASHREA standard, neglecting some important features, for example Coincident Temperatures, therefore the need for comprehensive data set is definite. Extreme conditions rarely encountered in life time of a HVAC system, if a system is designed at the most extreme condition, it will operate at low efficiency most of the time while the initial and maintenance expenses are higher than a system with comparatively lower capacity. If appropriate design conditions applied, system can be sized in a way that works more efficient with a minor discomfort at a limited time of the year. To determine the optimum design condition for a specific building the statistical analysis must be used over a time interval. Longer the time interval, the more reliable design conditions can be derived. Thermal load of a sample office, based on proposed design condition compared with the heat load based on current design condition used in Tehran, is up to 14% lower, which shows considerable energy saving potential.

Keywords: Outdoor design condition, HVAC, Coincident Temperatures, Thermal load

Thermodynamic Analysis of Carbon Dioxide as Alternative Refrigerants of Ammonia in the Refrigeration Cycle

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ABSTRACT

Advanced societies because of toxicity of ammonia and its negative impacts on foods, seek to reduce its use in fridges and food storage sites. Today carbon dioxide is one of the refrigerants is used as an alternative of ammonia in the refrigeration cycle. Environmentally carbon dioxide is a good alternative for ammonia, but refrigeration systems with carbon dioxide as refrigerant due to high energy consumption and low efficiency, are not used. In this paper, at first thermodynamic analysis and comparison of carbon dioxide refrigerant with ammonia as a common refrigerant in refrigeration cycle for a five-thousand-ton fridge is investigated. Since use of only carbon dioxide as a refrigerant is not justified an alternative cascade, system is used instead and is analyzed. Finally, both ammonia and carbon dioxide refrigerants in addition to an alternative cascade system from three aspects, the environment, energy consumption and commercial benefits have been examined and conclusions about them has been done.
Results suggest that by considering the need to reduce ammonia refrigerant usage in refrigeration industry, the most appropriate alternative method is using the ammonia-carbon dioxide cascade system. It can be seen that the energy consumption and performance coefficient of cascade systems in certain ranges of refrigerant temperature in the evaporator is justified, and at other temperatures, using ammonia-carbon dioxide cascade system is not cost effective.

Keywords: refrigerant, cascade system, Thermodynamic analysis, performance coefficient

The Analyze of Natural Ventilation`s Effect on Decrease of Cooling Energy Consuming in Construction

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ABSTRACT

Wind is a renewable energy resource that can used to create natural cooling and ventilation. This paper studies condition of natural ventilation and its effect on the making appropriate ventilation in a sample building at cold climate (Abhar). In the first part, energy consuming in electrical cooling systems is calculated and in the other part, condition of natural ventilation is revised. Comparing between comfort temperature and average of maximum temperature of year`s month shows need of cooling since June to September that is equal 1054 hours. The amount of energy consuming for these hours can estimated 881.14 KW for water cooler system and 3214.70 KW for air conditioner. The condition of natural ventilation in this project is evaluated for two states: ventilation whit windows of just one external wall and ventilation whit windows of two external walls. Conclusion of project can be stated here:

- The best orientation to meet need of cooling is North west-South east.
- For the wind opposite facade with two windows, just having vertical element between windows and just in June (except midday), there is adequate wind speed to ventilation and in other months should use electrical cooling system.
- For the wind facing facade with two windows every side, with vertical element, necessary wind speed is provided in all time. But without vertical elements, should be use electrical cooling system in midday.
- The best position of using local winds in natural ventilation is laying windows in the both side of construction: wind facing and opposite wind facing.

Keywords: natural ventilation, natural cooling, energy, construction

Thermal Performance Investigation of Mechanical Cooling

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ABSTRACT

Cooling towers are equipment devices commonly used to dissipate heat from power generation units, water-cooled refrigeration, air conditioning and industrial processes. Experiments were carried out on the heat transfer laboratory at Islamic Azad University of Mashhad in Iran. In this study outlet water temperature was used in determining experimentally the thermal performance of the cooling tower. Outlet water temperature decreases as air mass flow rate increases, the outlet water temperature increase as the wet bulb temperature increases, the outlet water temperature decrease as mass flow rate ratios increases, the water outlet temperature decreases as volume of tower increases, the outlet water temperature decreases as the pressure drop increases. The tower Characteristics decreases as mass flow rate ratios increases. Thermal efficiency decreases as mass flow rate ratios increases. Water evaporation rate increases as airflow rate increases. Water evaporation rate decreases as wet bulb temperature of moist air increases.

Keywords: Cooling Tower, coefficient of mass transfer, heat transfer coefficient, outlet water temperature, pressure drop.

Modeling and Exergy Analysis of an Ejector Refrigeration Cycle

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ABSTRACT

The ejector refrigeration system has a great potential for wide application due to its electrical energy saving, simplicity in construction, installation and maintenance. However, there are currently no commercially ejector refrigeration systems due to the low $COP_{thermal}$, whereas high $COP_{mechanical}$. In this article exergy analysis is used to find the bottlenecks for improving the cycle performance by tracing exergy flow. An ejector refrigeration cycle is considered. First, an algorithm is presented for its thermodynamic analysis and finding the optimal entrainment ratio. EES is used to model and analyze the system. After thermodynamic analysis of the system in EES, the exergy analysis of the system has been done and irreversibilities and exergy loss of each component has been calculated. The results of exergy analysis of the system have been presented in some diagrams. In a column diagram, exergy input, exergy output and irreversibilities for each component are shown. In a pie diagram, percentage of exergy loss of components is presented. Grassmann diagram is another useful instrument that is employed to present exergy flows and losses of the components. Through these three diagrams, we can easily find that the most exergy loss of the system is in the ejector that surely affects on the performance of the system. Therefore, for improving the performance of the system, the most important component that we should modify is the ejector. A reason of irreversibilities in the ejector is mixing two different temperature flows. Therefore, a lower boiler temperature and higher evaporator temperature can improve the performance of the system. Using refrigerants with the lower boiling point can have some benefits. It can be led to the reduction in irreversibilities and energy consumption in the boiler. Another thing that we should consider is not to use this cycle for low temperatures. Because the ejector refrigeration cycle has poor performance in low temperature, it is suggested to couple this cycle with another one that has high performance in this situation. Using refrigerants which has low boiling temperature has another benefit too. By using this kind of refrigerants, we can obtain required energy for this cycle from where waste heat is easily available from sources such as industrial processes, automobiles and solar.

