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A Review of Ventilation System Performance under Natural Convection

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ABSTRACT

*This paper seeks to gift a panorama of cooling connected analysis in office buildings, categorising reportable analysis experiences from the past ten years, so as to spot information gaps and define current ways and trends for more exploration. The overall goal behind this analysis is to support the planning of property office buildings in hot climates through examination of past experiences, so the paper focuses on methods at the building level and specially connected with façade style peer reviewed journal articles were chosen because the supply for the study, given the responsibleness of the data revealed below peer-review processes. Considering printed papers from 2008 onwards. The resulting article info was then explored through descriptive analysis and in- depth review of some articles to expand on specific topics so as to completely visualize scientific interest and tendencies inside the field of study for the last ten years. As results of the review it's potential to state the high current connection of cooling analysis, having old a rise of publications below different climate contexts and varied topics starting from passive to solar cooling, that is seen as an enquiry field on its own. Also, in terms of analysis strategies, package simulations appear to be the first tool for cooling analysis, that is smart for performance driven developments. On the opposite hand, the most information gaps identified are the requirement for specific analysis relating to potentialities for application and field of study integration of cooling systems. The shortage of articles addressing some specific cooling methods, like the employment of state change and ground cooling; and also the want for additional data about the operation of cooling systems, particularly taking users' perception and their behavior under consideration.***

KEYWORDS

Passive Cooling, Simulation, Natural Ventilation, Solar Chimney, Thermal Comfort.

1.1INTRODUCTION

There is global concern over climate change caused by emissions of gases from human activity, such as the various production processes in industrial plants, power electrical generation in power plants, construction and fossil fuel consumption around the world. According to internationally approved reports, the largest energy consumption occurs in the building sector and by 42% of total energy consumption in the world. Thus, carbon emissions Estimated at 33% as a result of this consumption. According to international standards by international organizations in heating, cooling and ventilation systems, the average energy consumption in buildings is estimated at 60% as shown in Figure (1). Thus, passive ventilation and cooling is an important contributor and has a major role in conserving energy, reducing dependence on other energy sources and reducing gas emissions. They are also efficient in providing good quality air and comfortable conditions in the indoor space. In addition, they are considered economical and provide ventilation with the use of solar energy.

"Ventilation can be defined as the supply and removal of air, to and from any space, in order to control the level of air contaminants, humidity or temperature within that space (American Society of Heating, Refrigerating and Air-conditioning Engineers [ASHRAE], 2001a **[2]**".

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This reduces the risk of environmental pollution due to the large consumption of energy. The solar chimney is one of the applications of negative ventilation effective in providing healthy and comfortable thermal conditions, which is an air channel based on the principle of buoyancy, where the solar energy is absorbed after the energy is released to the air to create currents Indoor air.The importance of the solar chimney has increased in recent years as a result of the great benefits compared to mechanical ventilation in terms of energy saving and economic cost in addition to environmental effect.

Renewable energy can contribute to cooling and heating loads through the use of solar energy. It is also important in reducing economic problems and the risks of environmental pollution and thus it is an effective method compared to cooling and mechanical ventilation.The most prominent of these applications for renewable energy is the solar chimney mentioned above, which works to increase airflow and provide appropriate ventilation requirements in buildings.

