Literature Review

Paper-[1]

Topic:

Modeling of natural ventilation in solar chimney and optimization of the channel profile by CFD method

Significance:

Increase the air movement through a building and thus potentially increase the thermal benefits of natural ventilation.

Methodology:

Using the CFD modeling software (Fluent) to simulate different chimney structures and compare with the experimental data

Innovation:

Optimization of solar chimney profile.

Conclusion：

A modified chimney profile of linearly tapered solar chimney could remove the reverse flow and improved the flow rate by 25%.

Paper-[2]

Topic:

Parameterization Studies of Solar Chimneys in the Tropics

Significance:

The performance of tropical solar chimneys by varying the design parameters and examining their effects on the interior air temperature and speed.

Methodology：

Studying the literatures

Physical Model and Parameterization

Computational Model

Innovation:

Use different methods to collect different parameters of the solar chimney.

Conclusion：

Simulation results show that the solar chimney's width is the most significant factor influencing the output air speed. Results further show that the ratio of solar chimney's length to hydraulic diameter should be greater than 15 to ensure developed flow and

the ratio of solar chimney's stack height to width should be less than 7 if air flow within the solar chimney is to be two-dimensional.

Paper-[3]

Topic:

The effects of opening areas on solar chimney performance

Significance:

Solar chimney creates air flow due to stack effect caused by temperature difference between ambient and inside wall. In addition, it is very hard to get good ventilation at night time by using a solar chimney.

Methodology :

CFD Simulation

Theoretical calculation

Experiment

Innovation:

One of the findings is the inlet opening area should be at least double the outlet opening area. This is due to bigger outlet opening area than inlet opening area is performing badly.

Conclusion :

The solar chimney performance does not effect if the area ratio between inlet and outlet varies from 1 to 2. This result will be useful for design and verification of actual solar chimney performance.

Paper-[4]

Topic:

Solar chimneys: simulation and experiment

Significance:

The use of solar chimneys in buildings is one way to increment natural ventilation and, as a consequence, to improve indoor air quality.

Methodology :

CFD Modeling and Test facility set up

Innovation:

A simplified model and a computer program that allow the quantification of solar assisted natural ventilation flow rate were developed.

Conclusion :

It is fundamental to use outside insulation in the brick wall, to take advantage of solar gains; if outside insulation is not used, solar assistance efficiency reduces by more than 60%; a thickness of 5 cm is sufficient.

Paper-[5]

Topic:

Solar chimney for enhanced stack ventilation

Significance:

Solar chimney can increase building ventilation by replacing the indoor and outdoor air for healthy and comfortable interior environment.

Methodology :

MATHEMATICAL MODELLING

Innovation:

A solar chimney is essentially divided into two parts, one -the solar collector and second the chimney.

Conclusion :

Considerable air ventilation can be generated by solar induced temperature difference if the system is properly designed. This has become evident by the fact that there is a potential of generating 100-350 (m^3/hr.) ventilation rates for a collector area of 2.25 m^2 and for solar radiation values of 100-1000 W/m^2 on the horizontal surface.

Paper-[6]

Topic:

An experimental investigation of a solar chimney model with uniform wall heat flux

Significance:

Experiments were carried out using an experimental solar chimney model with uniform heat flux on one chimney wall with a variable chimney gap-to-height ratio between 1:15 and 2:5 and different heat flux and inclination angles.

Methodology :

Experimental investigations

Numerical modeling

Analytical investigations

Innovation:

The airflow rate prediction method available in the literature is based on two basic assumptions, i.e. heat balance analysis gives the correct stack pressure and normal forced flow pressure loss coefficients can be applied to solar chimneys.

Conclusion：

That a maximum airflow rate was achieved at an inclination angle around 45° for a 200mm gap and 1.5m high chimney, and the airflow rate is about 45% higher than that for a vertical chimney at otherwise identical conditions.

Paper-[7]

Topic:

A mathematical model of a solar chimney

Significance:

Passive cooling could be obtained from a solar chimney. Increasing the solar chimney efficiency.

Methodology：

Physical model

Thermal network

Temperature distribution along flow direction for a short wall

Innovation:

A simple mathematical model of a solar chimney is proposed. The physical model is similar to the Trombe wall.

Conclusion：

The performance of a solar chimney has been predicted using a simple model. Further experimental work is in progress to refine the model.

Paper-[8]

Topic:

Solar chimney-A passive strategy for natural ventilation

Significance:

Solar chimney is an excellent passive ventilation system which relies on natural driving force.

Methodology :

Numerical calculation

CFD software

Innovation:

Open ended vertical channel geometry, vertical chimney attached to the building and inclined chimney have been the major design configurations used for most of the solar chimney studies.

Conclusion :

Despite the continuous research on solar chimney over an extended period, there are contradictory claims reported in the literature, which indicates that solar chimney as a ventilation strategy has not been fully understood and needs further research attention.

Paper-[9]

Topic:

Solar chimney and building ventilation

Significance:

The prospect of global warming has induced architects and building engineers to search for ways of heating, cooling and ventilating buildings by passive means rather than energy-consuming mechanical devices.

Methodology :

Climate studied

Calculation procedure

Turbulence model

Innovation:

The optimum slope-angle for maximum flow is 67.5° from the horizontal, giving an average benefit of 11% increase in flowrate in comparison with that for a vertical chimney.

Conclusion :

The roof angles less than 23° from the horizontal, the effect of wind always is to increase the stack suction pressure.

Paper-[10]

Topic:

Optimizing energy performance of a ventilated composite Trombe wall in an office building

Significance:

Building energy saving design.

Indoor climatecontrols that regulate humidity and temperature to provide thermal comfort and indoor air quality.

Methodology：

Office building description

Description of the composite Trombe wall for studying

Software, weather and location

Innovation:

The ventilated composite Trombe wall efficiency is not only related to outdoor air temperature, but it is also affected by the solar radiation.