Keywords: Exergy, Ejector refrigeration cycle, Second law analysis, Irreversibilities

Analytical Solution of Time Lag and Decrement Factor for Different Building Materials in Climate of Tehran

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ABSTRACT

Time lag and decrement factor are very important characteristics to determine the heat storage capabilities of materials. In this paper, time lags and decrement factors for different building materials that are utilized in Iran have been investigated analytically. For this goal, transient heat conduction equation is solved analytically using Green function under time-dependent convection boundary conditions. According to the climate of Tehran, periodic boundary conditions are applied to the outer surface of the wall. In this study, building materials, which are more common in Iran, have been utilized. Effects of different parameters such as wall thickness and both inner and outer heat transfer coefficient on time lag and decrement factor are investigated. Effect of thermal insulation layer in sandwich wall on time lag and decrement factor is also presented. The results of present study are applicable for designing more effective passive solar buildings, optimized design of walls and other related areas resulting in reduction of energy consumption and reduction of environmental pollution through diminishing of pollutants such as Co_2.

Keywords: Time lag, decrement factor, climate of Tehran, reduction of energy consumption

Estimation and Comparison of Initial Cost and Energy Usage for Implementing Floor Heating and Radiator Heating Systems in a Sample Residential Building

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ABSTRACT

In line with industrial, economical and technological developments, the need for efficient energy consumption is increased. Recently, floor heating system has been widely used for heating residential buildings in USA and in European countries. In this study in addition to a brief review of this system, by doing a simple analytical analysis, energy consumption has been estimated for a four-month cold season in a usual sample building whereas either a conventional radiator heating system or floor heating system is used. A cost analysis showed that the total initial cost for implementing floor heating system is not much different from radiator system. However, by assuming natural gas as fuel, estimation of energy consumption revealed a 600m^3 reduction in gas usage when floor heating is used instead of radiator system. If this system is implemented in all of the new residential buildings, which are built each year in Iran, a total of 360000000 m^3 of natural gas is saved annually.

Keywords: Floor heating, Energy saving, comparing heating costs.

Optimization of Solar Collector Surface in Solar Desiccant Wheel Cycle

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ABSTRACT

This work presents the optimization of a solar collector surface in solar desiccant wheel cycle which for cooling process with typical configuration naming one desiccant wheel, one sensible heat exchanger and a water spray evaporative cooler. In this cooling cycle the thermal solar energy is used to heat the regeneration air of desiccant wheel cycle. In this process outside air is processed to become supply air with desired temperature of $25^{o}C$. The effect of the design parameters such as wheel speed, velocity of air, thickness of the desiccant wheel, hydraulic diameter of the desiccant wheel and the operating parameters such as inlet air temperature, inlet air humidity ratio, regeneration air temperature and solar irradiance on the necessary solar collector surface are studied and discussed. The optimal solar collector surface is determined by examining design parameters and operating parameters.

The most important section of present study is to calculate outlet air conditions from desiccant wheel. In this section, outlet temperature and humidity of outlet air from desiccant wheel will be calculated with using a mathematical model. This model is achieved by solving heat and mass transfer equations. For calculated necessary surface of solar collector, thermodynamics' equations are solved.

The results show necessary surface of solar collector is depend on design parameters of desiccant wheel. In this way, optimized value of solar collector surface can be obtained for design parameters of desiccant wheel. The obtained optimized value for design condition in this work shows that necessary solar collector surface is decreased about 45% in comparison with published actual values of an empirical model in equal operating conditions. The results of this study show that necessary solar collector surface will be decreased when inlet air temperature, inlet air humidity ratio and solar irradiance are increased and that necessary solar collector surface will be increased when the regeneration air temperature is increased.

Keywords: Hybrid system, Desiccant Wheel, Solar Collector surface, Design Parameter, Operating Parameter

The Impact of Different Glazing System on Human Thermal Comfort and Energy Saving (Heating and Cooling) in Residential Building

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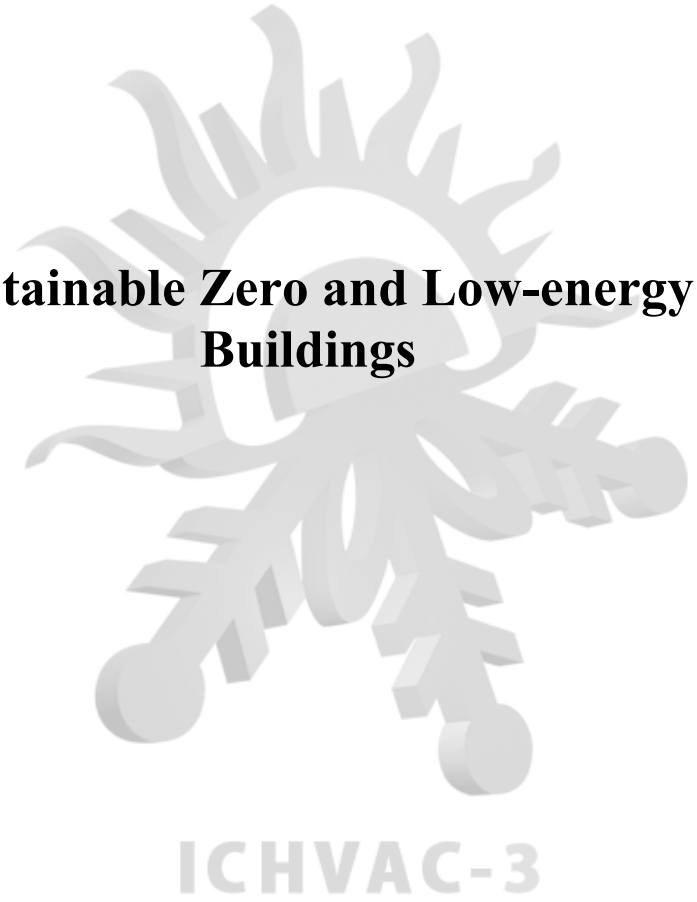
ABSTRACT

In this paper, fifteen different glazing systems ranging from 3 mm single glazed clear glass to triple glazed with low-e have been analyzed in terms of their human comfort impact and energy saving. This work is helpful in selecting the best window for a given building and given climate. Thermal comfort is measured in term of PMV (predicted mean vote) and PPD (predicted percentage of dissatisfaction).Typical values of metabolic rate and clothing insulation taken are 1.2 met and 0.5 clo for summer and 1.0 met and 1.0 clo for winter , respectively. Inside room air velocity is taken as 0.15 m/s round the year.
By using WINDOW 6.0, u-value and solar heat gain coefficient have been computed and by Energyplus v6 energy balance equation has been solved in sample opaque. A typical room (8x6x2.7 m) with a 6m^2 window facing south, based on ASHRAE-140, is modeled. . Analysis is done for Tehran climatic conditions using standard format data, TMY2 (Typical Meteorological Year, version2) that has been procured from Iran Meteorological Organization. Fanger comfort criteria are used in both thermal comfort and asymmetric radiation PD (percentage dissatisfied) evaluation.
The results have been shown, we can reduce energy consumption about 16 percent by choosing proper glazing system among our choices and also we can improve the predicted percentage of dissatisfaction from 60% to 10%.