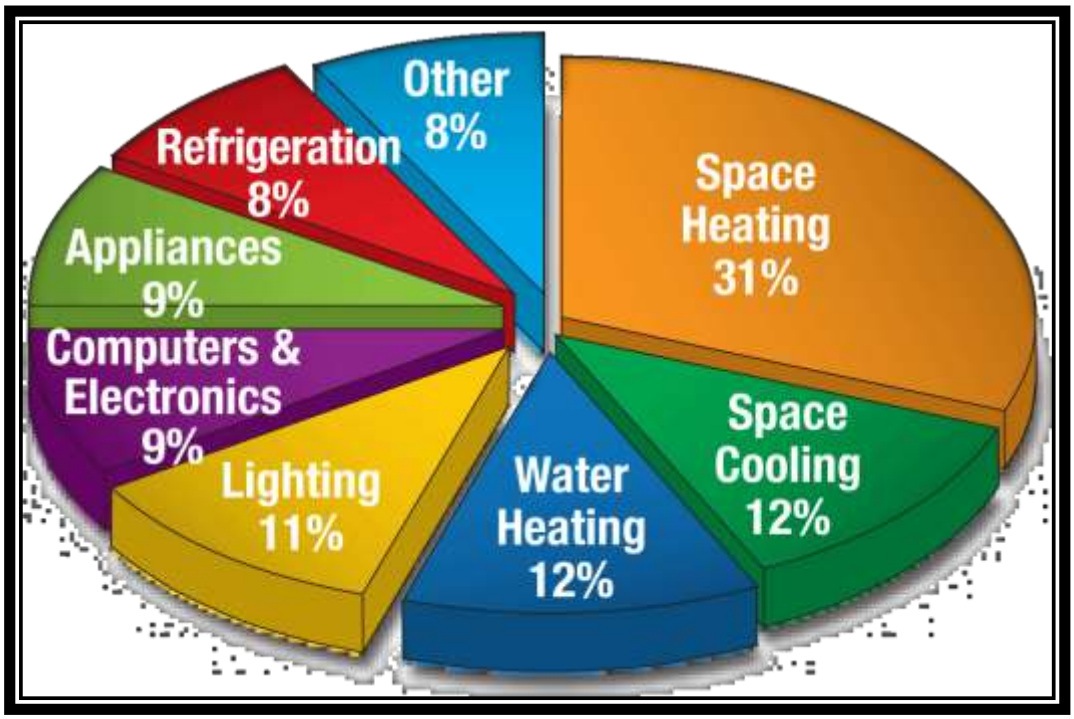

Fig:1 Energy utilization by various applications in buildings [1]

1.2 PASSIVE COOLING:VENTILATION AND SOLAR CONTROL.

There are obviously two main sub fields with passive cooling analysis: research about solar control methods (shading, glazing and building orientation), and analysis of ventilation methods (single-sided and cross ventilation, buoyancy impact and nocturnal ventilation). There are substantial data and specialized interest in these areas to identify them as specific and differentiated analysis fields.

1.3SOLAR CHIMNEY

A chimney is a particular installation consisting of walls, as well as external openings to the atmosphere and internal openings connected to the building used to to extract hot gas or smoke into the atmosphere due to the difference in temperature between the internal space of the building and the chimney caused by an external source,resulting in air circulation and Provide Suitable natural ventilation.

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Solar chimneys different from ordinary conventional chimneys. They consist of Opaque walls except for one wall that is transparent allowing solar radiation to enter the chimney, which will be absorbed by the absorbent board which has a high capacity to absorb solar radiation and thus will heat the air inside the solar chimney as a result of heat transfer. The natural load of the absorbent board to the air which in turn will move out of the building.Where it is replaced by another fresh air through the windows and other openings, which leads to the rotation of air inside the space causing a natural ventilation of the space accompanied by a drop in temperature. Evaporative cooling can be used indirectly in cooling and negative ventilation by using wet pads or spray water at entry slots.

A solar chimney could be a natural-draft device that employs solar radiation to move air upward, so changing alternative energy (heat) into mechanical energy (motion) of air. At a constant pressure, air density, lowering with increasing temperature. It means air with higher temperatures than close air is driven air upwards by the buoyancy force. A solar chimney exploits this physical Development and uses alternative energy to heat air. Therefore, the solar chimney needs to absorbent panel; a surface manufactured from a material that absorbs radiation, and that permits solar heat to be transmitted to the air by means that of natural convection. The first common formations of solar chimneys are those utilizing the "greenhouse" impact- air cavities with a transparent material (glass) on one facet of the cavity and a solar absorbent on the opposite side. These solar chimneys are very the same as solar air collectors.

1.4 THE PRINCIPLE OF SOLAR CHIMNEY

It is one of the modern technologies that rely on solar energy. The solar chimney is economical and inexpensive. It depends on the principle of buoyancy. Radiation on the radiation-absorbing plate increases the heat of air in the solar chimney as a result of global warming. The hot air rises to the top, which can rotate the air inside the space. The Trump wall can be used as a solar chimney and as shown in Figure (2).The solar chimney has advantages including:-

1 - No mechanical parts so need low maintenance.

2 - No electricity consumption is dependent on solar energy.