Conclusion：

These investigations revealed that the building with ventilated composite Trombe wall in Kitakyushu, Fukuoka, Japan, by using solar energy may save around 3.7% of the energy cost during heating compared to the building with non-ventilated composite Trombe wall.

Paper-[11]

Topic:

Ventilation potential of an absorber-partitioned air channel solar chimney for diurnal use under Mexican climate conditions

Significance:

The demand for the conditioning of building indoor spaces is one of the factors that influence energy consumption in Mexico since 65% of its territory has warm weather. Therefore, within the strategies to reduce the energy consumption of this country, it is necessary to improve the energy performance of residential and non-residential buildings.

Methodology :

Physical model

Mathematical model for the channels

Weather data

Numerical procedure and validation

Innovation:

Hourly climatic data from the coldest and the warmest days of each month of 2014 were used to assess the behavior of the solar chimney in Mérida, México. A numerical code based on the Finite Volume Method was developed to evaluate the ventilation potential of the solar chimney.

Conclusion :

Under the worst conditions of the year, the solar chimney extracted an average mass flow rate of 0.0832 kg/s. The values comply with the requirements recommended by ASHRAE.

Paper-[12]

Topic:

Ventilation impact of a solar chimney on indoor temperature fluctuation and air change in a school building

Significance:

Investigate, experimentally, both the feasibility of a solar chimney to reduce heat gain in a house by inducing natural ventilation and the effect of openings (door, window and inlet of solar chimney) on the ventilation rate.

Methodology :

Experimentation started at 9 AM and ended at 5 PM by recording data at 30-min intervals.

Innovation:

Four configurations of solar chimney, each with approximately 2 m^2 of surface area, were built by using common construction materials: The Roof Solar Collector (RSC), the Modified Trombe (MTW), the Trombe Wall (TW) and the Metallic Solar Wall (MSW).

Conclusion：

The temperature difference between average room temperature and ambient, by about 50%; Room temperature was about 2–3°C above ambient.

Paper-[13]

Topic:

Performance of a solar chimney

Significance:

Passive cooling plays an important role in providing a thermally suitable environment for human comfort in under-developed countries by providing natural ventilation in dwellings.

Methodology：

Mathematical model

Experimental investigation

Innovation:

Present a mathematical model to simulate the thermal performance of a solar chimney by predicting the surface temperatures of the wall and glass cover and the temperature and induced natural convection flow rate of the air stream in the chimney.

Conclusion：

More satisfactory qualitative agreement was obtained between experimental and theoretical results for air flow and air temperature rise for the larger air gap of 0.3 m between radiation intensity values from 200 to 650 W m^{-2}. No reverse flow was observed up to 0.3 m gap.

Paper-[14]

Topic:

A study of solar chimney assisted wind tower system for natural ventilation in buildings

Significance:

The concept of a solar chimney coupled with a wind tower to induce natural ventilation has been studied analytically in this paper. It is estimated that the effect of a solar chimney is relatively much higher for lower wind speeds.

Methodology :

Experiment

Mathematical calculations

Innovation:

For ambient wind speed of 1.0 m/s the wind tower alone creates a mass flow rate of 0.75 kg/s only, while the solar chimney assisted system is able to create an airflow up to 1.4 kg/s at 700 W/m^2 incident solar radiation.

Conclusion :

A solar chimney in combination with a wind tower creates an interesting system for integration in a building to provide natural ventilation. Such a system provides ventilation for variable wind speeds with a collector area of 3.0 m^2.

Paper-[15]

Topic:

A numerical study of solar chimney for natural ventilation of buildings with heat recovery

Significance:

Solar chimneys are used to enhance air movement in naturally-ventilated buildings.

Methodology :

CFD technique

Numerical study of a glazed chimney

Innovation:

The performance of a glazed solar chimney for heat recovery in naturally-ventilated buildings was investigated using the CFD technique.

Conclusion :

Single glazing is shown to be inadequate for solar chimneys due to possible condensation and downdraught in a cold winter. Even with double glazing, there still exist risks of condensation on the glass and downdraught in the chimney in a cold winter. Triple glazing for a solar chimney can reduce both risks of condensation and downdraught.

Paper-[16]

Topic:

An analytical and numerical study of solar chimney use for room natural ventilation

Significance:

The solar chimney is an effective practical way to enhance space natural ventilation. In most tropical countries, where it is almost very difficult for the majority to have an air conditioner, people rely on natural ventilation, instead, to achieve comfort through opening windows.

Methodology：

Mathematical analysis

Numerical analysis

Innovation:

The solar chimney concept used for improving room natural ventilation was analytically and numerically studied.

Conclusion：

The absorber average temperature could be correlated to the intensity as: (Tw = 3.51I^0.461) with an accepted range of approximation error. In addition the average air exit velocity was found to vary with the intensity as (Vex = 0.013I^0.4)

Paper-[17]

Topic:

Summer-performance of inclined roof solar chimney for natural ventilation

Significance:

During summer months, due to the higher altitude of sun, absorber at small inclination with the horizontal plane captures more solar radiation, but suffers with reduction in the stack height.

Methodology :

Mathematical modeling

Development of energy balance equation for glass, air, and absorber

Calculation of mass flow rate through the chimney

Experimental validation

Innovation:

Effect of inclination of absorber on the airflow rate has been investigated in a solar induced ventilation system using Roof Solar Chimney concept.

Conclusion :

The developed solution show that optimum absorber inclination varies from 40° to 60° depending upon the latitude of place. At Jaipur (India) 45° is found to be optimum for obtaining maximum rate of ventilation. At this inclination, the rate of ventilation is about 10% higher as compared to 60° and 30° inclinations.