Keywords: Glazing, Thermal comfort, Energy saving, PPD, PMV

Sustainable Zero and Low-energy Buildings



Air Conditioning with Solar System - A Case Study

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ABSTRACT

Modern world emerging with lot of amenities to get comfort but in adverse the world is warming and other problems related to air quality, diseases are occurring. The resources are limited and population is increasing, demand is increasing and all people have a role how to utilize the resources in proper manner with researchers, engineers, medical practitioners and all. Unites nation (U.N) is holding seminar to utilize resources in proper way and try to introduce environment friendly refrigerant related to global warming and Ozone depletion and encourage in designing considering alternative energy sources like solar, wind, biomass, fossil, tidal, nuclear etc to keep the environment green.

In this paper A LEED platinum project (An office building) which was completed in 2009 in Madras, India, the brief description will be presented. The credit is scored according to USGBC (United states global building council) related to energy saving which considers solar energy / wind energy for electricity generation related to operation of pump, lighting, design in consideration with day lighting, air conditioning with solar absorption system by utilizing hot water as source of heat with the help of solar collector. A comparison will be made between standard air conditioning system considering Vapor compression cycle with absorption system considering solar heat and also the cost implication and its payback period. The equipment cost is decreasing as technology is improving and payback period is becoming lesser and people are becoming conscious to build up green environment.

Keywords: Solar collector, Water as Refrigerant, USGBC Platinum Rated

Feasibility Study and Performance Evaluation of a Zero Net Energy Building in the Metrological Condition of Kerman, Iran

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ABSTRACT

Almost 40 % of the total consumptions of fossil energy in Iran are assigned to the branch of housing and urban development; however, the majority of buildings in the country do not have essential criterions for energy dissipations. The aim of this paper is first study the use of different renewable energy to provide the energy consumption needed in a building and then present various methods in order to decrease energy dissipations and achieve the optimum energy consumptions. For the numerical modeling, the commercial program TRNSYS is used to solve the governing partial differential equations by using iteration algorithm. The area of the tested room is 120m^2 and the area of the window faced to the south is 12.2m^2.

The results show that it is possible to have a building with the zero net energy in the meteorological condition of Kerman. Note that the net energy consists of the total needed heating load, the total needed cooling load and the total needed electricity for lightening. Different designing parameters are also presented for this situation and the calculated optimum value of the area of the collectors for providing the needed warm water is 4m^2. For providing the needed electricity of the building, photovoltaic panels are employed which are mounted at monthly optimum slope angles. Furthermore, according to the hot and dry climate of the studied region, the water cooler is more appropriate than other air conditioning systems. Solar floor heating system is employed in the building can provide almost 60% of the needed heating load in the coldest day of a year and some other methods employed for the rest needed energy.

Since in solar systems, the results have been affected extremely from different parameters such as air temperature and the gradient of that in a day, solar intensity, the clearness index parameter, the latitude and some others, the results of this paper cannot be able to compare with the results of previous references with different investigated meteorological conditions, however, by varying different effective parameters, the accuracy of the results are checked.

Keywords: Solar house, Zero net energy building, Numerical modeling, TRNSYS

Professional Experiences

Thermal Design of Cooling Tower

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ABSTRACT

There are some problems in thermal design of cooling tower and Evaporative cooling devices. One of the most important of these problems is the combination of Heat and Mass transfer. This causes hard to predict the application of an evaporative phenomenon. Many types of heat and mass transfer devices defined the solution by theoretical methods or dimensional analysis. Design data must be obtained by the full-scale tests under the actual operating conditions. Items such as evaporative condensers in which an internal heat load is being applied, along with water and air being circulated over the condenser tubes in indefinable flow patterns, presents a problem which cannot be solved directly by mathematical methods. The boundary conditions have not been adequately defined and the fundamental equations describing the variables have not been written. Other devices such as atmospheric spray towers and the newer spray canal systems have not been accurately evaluated solely by mathematical means. This type of equipment utilizes mixed flow patterns of water and air. Many attempts have been made to correlate performance using "drop theories", "cooling efficiency", number of transfer units, all without proven results. Accurate design data are best obtained by the actual tests over a wide range of operating conditions with the specified arrangement. The early investigators of cooling tower theory grappled with the problem presented by the dual transfer of heat and mass. The Merkel theory overcomes this by combining the two into
a single process based on enthalpy potential. Merkel developed a cooling tower theory for the mass (evaporation of a small portion of water) and sensible heat transfer between the air and water in a counter flow cooling tower. The theory considers the flow of mass and energy from the bulk water to an interface, and then from the interface to the surrounding air mass. The flow crosses these two boundaries, each offering resistance resulting in gradients in temperature, enthalpy, and humidity ratio.
Since, by a combination of experimental and computation method, the prediction of cooling tower at design and off design condition may be possible. The computation method and algorithm for calculating the tower demand and tower curve is discussed here. In addition, you can find the most important parameters and their effects on cooling tower application such as cooling water flow, cooling water temperature, and wet bulb of the ambient and bypass wall. Detail information is discussed. Furthermore, the experimental method is discussed too. This performs by measuring the wet bulb of ambient temperature, inlet and outlet water temperature, range and approach of cooling tower.