3. There is no environmental risk of no pollution.

4. Can be used for heating and cooling.

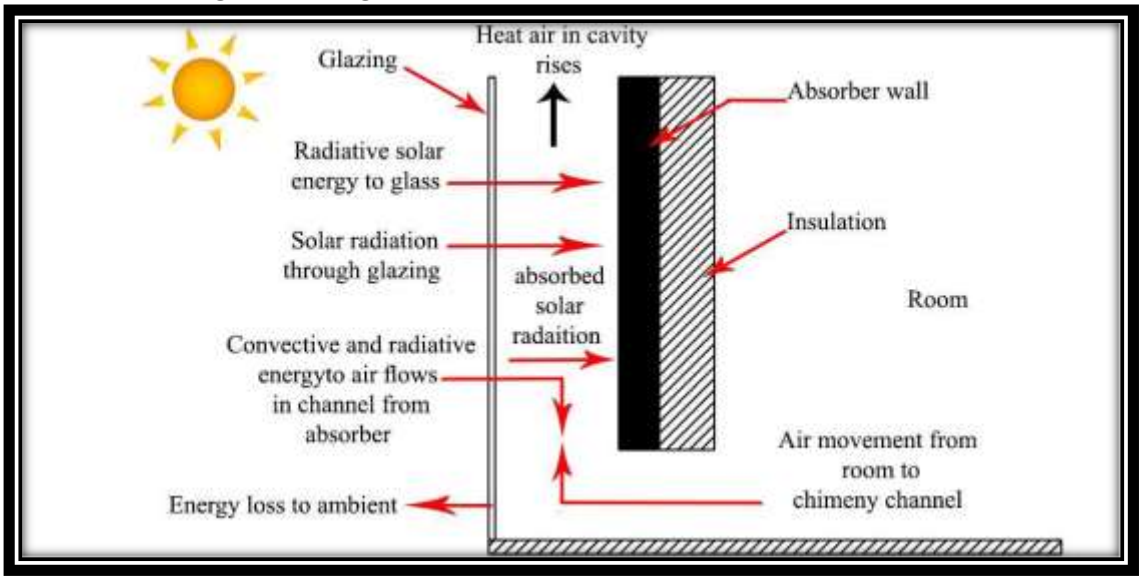

Fig:2Operation of solar chimney[6]

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1.5 METHODOLOGY.

Through the previous studies reviewed, there are many engineering parameters that are reliable and are studied by researchers to highlight their impact on the thermal performance of the solar chimney.

The density of solar radiation is the most widely used parameter of the researchers and that increased solar radiation leads to a higher temperature and wind velocity within the chimney. The interior conditions are thermally comfortable during low solar radiation. In tropical areas, the amount of solar radiation is constant during the afternoon.

The solar chimney angle is another parameter that affects the performance of the solar chimney and ventilation rate. The angle of the solar chimney angle varies from completely horizontal to completely vertical, which is widely used in buildings. We can get the best angle of inclination for the solar chimney whenever solar radiation is perpendicular to the solar chimney and thus exposure to the largest amount of solar radiation.

Anther parameter is the depth of the chimney. Through previous studies, the air velocity is proved to be slow and the friction losses are significant when the depth of the chimney is small due to the intersection of the thermal boundary with each other and as a result affects the performance of the chimney.

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Other parameters used in studies are widely explored by researchers to dimension chimney length and width of the chimney. The results obtained showed that the width of the chimney has a significant effect on the performance of the thermal flue and the provision of suitable thermal conditions.

1.6 LITERATURE REVIEW.

The solar chimney is one of the modern technologies used to save energy and reduce excessive consumption by taking advantage of renewable energies (solar energy). Natural ventilation using a solar chimney has become one of the best ways to save energy in the building sector. Since the last two decades studies have been going on to perform solar chimneys for models carried out on various mathematical applications.When reviewing these studies we find that most of the research uses the simulation system to support the experimental results and this indicates that the simulation method of the results is important for predicting and understanding the complex behavior of the solar chimney. The mathematical models are using many mathematical equations and thermal (standard equations of heat balance) to arrive at more reliable results to predict the complex behavior of the solar chimney. The literature reviews which are provided include three types of reviews: Applications, Experimental Studies, and Mathematical Studies.

Literature scanning as per the previous work carried out by the researcher shows that solar chimney is the best way to ventilate the passive building, hence decreasing in temperature of the room and further decreasing the cooling load of a typical air conditioning used for the cooling purpose. Several of study and experimental work has been done to boost the performance of passive cooling and ventilation system.