Paper-[18]

Topic:

Experimental investigations on solar chimney for room ventilation

Significance:

This concept can be applied in buildings located in hot climatic conditions because windows are usually kept closed during the sunshine hours to avoid direct heat gain in the building envelope.

Methodology :

Mathematical modeling

Innovation:

In the present paper, attempts have been made to explore feasibility of improved ventilation using a chimney of smaller size, which can be embedded in a regular window without major structural changes.

Conclusion :

There is a potential of inducing ventilation corresponding to 55–150 m3/h airflow rate for 300–700 W/m2 solar radiation incident on the vertical surface. This rate is corresponding to 2–5.6 air changes per hour for a typical room of 27 m^3 volume.

Paper-[19]

Topic:

Air flow and thermal efficiency characteristics in solar chimneys and Trombe Walls

Significance:

Investigation into heat transfer and mass flow in thermos phoning air heaters, such as solar chimneys and Trombe Walls.

Methodology：

Experimental

Innovation:

Close control of the heat input was achieved by using an electrical heating mat—steady-state heat inputs ranged from 200 to 1000 W, and the channel depth was varied between 20 and 110 mm. Temperatures were recorded throughout the test rig, as was the air velocity.

Conclusion：

The data from this investigation yield some insights into the performance of solar chimneys and passive solar collectors, by varying the heat input and channel depth in a test rig resembling a passive solar collector, approximately 1 m^2.

Paper-[20]

Topic:

Natural ventilation performance of a double-skin facade with a solar chimney

Significance:

In order to reduce the global environmental damage and pursue the high-quality indoor conditions of the office building, the facade (glass window) provides weather protection, improves sound insulation and resists external noise. Adjustable sunshade devices, such

as blinds, are typically installed in the intermediate space to protect the interior from high cooling loads caused by insulation.

Methodology：

Prototype building

Model experiments

Numerical modeling

Comparison of CFD and experimental results

Innovation:

Comparing with conventional double-skin facades, a thermal storage space called solar chimney is set up above the double-skin space to enhance stack effect in the intermediate space, and thus to ensure stable natural ventilation performance throughout the building even without encouragement of wind.

Conclusion：

Increasing the height of the solar chimney makes more ventilation rate and also is profitable to obtain favorable pressure difference distribution. As there are always limitations on the acceptable height of the solar chimney, the solar chimney is recommended to be more than two-floor high.

Paper-[21]

Topic:

Simulation of buoyancy-induced flow in open cavities for natural ventilation

Significance:

Solar heated open cavities including solar chimneys and double facades were studied for enhancing natural ventilation of buildings.

Methodology：

CFD

Innovation:

It was found that there existed an optimum cavity width for maximizing the buoyancy-induced flow rate and the optimum width was between 0.55 and 0.6 m for a solar chimney of 6 m high. The ventilation rate in a double facade of four-storeys high generally increased with cavity width but decreased with floor level from bottom to top.

Conclusion :

The numerical simulation has shown that the ventilation rate generated by buoyancy in open cavities, such as solar chimneys and double façades increases with solar heat gains.

Paper-[22]

Topic:

Modeling of window-sized solar chimneys for ventilation

Significance:

Ventilation is one of the important options in providing thermal comfort in buildings. A solar chimney is one of the several available options for achieving natural ventilation in building through solar-induced air movement of air.

Methodology :

Mathematical modeling

Solution of equations

Observations and results

Innovation:

The small size of the analyzed solar chimney has opened possibilities of utilizing windows as solar chimneys since the flow velocity upto 0.24 m/s has been experimentally recorded.

Conclusion :

Hot climatic conditions, when windows are kept closed/covered for preventing the entry of solar heat, the concept of solar chimney can be utilized by making minor modifications in the existing window design.

Paper-[23]

Topic:

Experimental study for natural ventilation on a solar chimney

Significance:

Solar chimneys are passive devices that may fit the construction, but they must be installed properly so that solar radiation should impinge the absorber plate without any shade in order to produce enough natural ventilation.

Methodology :

Experiment

Innovation:

It was observed that the air flow rate through the solar chimney is influenced by a pressure difference between input and output, caused by thermal gradients and wind velocity, mainly.

Conclusion :

A maximum air temperature increment of 7.0 °C was obtained through the system for a maximum irradiance of 604 W/m^2 occurring around 13:00 h. Values of 50–374 m^3/h were obtained for a typical day of September 15th 2007. An average air flow rate of 177 m^3/h was obtained from 0:00 h to 24:00 h.

Paper-[24]

Topic:

Theoretical evaluation of the influence of geometric parameters and materials on the behavior of the airflow in a solar chimney

Significance:

The conservation and transport equations that describe the flow were modeled and solved numerically using the finite volumes technique in generalized coordinates.

Methodology :

Mathematical model

Experiment

numerical methodology validation

Innovation:

Flow energy can be converted into mechanical energy in one or more turbines placed at the base of the tower and into electric energy in conventional generators.

Conclusion :

Analysis showed that the height and diameter of the tower are the most important physical variables for solar chimney design.

Paper-[25]

Topic:

Modeling of the optimum tilt of a solar chimney for maximum air flow

Significance:

Optimum tilt of a solar chimney for maximizing air flow starting from data of daily total solar irradiation on a horizontal plane

Methodology：

CFD

Experiment

Innovation:

Develop a mathematical model to determine the tilt that maximizes natural air flow inside a solar chimney using daily solar irradiance data on a horizontal plane at a site.

Conclusion：

A composite engineering model is developed that estimates the tilt of a solar chimney that yields the largest natural air flow through it.

Paper-[26]

Topic:

A review for the applications of solar chimneys in buildings

Significance:

In this paper, the main configurations and the integrated renewable energy systems based on solar chimneys were summarized. Then the suggestions were given.

Methodology：

Summary of literature

Innovation:

Solar chimney technology has been regarded as an effective and economical design method in low carbon buildings.