Keywords: cooling tower, heat and mass transfer, Merkel equation

Software Preparation of Mechanical Design of Fire Tube Boilers

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ABSTRACT

Mechanical manual design of fire tube steam boilers requires to take so much time and energy, and this matter result in high design price, delay in a project and also many mistakes and errors related to using some drawing softwares like *AUTOCAD*. For mechanical design of this boilers, like all pressure vessels different parts like shell, saddles, nozzles and the other parts should be analyzed, but the most important parts taking so much time are tube plates, which first should fix the arrangement of tubes and stay bars (with taking into consideration breathing spaces according to the standard [1]) according to tube plate thickness, design pressure and stay allowable stress.
So difficulties and related defects of boiler mechanical design made us so much interested to solve this industrial problem of fired tube boilers. In this software after specifying the place of shell, furnace, access tube, normal water level and diameter and thickness of tubes and stays at tube plates (front, rear and wrapper) arrangement of second and third tube passes will be drawn automatically. Then by specifying the place of stays area covered by each stay will be drawn and measured automatically (the most difficult part) which because of doing so much fast (by software), designer has enough time to turn back, if there is any problem, and change the arrangement and run the program repeatedly and reach to the best arrangement at a little time. By hand one try may take some week time but by program much time can try at only some minutes.
This program is written at *VLISP, DCL* and the other benefits of it is fast meshing of tubes, fast derive of the area covered by stays, stress derivation and comparing by allowable, reading data from and writing it into another file also, user friendly, shop drawing output in "*dwg.*" Format.

Keywords: Fire tube, Software, Mechanical, Nesting, Tube plate

Increasing Outlet Temperature of Radiation Super Heater at Wet Back Fired Tube Boilers

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ABSTRACT

In this paper in order to increase temperature of super heated vapor in wet back fired tube boilers a method is introduced based on dry back fired tube boilers. Because of placing super heater at the reversal chamber, temperature of saturated steam can be increased from 60 to 100 °C (depending on size of boiler and reversal chamber), with so much saving in material. In convection type super heaters it is difficult and so much expensive to reach this temperature and sometimes not accessible. The method introduces hear as said previously is derived from dry back super heaters with add in a layer of cement with a thickness of 50 to 70 mm at wrapper back tube plate which makes coefficient of radiation double.

Keywords: non-burned cement, fired tube, super heater, wet back, radiation

An Investigation of Radiant Panel (Floor Heating): Energy Cost and Thermal Comfort Comparison

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ABSTRACT

In this article, we discuss the radiant panel and continue to analyzing the floor heating. Then we will compare its advantages with other heating systems in energy consumption. By the increase in the population and decrease in energy sources, proper energy consumption is an inevitable fact. Therefore, the engineers are focusing on choosing high efficiency performing methods. The purpose of creating such fundamentals, which are concerned as the heart of the building, is to provide the residents with the new and modern heating methods. Nowadays, the floor heating has become so common in the European and American countries and this is because of improvement in proper energy consumption by using modern technologies. There are different heating systems that the most commons are:

1- Heating by the use of Heaters
2- Radiant Heating and Fan Coil
3- Floor Heating

The floor heating, which the radiant panel has an important role in it, is not only better in proper energy consumption in comparison with other methods but also it has got many strength points in heating comfort for those who live in apartment. It shares equal heat in the environment and does not make the walls dirty by dust. Floor heating radiates and shares the heat by the slow movement and cycle of warm water in the pipes under the floor. In this system, the underground pipes cover all over the floor and the heat is shared and radiated equally in the environment. It is known as the most user-friendly & convenient heating system and the healthiest one and has many facilities. The warm 40°-45 ° water circulates in the pipes and the floor temperature would be 29°c and more than %60 of the energy would be radiated to environment.

Floor heating by its different functions can be used in a variety of places such as Villas, Apartments, Pools and Sports Halls, Trade Centers, Parking & Roofs and also it helps melting ice and snow in airports and etc.

From a long time ago, floor heating has been used in different ways & there are totally 3 common methods for it as follow:

1- Floor Heating by Warm Air
2- Floor Heating by Electricity
3- Floor Heating by Warm Water

Advantages:

- Highest level of Convenience
- Equality in the Environment heating
- Energy Proper Consumption
- Higher heat Stability rather than other methods
- Not Limiting the Interior Design of the area
- Keeping indoor space Clean and Tidy
- Healthier Air that would not get dry
- Drying the Wet Surfaces such as in the bathroom
- Using Variety of Heating Sources

The first step is to make an assessment and calculate the required heat for each of the rooms and areas. Its best advantage is the higher radiated temperature in comparison with other heating systems with the warm air circulation. In conclusion, we should say that because of the Shortage in Energy Sources and the Importance of Energy Proper Consumption, the Floor Heating is a Necessity to be chosen and Not Just an Option.

Keywords: Floor heating, Energy Consumption, Thermal comfort

Indoor Air Quality and Comfort Conditions

Thermal Comfort and Occupant's Satisfaction in Comparison to International Standards in Traditional Buildings in Isfahan, Iran

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ABSTRACT

It is essential to associate thermal comfort requirements adapt to energy consumption, and this has been investigated in recent years. Overheating in some buildings may cause thermal discomfort and also energy waste, thus thermal comfort is considered as an effective factor to reduce energy consumption. There are traditional buildings that have been refurbished and changed to offices in Iran without considering their quality of indoor thermal comfort condition and occupant satisfaction. The aim of this paper is to assess the existing quality of thermal comfort in comparison to well-known international standards in a number of refurbished traditional buildings in Isfahan city, Iran. Also to find out what routes may be available to improve thermal comfort in these office buildings. The research conducted Short term physical monitoring in 4 selected traditional buildings in winter. Physical measurements and questionnaire response has been undertaken simultaneously. The results showed that although the indoor thermal comfort conditions were not in compliance to international standards such as ASHRAE standard 55 and ISO 7730, but most of the occupants were satisfied with the thermal condition in their workspace. The overall findings suggest that it may prove beneficial to develop thermal regulations for those buildings based on local climate and cultural conditions. This not only increases the occupant satisfaction but also results in energy reduction.

Keywords: Thermal comfort, Traditional buildings, Office buildings, Field study, International standards

Evaluation the Influence of Thermal Inertia of A Typical Residential Building on Performance of Radiant Hydronic Heating-Cooling Systems

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ABSTRACT

In this study, a sample building is simulated using EnergyPlus Version 6.0 in order to evaluate the impact of thermal inertia on energy consumption. The building simulation has been validated by case 620 and 920 of ASHRAE standard 140. In the next step, the constructions of opaque walls replaced by three common building constructions in Iran, namely HI (High Inertia), MI (Medium Inertia) and LI (Low Inertia). Equivalent ρC_p for each construction type is calculated to specify the thermal inertia. Analysis is done for different climatic conditions of Iran using standard format data, TMY2 (Typical Meteorological Year, version2) that has been procured from IMO (Iran Meteorological Organization). The model is utilized with an ideal load system enabling energy consumption analysis. In order to control the heating and cooling systems, setpoint for each one is needed. In this study, for each weather condition, setpoints are defined corresponding to PMV=-0.5 for heating and PMV=0.5 for cooling, based on Fanger Thermal comfort criteria. People activity and clothing are set according to ASHRAE standard for residential situations. Thermal comfort and energy viewpoints are considered simultaneously in order to achieve a comprehensive analysis, which can lead to practical suggestions in building design.