Conclusion：

It has been testified that solar chimney technology is a very suitable system for regions where solar irradiation is high and wind speed is normally low. In the hot and humid climate, stack ventilation is inefficient due to small temperature difference between the inside and outside of naturally ventilated buildings.

Paper-[27]

Topic:

The effect of solar chimney layout on ventilation rate in buildings

Significance:

The layout of solar chimney in different parts of the building affects the ventilation rate and performance of solar chimney due to its effect on air flow rate.

Methodology :

Energy plus software

Innovation:

This research examines the performance of solar chimney based on its layout in southern, west-southern and east-southern part of the building. Then, the performance of solar chimney is compared in the plan center and southern façade-connect part.

Conclusion :

The results show that locating solar chimney in east-southern part of the building provides maximum ventilation rate due to the maximum radiation and two side absorbing wall. It was also found that every solar chimney provides necessary ventilation rate for spaces attached to it.

Paper-[28]

Topic:

Twenty-four-hour simulation of solar chimneys

Significance:

A model for calculating the airflow rate and the temperatures of the three main components of the solar chimney during an entire day is developed. The model uses a transient thermal analysis of a solar chimney with comprehensive spectral radiative properties of cover glass and a stack effect/convection correlation.

Methodology :

Calculation Simulation

Innovation:

A model for time dependent analysis of solar chimneys is presented. The energy balance equations for three components of solar chimneys, absorbing plate, cover glass and air-gap are discretized with respect to time using an implicit finite difference model.

Conclusion :

It is demonstrated that an increase in the thermal mass of the absorbing plate results in a greater airflow rate during evening and early morning hours, when the solar irradiance does not exist or is weak. The increase in thermal mass of the absorbing plate results in smaller variation of airflow rate.

Paper-[29]

Topic:

Design, Development of a Solar Chimney with Built-in Latent Heat Storage Material for Natural Ventilation

Significance:

Description of the fabricated prototype solar chimney with PCM storage, thermal analysis to predict the air flow rate, and temperatures of the component of the system with experimental results are presented.

Methodology :

EXPERIMENTAL

Innovation:

A prototype of a solar chimney with a built-in latent heat storage system for prolonging ventilation system operation until evening/night or even 24 hours was designed and developed.

Conclusion :

Integration of PCM storage inside the solar chimney is positive and it can supply the nearly constant average airflow rate of 155 m3/h (air gap = 0.20 m, inclination angle = 45 degrees) in evening and night if PCM completely melted in the day. The prototype solar chimney is capable of providing an average airflow rate of nearly 200 m3/h (air gap = 0.20 m, and inclination angle = 45 degrees) in daytime (6:00 to 17:00). It was also observed that PCM does not melt under the solar radiation of 325W/m2.

Paper-[30]

Topic:

A Simulation of the Thermal Performance of a Small Solar Chimney Already Installed in a Building

Significance:

The study of these passive systems has been intensified due to economical and practical new designs that may result if they are planned before a building is constructed.

Methodology：

Theoretical Analysis

Verification

Innovation:

In this paper, we present a theoretical study of a small solar chimney. The dimensions of the solar chimney channel are 1.95 m high, 1.70 m wide, and 0.24 m deep.

Conclusion：

When solar irradiance increases from 100 to 700 W/m2, the maximum instantaneous efficiency of the system varies from 28% to 37%, and also, the volumetric flow rate increases from 61 to 147 m3/h.

Paper-[31]

Topic:

Determining the influencing factors on the performance of solar chimney in buildings

Significance:

Solar chimney as a reliable renewable energy system has been largely utilized in buildings under the fact of serious environment problem and energy crises with the continued exploitation and overuse of fossil energy. This is because buildings can consume about 42% annual energy usage of the whole world, mainly for heating, cooling, providing electricity and air conditioning.

Methodology：

Mathematical models

Literature

Innovation:

To enhance the performance, a solar chimney is suggested with possible high cavity and solar radiation, a cavity gap of 0.2–0.3 m, equal inlet and outlet, a height/gap ratio of around 10, an inclination angle of 45–60° (for roof solar chimney considering latitude), an appropriate opening of room, double/triple glazing, a 5cm thick insulation wall, and a solar absorber with larger absorptivity and emissivity. These optimum values may not be applicable to all configurations as they are interdependent.

Conclusion :

This paper reviewed the influences of four types of influencing factors on the performance of solar chimney, including configuration, installation conditions, material usages, and environment.

Paper-[32]

Topic:

Research for Ventilation Properties of Solar Chimney with Vertical Collector

Significance:

Modern buildings should maximize use of natural energy sources and reduce the consumption of non-renewable energy.

Methodology :

Theoretical analysis

Numerical simulation

Experimental Study

Innovation:

Theoretical research and numerical simulation for ventilation properties of solar chimney with vertical collector are performance and they are compared with experimental results.

Conclusion :

There are many factors to affect solar chimney ventilation that include heat collection height and width, solar radiation intensity, inlet and outlet area ratio of chimney and air inlet velocity, etc.

Paper-[33]

Topic:

Enhancement of natural ventilation in buildings using a thermal chimney

Significance:

As architects and engineers continue to search for better ways to improve both the indoor environmental quality and energy efficiency of buildings, cooling buildings using natural ventilation continues to be an approach that is considered highly desirable provided that enough air movement can be provided and that thermal conditions of the exterior environment can provide cooling.

Methodology :

Modeling

Implementation into EnergyPlus

Parametric Analysis

Innovation:

A new module was developed for and implemented in the EnergyPlus program for the simulation and determination of the energy impact of thermal chimneys. This paper describes the basic concepts, assumptions, and algorithms implemented into the EnergyPlus program to predict the performance of a thermal chimney.

Conclusion：

It turned out that significant building cooling energy saving can be achieved by properly employing thermal chimneys and that they have more potential for cooling than for heating. In addition, the performance of a thermal chimney was heavily dependent on the climate of the location.

Paper-[34]

Topic:

On a simple analytical model for solar chimneys

Significance:

In the past few years, the solar chimney technology has found widespread applications especially in areas such as crop drying and ventilation.

Methodology：

Math calculation

Innovation:

A simple analytical model is developed to predict the performance of a solar chimney system. The effect of various geometrical and operating parameters on the chimney performance is more easily understood by the analytical model.

Conclusion：

A set of differential equations is developed to analyse a solar chimney. This model is expected to be useful during optimization studies.

Paper-[35]

Topic:

Numerical study on thermal behaviours of a solar chimney incorporated with PCM

Significance:

To study that the thermal behaviors of a solar chimney incorporating with organic phase change material (PCM) RT-42 unit under different heat fluxes

Methodology：

Experimental

Numerical Model

Innovation:

Using high effective thermal conductivity when the heat flex lower than 500 W/m2

Conclusion：

The performance of the system deteriorates sharply once the heat flux is or lower than 500 W/m2, but not big improvement if the heat flux is higher than 700 W/m2.

Paper-[36]

Topic:

Achieving standard natural ventilation rate of dwellings in a hot-arid climate using solar chimney

Significance:

Solar chimney, in particular, is a promising alternative to enhance thermal and ventilation performance for the indoor environment by using convection of air heated by passive solar energy.

Methodology：

Mathematical model

Literature review

Numerical analysis

Experimental validation

Innovation:

To improve the performance of solar chimney during the daytime.

Conclusion：

The result shows an optimum air flow rate of 0.019–0.033 m3/s was achieved by 88.2% during the daytime when the dimensions of a proposed solar chimney are 45° inclination angle, 1.4 m length, 0.6 m width and 0.20 m air gap.

Paper-[37]

Topic:

Design and measured performance of a solar chimney for natural-circulation solar-energy dryers

Significance:

Design and construction of a solar chimney which was undertaken as part of a study on natural-circulation solar-energy dryers.

Methodology：

Experiment

Innovation:

The results obtained from the experimental solar chimney have illustrated that solar chimneys if designed properly can maintain chimney air temperatures consistently above the ambient temperature which would enhance the desired buoyancy-induced air flow through the chimney.

Conclusion：

Better performance was obtained with a solar radiation absorbing surface within the chimney.

Paper-[38]

Topic:

Air-conditioning system with underfloor air distribution integrated solar chimney in data centre

Significance:

Build an under-floor air-conditioning system with integrated solar chimney.

Methodology:

Numerical simulation

Experiment

Innovation:

Solar chimney is using to optimized the air-conditioning system the heat island effect impairs and the temperature of all compared points have a decline, which reached an average decline of about 4.4 ℃.

Conclusion：

The improve system can reduce energy consumption due to annual cooling.

Paper-[39]

Topic:

Mathematical analysis of the influence of the chimney height and collector area on the performance of a roof top solar chimney

Significance:

To determine the roof top behavior during the day time is essential for the proper designing and sizing

Methodology :

MATLAB

Innovation:

The analysis was carried out at various collector areas (15,150,600 m^2) and various chimney heights (5,10,15m) The system becomes functional for space ventilation when the solar intensity is higher than 400 W/m2 with a 15 m2 collector area and 5 m chimney height, under Malaysia and similar weather conditions. As the wind speed increases from 1.5 to 6 m/s, it contributes to reduce the system performance by 25% at solar intensity of 900 W/m2.

Conclusion:

The results demonstrated that the performance of the system highly influenced by the solar intensity.

Paper-[40]

Topic:

Numerical investigation of rectangular fin geometry effect on solar chimney

Significance:

The performance of solar chimney as a natural convection solar air heater with longitudinal rectangular fins is numerically investigated.

Methodology:

Numerical model

Innovation:

Mass flow rate, outlet temperature and thermal efficiency increase with growing solar radiation intensity. Ambient temperature has a significant impact on outlet temperature.

The increase of the ambient temperature increases outlet temperature and reduces mass flow rate.

Conclusion:

Solar chimney with longitudinal fins on the absorber has been studied numerically. The turbulent natural convection of air within a three-dimensional domain is solved with the finite volume method considering the radiation effect.

Paper-[41]

Topic:

Enhancement of natural ventilation in a solar house with a solar chimney and a solid adsorption cooling cavity

Significance:

To test can we get the better performance when the solar chimney and a solid adsorption cooling cavity are combined.

Methodology:

Experiment

Innovation:

Close the solid adsorption cooling cavity when low solar irradiance and temperature or using artificial solar radiation to make the solid adsorption cooling cavity can work as high solar radiation.

Conclusion:

The solar house with 2.5m solar chimney can create an airflow rate of more than 150kg/h, and the ventilation rate can increase about 20% with the solar adsorption cooling cavity.

Paper-[42]

Topic:

Technical feasibility assessment of a solar chimney for food drying

Significance:

Solar dryers use free and renewable energy sources, reduce drying losses (as compared to sun drying) and show lower operational costs than the artificial drying, thus presenting an interesting alternative to conventional dryers.

Methodology:

Experiment

Innovation:

The solar chimney is a device technically feasible for the drying of food, mainly grains. The performance of the solar chimney can be modified by equipping the device with the proposed improvements, in accordance with each farmer's specific needs.

Conclusion :

The constructed chimney generates a hot airflow with a yearly average rise in temperature (compared to the ambient air temperature) of 13 ± 1 °C. In the prototype, the yearly average mass flow was found to be 1.40 ± 0.08 kg/s, which allowed a drying capacity of approximately 440 kg.