This study is concentrated on daily analysis and annual analysis. Results show that, better energy performance is obtained from HI construction simulation versus LI construction. In Tehran, with cold winters and hot summers, these results were obtained from HI construction in comparison with LI construction simulations: annual heating energy consumption is reduced from 4.3 MWh to 2.9 MWh which is 32.5% saving and annual cooling energy consumption is reduced from 5 MWh to 4.3 MWh which is 14% saving. For other climates energy saving could be achieved by wall thermal inertia increase but the percentage is different.

Daily results show that the fluctuation in energy consumption is decreased by thermal inertia increasing; from peak load viewpoint, which is important to HVAC system selection, 31% reduction in heating, and 33% in cooling peak load is resulted by implementing HI instead of LI construction.

Keywords: thermal inertia, Fanger comfort criteria, heating- cooling loads, asymmetric radiation, climates of Iran.

Dispersion of Evaporative Droplets in an Office with Mixing Ventilation System

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ABSTRACT

Transmission of diseases from one person to another due to coughing by emission of droplets that carrying viruses and bacteria in office room with two people is studied. A computational model for simulating the airflow, the thermal and the humidity condition in room is developed and the distributions of evaporating droplet in the office were studied. The $k-\varepsilon$ turbulence model was used for continuous fluid phase calculations and the trajectories of the evaporating droplets were evaluated with a Lagrangian method. The particle equation of motion included the viscous drag, the Brownian, the Saffman lift and the gravity forces. Mixing air distribution system was considered and trajectories of particles with size of 50 and 100 microns were simulated. The simulation results suggested that the droplet temperature reaches to wet-bulb temperature in less than a second. In addition, dispersion of droplets increases when the effect of evaporation is included.

Keywords: Evaporative Droplet, Indoor Air, Ventilation system

Evaluation of the Effects of Draught on Changing the Admissible Range of Thermal Comfort By Using the General Thermal Discomfort Index

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ABSTRACT

In the existing analytical thermal comfort models, the effects of seven general discomfort parameters are considered and the effects of local discomfort parameters are neglected. Among these local parameters, draught is the most important phenomena. Several researches have shown that the overall thermal discomfort of occupants may be significantly affected by the draught phenomena. But, up to now, the interactional effects of local and general discomfort parameters are neglected in the existing thermal comfort models. In the present study, the interactions of draught and thermal sensation are investigated by defining a new general discomfort index. The results indicate that the draught phenomena can significantly affect the admissible range of thermal comfort. Furthermore, the results show that the draught causes the summer and winter indoor design temperatures to increase about 3.2°C and 3.5°C, respectively. Consequently, draught can cause to increase the heating and decrease the cooling load of the buildings.

Keywords: Draught, Thermal comfort range, Thermal discomfort

New Emerging Technologies in HVAC&R

Thermal Performance Enhancement of Two-Phase Closed Thermosyphon with Adding Carbon Nanotube to Deionized Water

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ABSTRACT

Nowadays, heat pipes and thermosyphons have numerous thermal engineering applications such as electronics equipments coolers, heat exchangers and power produce. Heat transfer coefficient and efficiency of these apparatuses can be enhanced by using nanofluids, which is a stable suspension of a base fluid and some nanoparticles as additives. Carbon nanotubes are known to have wonderful thermal properties and have great potentials of applications in the heat transfer field. Thermal conductivity of carbon nanotube is fairly higher than metal nanoparticles, and they seem to have the proper potential of applicability in TPCTs.
The thermal performance of a two-phase closed thermosyphon (TPCT) operating with multi-walled carbon nanotube (MWCNT) nanofluids, including deionized water as base fluid is studied. The experiments were carried out in a copper TPCT with a diameter of 20 mm and length in 450 mm. The investigation of effects of addition of MWCNTs in deionized water on Nusselt number, thermal efficiency, temperature and vacuum pressure variation were included the aims of this study.
MWCNT is used with the diameter of 10-20 nm and length of 5-15 microns. Nanofluids with different weight concentrations of MWCNT including 0.2%, 0.5% and 1% were prepared and for each sample input powers of 30, 45, 60 and 90W are applied. Experimental results show that with increasing weight concentration of nanofluids, thermal efficiency improves and Nusselt number decrease. In addition, the increased input power leads to an increase in thermal efficiency and Nusselt number. However, the maximum thermal efficiency and Nusselt number, which is attained in input power of 90 W, are 90% and 1738 respectively.
When nanofluid is concentrated it may cause significant changes in vacuum pressure drop which affects boiling process. In addition, in all input powers, minimum and maximum of time to achieve stability are 5140 and 6060 (Sec) that belong to deionized water and nanofluid of 0.2 wt%, respectively.

Keywords: Nanofluid, Thermosyphon, MWCNT, Thermal efficiency, Nusselt number

Developing Necessity of Combined Cooling, Heating and Power System (CCHP) in Buildings Sector

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ABSTRACT

In This paper optimal Design of a combined cooling, heating and power (CCHP) system for building sector has done. The energy management in design and operation of these systems is an important task. In this project two optimal layout of CCHP has designed. The first one is with operation of gas turbine and the second with a gas engine as a prime mover. The components of such systems consist of heat recovery steam generator (HRSG), an auxiliary boiler to supply the heating load, absorption and electric chiller to meet the cooling demand. An innovative procedure to optimize the total energy cost of the system is presented. Finally, an optimal size of CCHP is determined for each layout. The annual demand and usage-avoided cost for varying turbine and absorption chiller size with continuous variable demands are discussed as well, showing that an optimum CCHP system with the gas engine prime mover is more capable in annual saving and has short Rate of Return in capital cost. Calculation of economic parameters shows that CCHP systems in addition of energy saving and reduction of fossil fuel consumption, causes to control and decreasing of environment pollutions.