Paper-[43]

Topic:

Experimental investigations on solar chimney for optimal heat collection to be utilized in organic Rankine cycle

Significance:

Solar ventilation systems via natural convection effect have been widely used to reduce heat gain in house over the past two decades.

Methodology:

Mathematical model

Experiment

Innovation:

The primary objective of this study was to propose an innovative approach for collecting the solar thermal energy from the concept of solar chimneys for electricity generation via organic Rankine cycles (ORCs).

Conclusion:

In a feasibility analysis of ORC application, the system provides to the buildings with 12 kW h/day of electricity, and the area of the collector required was 41.0 m2. The experimental results indicated that the proposed method is feasible for solar chimney provide acceptable quality and quantity of heat for ORC.

Paper-[44]

Topic:

Experimental analysis on use of thermal conductivity enhancers (TCEs) for solar chimney applications with energy storage layer

Significance:

The influences of thermal conductivity enhancers on heat transfer performance inside the phase change material during the melting and solidification processes for solar chimney application.

Methodology:

Experiment

Innovation:

Combine the performance of the SCS and HCS.

Conclusion:

For melting process, the efficiencies of VF, HF, HCS and SCS are 8%, 12%, 14.5% and 16% respectively for the decrease in the melting time with comparison to the pure PCM sample, and during the solidification process, the efficiencies are improving the solidification speed are 11%, 10%, 12% and 8% based on the pure PCM sample.

Paper-[45]

Topic:

Study on solar chimney used for room natural ventilation in Nanjing

Significance:

Methodology:

Mathematical models

Experimental validation

Innovation:

The rate of ventilation increases with increase of the ratio between height of absorber and gap between glass and absorber in Nanjing.

Conclusion:

45° is found to be optimum for obtaining maximum rate of ventilation in Nanjing.

Paper-[46]

Topic:

Solar heating—Ventilating system using a solar chimney

Significance:

Trombe wall collector has a major problem is the excessive heat losses from the wall, which is insulated from outside with only a double window.

Methodology：

Math Calculation

Innovation:

The objective of this study was to investigate the possibilities of reducing these excessive heat losses by separating the heat collector panel from the heat storage mass

Conclusion：

The results have been verified with the experimental studies obtained at the Solab, the Solar Research House of Ecole Polytechnique.

Paper-[47]

Topic:

Application of a Wall-Solar Chimney for Passive Ventilation of Dwellings

Significance:

To examine the effects of the wall-solar chimney on airflow distribution and thermal conditions in a room.

Methodology：

Numerical Methodology

CFD

Innovation:

This study also developed a new characteristic Rayleigh number relating the chimney inlet and width, which showed good consistency with the prediction of the flow regime. The investigations of Rayleigh number and the flow regime indicated that the flow becomes turbulent for 0.8x10^8.

Conclusion：

The wall-solar chimney system was investigated utilizing CFD with error 6.62% and also shows that using a three-dimensional model gave better results than that reported for two-dimensional modelling.

Paper-[48]

Topic:

Natural Ventilation Using Glazed Solar Chimney and Hot Water Collector Production

Significance:

The glazed solar chimney and hot water collector production can be proved the hot water for living use, also can increase the natural ventilation.

Methodology:

Experiment

Innovation:

Use filters to keep the water clean and also can increase the size of hot water collector.

Conclusion:

The indoor temperature of the GSC-HWC room was significantly less than the SG room. Also, the GSC-HWC is expected to promote the growth of solar energy usage; save energy in heating, cooling and ultimately help the environment.

Paper-[49]

Topic:

A study of the ventilation performance of a series of connected solar chimneys integrated with building

Significance:

In China, 30% of the total energy consumption is used for housing, in which the percentage of the heating, the ventilation, and the air conditioning is up to 50–60%. There have been many studies on the ventilation of solar chimney aiming at reducing the energy consumption.

Methodology：

Mathematical model

Computational results

Innovation:

A series of connected solar chimneys consisting of an inclined section on the roof and a vertical section near the south wall was studied in a typical two-floor house.

Conclusion：

With the increase of chimney inclined angle, the velocity distribution inside the chimney was improved and the air flow rate increased.

Paper-[50]

Topic:

Investigation on the application of solar chimney for multi-storey buildings

Significance:

Solar chimney combined with other solar chimney wall and roof configurations can induce high air ventilation rates, allowing the substitution of stagnant room air with fresh outside air for a healthy and comfortable interior environment and maintain indoor temperature at comfortable level, as natural ventilation does not use electrical energy, the proposed system is aimed at saving energy and environment.

Methodology:

Mathematical model

Experimental testing

Innovation:

Multi-storey solar chimney is an interesting option and could be applied for hot climate like in Thailand to save energy and environment.

Conclusion：

The comparison between the solar chimney model and common model demonstrated that multi-storey solar chimney is a good alternative and could be applied effectively. Room temperature of the solar chimney model was lower than the room temperature of the other model by about 4–5 °C.

Bibliography:

[1] Y. X. Su, F. N. Lei, and Y. F. Xue, "Modeling of natural ventilation in solar chimney and optimization of the channel profile by CFD method," in *Frontiers of Green Building, Materials and Civil Engineering Iii, Pts 1-3*, vol. 368-370, J. C. M. Kao, W. P. Sung, and R. Chen, Eds. (Applied Mechanics and Materials, 2013, pp. 549-553.

[2] A. Y. K. Tan and N. H. Wong, "Parameterization Studies of Solar Chimneys in the Tropics," *Energies,* vol. 6, no. 1, pp. 145-163, Jan 2013.

[3] L. S. Ling, M. M. Rahmanh, C. M. Chu, M. S. Bin Misaran, F. M. Tamiri, and Iop, "The effects of opening areas on solar chimney performance," in *International Conference on Materials Technology and Energy*, vol. 217(IOP Conference Series-Materials Science and Engineering, 2017.