Keywords: CCHP System, Optimization, Micro turbine, Gas engine, Building Sector

The Effect of Ambient Conditions on the Performance of an Open Desiccant Cooling from First and Second Laws View Point a

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ABSTRACT

An open desiccant cooling process is presented and applied to ventilation and recirculation modes of the system operation. The cooling system consists of a desiccant wheel, a rotary regenerator, two evaporative coolers, and a heating unit. Certain ideal operating characteristics based primarily on the first law of thermodynamics are assumed for each component. The system with indoor and outdoor ARI conditions has a thermal coefficient of performance (COP) of 1.106 in ventilation mode and 1.235 in recirculation mode. A second law analysis is also performed and at ARI conditions, the reversible COP of the system is determined to be 2.671 in ventilation mode and 2.813 in recirculation mode. Variation of the first and second law based COP terms and cooling load with respect to ambient temperature and relative humidity are investigated in both modes of the system operation. The results of the analysis provide an upper limit for the system performance at various ambient conditions and may serve as a model to which actual desiccant cooling systems may be compared. As an additional study, a non-ideal system operation is considered, and it is determined that both the COP and cooling load decrease with increasing ambient temperature and relative humidity, and they approach zero at high values of ambient temperature and humidity.

Keywords: Desiccant Cooling, Ambient Condition, Second-law Analysis, COP

Analysis of Pre-cooling Effect on Dehumidification and Improvement of an Evaporative Cooler

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ABSTRACT

In this study, effect of desiccant wheel, heat exchanger and two cooling coils will be evaluated on decreasing the wet bulb temperature of entering air to a cooling tower and decreasing the outlet cold water temperature. For this purpose, change effect of desiccant wheel parameters will be investigated on wet bulb temperature of inlet air to a cooling tower. After that, optimum parameters and minimum wet bulb temperature will be selected. Then, outlet cold water temperature will be achieved for various cooling coil surface temperature with definition of a bypass factor and also by using optimum desiccant wheel parameters and entrance air wet bulb temperature to tower related to cooling coil surface temperature. The most important section of present study is to calculate outlet air conditions from the desiccant wheel. In this section, outlet temperature and humidity of outlet air from the desiccant wheel will be calculated with using a mathematical model. This model is achieved by solving heat and mass transfer equations. For calculated necessary surface of solar collector, thermodynamics' equations are solved. To calculate wet bulb temperature, a mathematical model will be used that shows physical properties of air. After that, a nomograph will be used to predict the effect of decrease of entrance air wet bulb temperature on reducing the outlet water temperature, and it will be done for several cities in Iran. In addition, an equation will be used to calculate required water to air mass flow rate for each outlet cold water temperature. With considering of known circulating water mass flow rate, required air for tower would be calculated and suitable desiccant wheel can be selected.

Keywords: Desiccant Wheel, Cooling Coil, Wet Bulb Temperature, Heat exchanger

Systematic Design Procedure of Mixed Refrigerant Cycle for Low Temperature Processes

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ABSTRACT

In industrial processes, many processes operate below the ambient temperature. Usually when these processes demand refrigeration over a very wide temperature range, cascade refrigeration systems are employed. Unfortunately, the cascade refrigeration systems are capital intensive because of major use of installed equipment and large energy requirements in operations. Therefore, the continuing development of new methods to reduce net power and capital costs of refrigeration systems is important in the design of low temperature processes. A recent advancement has been the introduction of mixtures as refrigerants in place of pure refrigerants. In mixed refrigerant cycles, the composition of the mixture can be selected such that the liquid refrigerant evaporates over a temperature range similar to that of the process cooling demand to provide the desired refrigerant characteristics. Small temperature driving force leads to a near-reversible operation, thus better thermodynamic efficiency and lower power requirement. In addition, a mixed refrigerant cycle features simpler machinery configuration and fewer maintenance problems. Due to the lack of systematic design method for mixed refrigerant cycle, conventional approaches are largely trial-and-error and therefore, operations can be far away from optimal conditions. The difficulty in design mainly stems from two aspects: one is the expensive and highly nonlinear nature of computation and the other is the sensitivity of the cycles to the operating changes, especially the change in the composition of refrigerant mixtures and, the suction and discharge pressures of compressor. In this paper, a novel method for systematic design of mixed refrigerant cycles is proposed by combined mathematical programming and thermodynamics approach. This method combines the power of thermodynamics and mathematical programming. While the mathematical programming can satisfactorily give the optimal choice of pressures operating conditions and refrigerant compositions, thermodynamics at the same time gives the user insights and confidence in solution. The procedure is demonstrated using a case study of design of two mixed refrigerant cycles for a typical olefin plant.

Keywords: Sub-ambient process, refrigeration system, mixed refrigerant.

Experimental Investigation of Free Cooling Using Nano Based Thermal Energy Storage System for Building Peak Load Operation

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ABSTRACT

This paper presents an experimental investigation of the free cooling of a low-energy building using a nano based thermal energy storage (NTES) system combined with a mechanical ventilation system. The spherical encapsulations having phase change material (PCM) with dispersed nanoparticles has kept inside the cylindrical container. The nano based PCM is charged the cold energy of the ambient air throughout the nighttime and it is discharged only during the on peak load hours. During peak load condition, the chiller unit is also operated for meeting out the part load demand. Nanoparticles in the spherical encapsulate on have enhanced the thermal conductivity and storage capacity of the PCM. Experimental result showed that a PCM with a melting temperature between 18^0C and 20^0C is the most suitable for free cooling for the given climate condition. From the test results, it is observed that the average on peak energy saving potential of the NTES air conditioning system is expected to achieve 14.2% while compared to conventional system.

Keywords: Phase change material, Nanoparticle, Charging, Discharging and Energy efficiency

Development and Construction of Bioclimatic Double Skin Active Facade for Hot and Humid Climate of UAE

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ABSTRACT

Transparency in architecture is desirable for many reasons. In order to build transparent buildings with high levels of occupant comfort without compromising energy performance, façade technology and integration of facade and environmental systems become still more advanced. The present paper deals with the development and construction of mechanically ventilated double skin façade with HVAC integration for hot and humid climate like UAE. A case study is presented, illustrating potential benefits of careful application of the available technologies adopting an integrated approach from the early design phases. Moreover, the paper gives an introduction to test and demonstrate the performance of the facade and HVAC integration.

Keywords: Climate- Active-Bioclimatic façade, Chilled beam, floor cooling

Calculation of Electrical Energy Production Cost Using Domestic Combined Cooling, Heating and Power (CCHP) Systems: Energy and Economic Analysis

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ABSTRACT

Today, considering the unique characteristics of the CCHP systems in very small Scale (MCCHP), such as a high efficiency, reduce environmental pollution and a major influence in reducing mortality in transmission systems caused that these systems rapidly growing in a residential section. CCHP Systems can provide energy to supply electricity with priority, provide energy to supply heat with priority should be exploited. in this article, for example an apartment in Tehran with the involvement of heating, cooling and electrical load and economic evaluation of electricity cost (COE), initial driving (gas engines, fuel cell and micro turbine) in a different strategies (FEL And FTL) has been set. The aim of the issue is maximizing the uniform annual net profit with solving the nonlinear, mixed integer assistance in GAMS software. The results show that the use of CCHP driven based on the initial gas engine for economic residential units is required.