[4] C. Afonso and A. Oliveira, "Solar chimneys: simulation and experiment," *Energy and Buildings,* vol. 32, no. 1, pp. 71-79, Jun 2000.

[5] N. K. Bansal, R. Mathur, and M. S. Bhandari, "SOLAR CHIMNEY FOR ENHANCED STACK VENTILATION," *Building and Environment,* vol. 28, no. 3, pp. 373-377, Jul 1993.

[6] Z. D. Chen, P. Bandopadhayay, J. Halldorsson, C. Byrjalsen, P. Heiselberg, and Y. Li, "An experimental investigation of a solar chimney model with uniform wall heat flux," *Building and Environment,* vol. 38, no. 7, pp. 893-906, Jul 2003.

[7] K. S. Ong, "A mathematical model of a solar chimney," *Renewable Energy,* vol. 28, no. 7, pp. 1047-1060, Jun 2003.

[8] R. Khanal and C. W. Lei, "Solar chimney-A passive strategy for natural ventilation," *Energy and Buildings,* vol. 43, no. 8, pp. 1811-1819, Aug 2011.

[9] D. J. Harris and N. Helwig, "Solar chimney and building ventilation," *Applied Energy,* vol. 84, no. 2, pp. 135-146, Feb 2007.

[10] Q. S. Ma, H. Fukuda, X. D. Wei, and A. Hariyadi, "Optimizing energy performance of a ventilated composite Trombe wall in an office building," *Renewable Energy,* vol. 134, pp. 1285-1294, Apr 2019.

[11] I. Zavala-Guillen *et al.*, "Ventilation potential of an absorber-partitioned air

channel solar chimney for diurnal use under Mexican climate conditions," *Applied Thermal Engineering,* vol. 149, pp. 807-821, Feb 2019.

[12] J. Khedari, B. Boonsri, and J. Hirunlabh, "Ventilation impact of a solar chimney on indoor temperature fluctuation and air change in a school building," *Energy and Buildings,* vol. 32, no. 1, pp. 89-93, Jun 2000.

[13] K. S. Ong and C. C. Chow, "Performance of a solar chimney," *Solar Energy,* vol. 74, no. 1, pp. 1-17, 2003.

[14] N. K. Bansal, R. Mathur, and M. S. Bhandari, "A STUDY OF SOLAR CHIMNEY ASSISTED WIND TOWER SYSTEM FOR NATURAL VENTILATION IN BUILDINGS," *Building and Environment,* vol. 29, no. 4, pp. 495-500, Oct 1994.

[15] G. Gan and S. B. Riffat, "A numerical study of solar chimney for natural ventilation of buildings with heat recovery," *Applied Thermal Engineering,* vol. 18, no. 12, pp. 1171-1187, Dec 1998.

[16] R. Bassiouny and N. S. A. Koura, "An analytical and numerical study of solar chimney use for room natural ventilation," *Energy and Buildings,* vol. 40, no. 5, pp. 865-873, 2008.

[17] J. Mathur, S. Mathur, and Anupma, "Summer-performance of inclined roof solar chimney for natural ventilation," *Energy and Buildings,* vol. 38, no. 10, pp. 1156-1163, Oct 2006.

[18] J. Mathur, N. K. Bansal, S. Mathur, M. Jain, and Anupma, "Experimental investigations on solar chimney for room ventilation," *Solar Energy,* vol. 80, no. 8, pp. 927-935, 2006.

[19] S. A. M. Burek and A. Habeb, "Air flow and thermal efficiency characteristics in solar chimneys and Trombe Walls," *Energy and Buildings,* vol. 39, no. 2, pp. 128-135, Feb 2007.

[20] W. T. Ding, Y. J. Hasemi, and T. Yamada, "Natural ventilation performance of a double-skin facade with a solar chimney," *Energy and Buildings,* vol. 37, no. 4, pp. 411-418, Apr 2005.

[21] G. H. Gan, "Simulation of buoyancy-induced flow in open cavities for natural ventilation," *Energy and Buildings,* vol. 38, no. 5, pp. 410-420, May 2006.

[22] N. K. Bansal, J. Mathur, S. Mathur, and M. Jain, "Modeling of window-sized

solar chimneys for ventilation," *Building and Environment,* vol. 40, no. 10, pp. 1302-1308, Oct 2005.

[23] J. Arce, M. J. Jimenez, J. D. Guzman, M. R. Heras, G. Alvarez, and J. Xaman, "Experimental study for natural ventilation on a solar chimney," *Renewable Energy,* vol. 34, no. 12, pp. 2928-2934, Dec 2009.

[24] C. B. Maia, A. G. Ferreira, R. M. Valle, and M. F. B. Cortez, "Theoretical evaluation of the influence of geometric parameters and materials on the behavior of the airflow in a solar chimney," *Computers & Fluids,* vol. 38, no. 3, pp. 625-636, Mar 2009.

[25] E. P. Sakonidou, T. D. Karapantsios, A. I. Balouktsis, and D. Chassapis, "Modeling of the optimum tilt of a solar chimney for maximum air flow," *Solar Energy,* vol. 82, no. 1, pp. 80-94, 2008.

[26] X. Q. Zhai, Z. P. Song, and R. Z. Wang, "A review for the applications of solar chimneys in buildings," *Renewable & Sustainable Energy Reviews,* vol. 15, no. 8, pp. 3757-3767, Oct 2011.

[27] S. Asadi, M. Fakhari, R. Fayaz, and A. Mandaviparsa, "The effect of solar chimney layout on ventilation rate in buildings," *Energy and Buildings,* vol. 123, pp. 71-78, Jul 2016.

[28] M. H. Naraghi and S. Blanchard, "Twenty-four hour simulation of solar chimneys," *Energy and Buildings,* vol. 94, pp. 218-226, May 2015.