Design of Roof Cooling System for a Residential Building in Dry Climates

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ABSTRACT

In hot and humid regions, air-conditioning is increasingly used to attain thermal comfort. Air-conditioning is highly energy intensive and it is desirable to develop alternative low-energy means to achieve comfort. Roof cooling systems using radiation heat transfer, provide the proper cooling of a space. In a roof cooling system, the heat is absorbed by a cold surface through the free convection of radiation and transferred into the outside. So the highest level of comfort is achieved. In this paper, after introducing the different types of roof cooling systems, benefits and disadvantages of them are discussed. At last, a typical roof cooling system for a sample plan is computed and designed. Results show the significant savings in energy consumption.

Keywords: roof cooling, optimization, hydronic, dry climate

Economic Assessment of Combined Heat and Power System Usage in a Building Complex- Case Study

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ABSTRACT

Small cogeneration power plants for generation of heat and cooling are among the solutions of increasing the efficiency of energy consumption for fossil fuels to protecting natural resources and the environment. The location and geometrical details of an educational building (Institute of Petroleum Engineering in Tehran University) with a total area of approximately 28 thousand square meters in Tehran, have been used in computer programs Dialux and Carrier HAP in order to calculate its electrical and thermal power values. Maximum demand values for electricity, heat and cooling are 401.2 kW, 1284 kW and 1460 kW respectively. After that, some of the products of Jenbacher, which is a company that produces modules of cogeneration, have been considered and annual costs have been optimized based on non-linear discrete modeling. Environmental issues have also been considered in the optimization.

Keywords: Cogeneration, Small power plant, Economical optimization, CHP module, Electricity demand

Using Condensing Boilers with Hydronic Heating Distribution System and Outdoor Reset Controller

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ABSTRACT

Today with the rising cost of fossil fuels and reduction of the fuel resources around the world, Engineers were in various parts were to apply some changes in the structure and operation process of machines and systems to reduce fuel consumption. Engineers in the construction sector came to good progress achievements. These advances have been in new materials, heating and cooling systems. One of these innovations in the field of heating buildings was a condensing boiler. The boiler with water vapor in the combustion products plays a significant role in reducing fuel consumption. Condensing boilers for best performance require a good hot water distribution system along with a great controlling system. According to researches, a proper hot water distribution system is a distribution system with variable round pump and a reset system out of control plays a role in the control. Distribution system with the variable speed pump has an ability to change the speed of the pump. Consequently, this will bring us the change and alteration in flow and the transferred heat to inner space. At coolest nights of the year, the variable speed pump would produce the maximum hot water flow, which would result in maximum heat transferred to inner space. The reset controller, controls speed of the pump by comparing ambient' temperature and consumer selection temperature. Rising outdoor temperature cause reduction in pump speed and reduction outdoor temperature cause rising in pump speed. This heating system is an optimize system in boiler's fuel consumption and in pump's power. In this article, we try to compare this new system with convectional by their performance. Another purpose of this article is to analyze this system for Iran's weather condition.

Keywords: Condensing boilers, Hydronic system, heating distribution, Outdoor reset controller, Building

Condensing Boilers Analysis, Efficiency Calculation Methods and Their Technical Rationalization

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ABSTRACT

Condensing boilers are a new generation of boilers, which unfortunately have not been well known in Iran, or maybe they have not been used ever, or a rather possible situation is that they have been used but without knowing how they work in the heating systems. Using condensing boilers in heating systems (in case of choosing the right one) can potentially increase thermal energy produced. In order to do this, we need to be thoroughly familiar with the structure and also keep in mind that one of the necessary conditions is that the returning water temperature should be about 10 °F lower than the saturated water vapor temperature from combustion (Available in combustion products). The saturation temperature of water vapor depends on other parameters such as type of fuel, the amount of additional air and it varies between 110°F to 135°F, while the returning water in non-condensing boilers is 180°F. Also, other important parameters such as length and trajectory of the flue, the heat value of fuel type in the location of boiler, Air humidity of environment, the type of burners used in boilers, the allowed moisture of combustion products in time of entering to the flue affect the efficiency and functionality of boilers. The boilers ought to have the ability to resist acidic water from a water vapor process in the combustion products. Although burners of these kinds of boilers are mostly blue flamed and produce less soot and carbon monoxide, which leads to a reduction of the acidic water property. This study has tried to use and exploit the practical research conducted around the world and catalogs' of world-renowned companies, the reasons to be efficient in condensing boilers and methods of calculating the efficiency have been reviewed, and the appropriate results are given to the values above 100% efficiency which some sources are claiming for the boilers. The results have shown that by choosing the right and commensurate boiler considering its suitability to environmental conditions, efficiency will reach to 96%, which, in fact, is quite desirable.

Keywords: Condensing boilers, Boiler efficiency, Heating system, Return water temperature.

Using of Sink Water to Pre Cooling Inlet Air with Mechanical Water Pump and Scrutiny the Effect of Shade on the Efficiency

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ABSTRACT

According to Iran's weather, evaporative cooling devices play an important role to supply cooling load at warm seasons of the year for the domestic places and offices, also these devices have high power consumption and low efficiency (coefficient of performance), COP, so we express three schemes to improve cop of these devices such as:

a. Pre cooling inlet air to the device with sink water
b. Change the structure of water pump from electrical to mechanical
c. Adding shade

Explain A: in evaporative cooling process, latent heat of sink water is the main cause of decrease temperature of air .in this process temperature of sink water reduces to surrounding wet bulb's temperature and the water will be evaporated, so the absolute humidity of the inlet air will be increased and it's temperature will be decreased. According to decreasing temperature of sink water from surrounding temperature to surrounding wet bulb's temperature, it is used to pre cooling inlet air; we designed a coil that decreases temperature of inlet air in constant absolute humidity process. Therefore, air arrives in the direct evaporative media of the device and decreases its temperature extremely. By adding the coil (pre cooling process) on the two speed evaporative cooling device, the percent of increase cop for low and high speed were obtained %9.4 and %12.4.