[29] S. D. Sharma, H. Kotani, Y. Kaneko, T. Yamanaka, and K. Sagara, "Design, development of a solar chimney with built-in latent heat storage material for natural ventilation," *International Journal of Green Energy,* vol. 4, no. 3, pp. 313-324, May-Jun 2007.

[30] J. Arce, J. P. Xaman, G. Alvarez, M. J. Jimenez, R. Enriquez, and M. R. Heras, "A Simulation of the Thermal Performance of a Small Solar Chimney Already Installed in a Building," *Journal of Solar Energy Engineering-Transactions of the Asme,* vol. 135, no. 1, Feb 2013.

[31] L. Shi, G. M. Zhang, W. Yang, D. M. Huang, X. D. Cheng, and S. Setunge, "Determining the influencing factors on the performance of solar chimney in buildings," *Renewable & Sustainable Energy Reviews,* vol. 88, pp. 223-238, May 2018.

[32] Y. Zhou, G. E. Jing, X. H. Liu, and Q. L. Li, "Research for Ventilation Properties

of Solar Chimney with Vertical Collector," in *2011 2nd International Conference on Challenges in Environmental Science and Computer Engineering*, vol. 11, Q. Zhou, Ed. (Procedia Environmental Sciences, 2011, pp. 1072-1077.

[33] K. H. Lee and R. K. Strand, "Enhancement of natural ventilation in buildings using a thermal chimney," *Energy and Buildings,* vol. 41, no. 6, pp. 615-621, Jun 2009.

[34] M. M. Padki and S. A. Sherif, "On a simple analytical model for solar chimneys," *International Journal of Energy Research,* vol. 23, no. 4, pp. 345-349, Mar 1999.

[35] Y. C. Li and S. L. Liu, "Numerical study on thermal behaviors of a solar chimney incorporated with PCM," *Energy and Buildings,* vol. 80, pp. 406-414, Sep 2014.

[36] A. A. Saleem, M. Bady, S. Ookawara, and A. K. Abdel-Rahman, "Achieving standard natural ventilation rate of dwellings in a hot-arid climate using solar chimney," *Energy and Buildings,* vol. 133, pp. 360-370, Dec 2016.

[37] O. V. Ekechukwu and B. Norton, "Design and measured performance of a solar chimney for natural-circulation solar-energy dryers," *Renewable Energy,* vol. 10, no. 1, pp. 81-90, Jan 1997.

[38] Y. Gao, J. X. Liu, X. L. Yuan, K. Zhang, Y. J. Yang, and Y. Wang, "Air-conditioning system with underfloor air distribution integrated solar chimney in data center," in *10th International Symposium on Heating, Ventilation and Air Conditioning, Ishvac2017*, vol. 205, P. Cui, J. Liu, and W. Zhang, Eds. (Procedia Engineering, 2017, pp. 3420-3427.

[39] H. H. Al-Kayiem, K. V. Sreejaya, and S. Gilani, "Mathematical analysis of the influence of the chimney height and collector area on the performance of a roof top solar chimney," *Energy and Buildings,* vol. 68, pp. 305-311, Jan 2014.

[40] S. S. Hosseini, A. Ramiar, and A. A. Ranjbar, "Numerical investigation of rectangular fin geometry effect on solar chimney," *Energy and Buildings,* vol. 155, pp. 296-307, Nov 2017.

[41] Y. J. Dai, K. Sumathy, R. Z. Wang, and Y. G. Li, "Enhancement of natural ventilation in a solar house with a solar chimney and a solid adsorption

cooling cavity," *Solar Energy,* vol. 74, no. 1, pp. 65-75, 2003.

[42] A. G. Ferreira, C. B. Maia, M. F. B. Cortez, and R. M. Valle, "Technical feasibility assessment of a solar chimney for food drying," *Solar Energy,* vol. 82, no. 3, pp. 198-205, 2008.

[43] D. S. Lee, T. C. Hung, J. R. Lin, and J. Zhao, "Experimental investigations on solar chimney for optimal heat collection to be utilized in organic Rankine cycle," *Applied Energy,* vol. 154, pp. 651-662, Sep 2015.

[44] Y. C. Li, S. L. Liu, and A. Shukla, "Experimental analysis on use of thermal conductivity enhancers (TCEs) for solar chimney applications with energy storage layer," *Energy and Buildings,* vol. 116, pp. 35-44, Mar 2016.

[45] J. L. Xu and W. H. Liu, "Study on solar chimney used for room natural ventilation in Nanjing," *Energy and Buildings,* vol. 66, pp. 467-469, Nov 2013.

[46] E. Bilgen and M. Chaaban, "SOLAR HEATING - VENTILATING SYSTEM USING A SOLAR CHIMNEY," *Solar Energy,* vol. 28, no. 3, pp. 227-233, 1982.

[47] D. Park and F. Battaglia, "Application of a Wall-Solar Chimney for Passive Ventilation of Dwellings," *Journal of Solar Energy Engineering-Transactions of the Asme,* vol. 137, no. 6, Dec 2015.

[48] P. Chantawong, "Natural Ventilation Using Glazed Solar Chimney and Hot Water Collector Production," in *2017 International Conference on Alternative Energy in Developing Countries and Emerging Economies*, vol. 138, J. Waewsak, K. Sangkharak, S. Othong, and Y. Gagnon, Eds. (Energy Procedia, 2017, pp. 26-31.

[49] W. Du, Q. R. Yang, and F. C. Zhang, "A study of the ventilation performance of a series of connected solar chimneys integrated with building," *Renewable Energy,* vol. 36, no. 1, pp. 265-271, Jan 2011.

[50] S. Punyasompun, J. Hirunlabh, J. Khedari, and B. Zeghmati, "Investigation on the application of solar chimney for multi-storey buildings," *Renewable Energy,* vol. 34, no. 12, pp. 2545-2561, Dec 2009.