Explain B: water pump in all evaporative cooling devices, which circulates the water, use an electric source directly but in this article a mechanical water pump was used which supply him required power from the electric motor which blow the air into the air conditioning space .there are so many reasons why mechanical water pump is better than electric water pump, such as:

i. power consumption decreases
ii. generating useless heat decreases
iii. circulating water flow increases when inlet air flow is increased

So when electric water pump is replaced with mechanical water pump, the percent of increase cop is equal to %13.5.

Explain C: the shade's mechanism, which was designed, has more ability. addition of shade ,it can be a cover for device in season which device is off and can be a support which protect coil and device from transport's damage .so if adding it ,the percent of increase cop is equal to %11.5 .(Note :this number is relative)

Keywords: Pre cooling, Evaporative cooling process, Efficiency, Water pump

Intelligent Multivariable Control of Automobile Air Conditioning System

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ABSTRACT

Control of air conditioning (AC) system is the most important factor to provide temperature and humidity inside the car. Manual control of AC system, which is often the case, results in distraction and reduced safety for driver. Therefore, automatic control of AC system is necessary for efficient driving, improved safety, and system optimization. AC systems are nonlinear, highly complex, and affected by environmental factors. In addition, in these systems, the interaction between temperature and humidity control loops is considerable and also the nonlinear behavior of actuators is inevitable. In this paper, a new thermal model is proposed for AC systems. For controlling temperature and humidity inside the car, air inflow (percentage of fresh air) and speed of fan are used as control variables. Thus, a multivariable controller (with two inputs and two outputs) is required for controlling temperature and humidity. Once the thermal model is obtained, first a classic adaptive PID controller, then a multivariable intelligent controller based on neural networks and finally a variable-structure fuzzy PID controller have been designed for controlling the Ac system.

Keywords: Adaptive PID, Automobile Air Conditioning, Comfort Factors, Cooling Model for Automobile AC, Intelligent Controller, Multivariable Control, Neural Controller, Variable-Structure Fuzzy PID.

An Application of Wireless Sensor Technology in HVAC Control Systems

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ABSTRACT

It is common to control several rooms in a building with a single sensor in one of the rooms and a single actuator driving just one control element such as an air damper. New, low-cost, wireless sensor technology in HVAC control systems now offers the opportunity to replace the single sensor in one room with a network of sensors where there is at least one sensor per room. This paper addresses this multi-sensor, single-actuator control problem.

Keywords: sensor, wireless sensor technology, HVAC control systems.

Experimental Study of Force Convective Heat Transfer for Cuo – Water nanofluid flow in a Tubular Heat Exchanger

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ABSTRACT

Addition of metallic nanopowder to common fluids result an enhancement in their thermal properties. In the present paper, we investigate the effect of a nanofluid on the heat transfer coefficient in a tubular heat exchanger. Samples of copper oxide and water suspension nanofluid are prepared in low concentrations about 1%, 2%, 4%wt and experiments are carried out for prediction of the heat transfer coefficient in a noval design tubular heat exchanger with using these samples as a hot fluid. As a result, using of CuO-Water nanofluid cause an increase in the heat transfer coefficient more than 30% compared with the result obtained from distilled water. Also, the effect of inlet temperature of nanofluid on the performance of the heat exchanger in the laminar flow has been studied. A careful examination of results reveals that by increasing inlet temperature, the Nusselt number is decreasing. Therefore, in lower temperatures nanofluids are more efficient than high temperature.

Keywords: Nanofluid, tubular, Heat exchanger, Heat transfer coefficient.

Industrial HVAC&R

Assessing Sound Pollution in Two Industrial Units and Offering Some Ways for Decreasing This Kind of Pollution

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ABSTRACT

One of the main harmful factors in industrial environments is noise. This uncomfortable thing is the most abnormal phenomenon in our life by which human has been affected during the years after industry revolution. Unfortunately, sound and its problems are unavoidable affairs in human's working and life places. Scientists have called noise and its problems "sound pollution". Sound pollution like other kinds of pollution in the world threatens human' health and necessarily, man must make a great attempt to find a proper solution in order to decrease its bad effects. Since nowadays in the industrial world, the rate of noise has grown up and this situation can put human's health and his psychic hygiene in danger, it is seriously necessary to do required suitable performances in order to control sound rate and decrease its damaging influences. To attain this goal sound intensity must be carefully controlled. It is very important for us to match sound rates in industrial places with standard international ones. A great communal effort is required to reach what is acceptable for the international standard organization and technical committee of professional hygiene. During recent decades, researchers have studied many ways and performed many experiments to find a good solution for decreasing sound pollution or at least damages. The aim of this study is to evaluate and assess "sound pollution" in two industrial units and then to find the ways of how to encounter and control this troublesome and damaging phenomenon there. Relevant results have been experimentally achieved by using a set of measuring instruments. It should be mentioned that the special equipment used for these measures was a sound measure set, model CASELLA CEL-450, with a microphone model CLASS II. Primary measuring and then appropriate assessments, proved that there was sound pollution in both above- mentioned industrial units, so it seemed vital for the researcher to look for the effective ways to control it and teach the workers how to encounter and deal with this problem in order to decrease its damages. Fortunately, good suggestions has been given to the workers, and they have been well instructed for right interacting with this difficulty. Evidences show that there is a better control over sound pollution in these units after recollecting the results.

Keywords: Sound pollution, Sound measure, Worker's encountering

Thermal Modeling of a Greenhouse Equipped with Artificial Ventilation

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ABSTRACT

Ventilation of the green houses is one of the important matters in gardening. In recent years, several researchers have studied theoretically and practically the temperature and humidity of the air in greenhouses. The aims have been improving the quality and the productivity. The most important factor investigated is greenhouse ventilation.
Present paper investigates artificial and natural ventilators. Natural ventilation is inexpensive, cheap and not harmful for environment. In north of Iran, natural ventilation is recommended and can be used in most situations. In areas with high solar radiation and with low humidity, namely south of Iran, both kinds of ventilators can be used. In this paper, we investigated and analyzed thermal model of green house with natural and artificial ventilators and compared the results with reliable literature available. One of the most important factors compared are wind speed, temperature differences between inside and outside of the greenhouse, opening rate of windows and the amount of solar radiation in calculation of ventilation rate and air circulation in order to obtain suitable air temperature and humidity in instable conditions.
The results of the present investigation could be applied in other places for ventilation of livestock breeding that requires special climate conditions.

Keywords: Greenhouse – Artificial ventilation-Ventilation fan- Cooling pad