Jun Lu et al.[3] studied Thermal air flow rate and storage capacity of a solar chimney combined with totally different PCMs are numerically studied through the nighttime. PCMs with phase alteration temperatures of 38°C, 44°C, 50°C, and 63°C are selected. Results proved that the maximum ventilation rate of 610 kg/m2 and maximum thermal storage of 4750 kJ/m2 are achieved at the phase change temperature of 38°C. Hence, Phase change period occurs at atemperature of 63°C, night ventilation doesn't occur under the similar conditions. The results reveal that a lower phase change temperature will increase the charge ability (and thus the discharge ability) of a solar chimney, since a higher phase change temperature require higher solar radiation intensity and lengthy charging time for a solar chimney.

Catherine Baxevanou et al.[4] presented study of two models of the solar chimney was carried out, where a test model was used(CFD) to reach the best performance of the solar chimney in order to provide a

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comfortable natural ventilation for occupants of the space. The detached Ordinates (DO) model is used for the falling radiation on the solar chimney as well as for activating the disturbance model k-w, also consideration given to the spectral properties of the materials used in the test. The design of the simplest solar chimney which has a single vent with ventilated chamber achieves the best performance. Average ventilation values obtained have been compared to analytical models. The two-dimensional simulation was used to determine the specific performance of the chimney. The results showed that the worst performance of the solar chimney gets in the back of June while the best performance is obtained in the morning and afternoon.

Jitendra Kumar et al.[5]studied a reduced scale chimney of horizontal and vertical design is modeled through CFD to analyze the development of natural ventilation. Two totally different parameters are thought of for current study viz. Outlet rate and Temperature of absorbent plate. Comparison between Vertical and Horizontal design has been done. Results showed that each design, vertical and horizontal are compared and it had been found that vertical chimney increased ventilation rate far better as compared to horizontalchimney the maximum amount as 275 % boost. Additionally, it had been found that Vertical solar Chimney increased air flow stream rate up to twenty two times.

BoubekeurDokkar et al.[6]presented study of energy savings and reduction of carbon dioxide emissions using different types of energy feeders for transmission and reception towers with mobile transmission stations. These stations are refilled in three different ways. The first method is to cool the plant using diesel fuel. In this way, the energy consumed is calculated by bills.Second method according to the method of net energy consumed (degree- days) for the process of sending and receiving and the third method the use of solar chimney and heat exchanger underground. The results showed the use of solar chimney lead to great energy saving.

TusharBhavsar et al.[7] conducted experimental study to use the negative approach in residential buildings and reduce energy consumption. In this paper, a wood room connected from one side to a solar chimney is used.The results show the maximum temperature difference between the room temperature and temperature of the solar chimney. Also, the solar chimney does not provide optimum discharge at cloudy times. To solve this problem, the following parameters are controlled :

- Inclination of absorber plate.
- Location of solar chimney.
- Absorbent panel material

M. A. Hosien et al.[8] presented a study of the performance of solar chimney with a mathematical model developed using the simulation system using several operating parameters. These parameters include: ambient temperature, wind speed, solar radiation, materials used in the solar chimney cover, as well as the dimensions of the chimney. The results showed that the use of a glass lid of the chimney achieves the highest flow rate leading to change in air hourly (ACH) is significant. Parameters (length, width, and air gap) significantly affect hourly air change (ACH).

Gehad M. Mekkwi et al.[9]conducted a numerical study on natural ventilation was carried out using a simulation system on a residential building in the city of Alexandria and evaluating the thermal performance of the solar chimney and the effect of the speed of ventilation. The results showed that the temperature inside the building decreased by 0.18°C and speed of the air increased by (50%).

NaciKalkan et al.[10] A numerical and analytical study was conducted to improve the thermal performance of the solar chimney in temperate and warm zones with the use of the simulation system. The study relied on the parameters of the direction of the chimney and the temperature and pressure of the buildings. Results showed the direction of solar radiation plays a large role in the temperature of the building.

Ahmed AbdeenSaleem et al.[11] Provide a mathematical test model to achieve the optimal design to achieve standard air rates using an oblique solar chimney at an angle (45°) under the climatic conditions of the city of Alexandria in Egypt. The results show that airflow increases by 88.2 % during the day. Dimensions of the chimney used (1.4*0.6*0.1) m.

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A. Al Touma et al.[12] studieddecrease the cooling loads in the spaces by lowering the window temperature and solar radiation entrance through the utilization of a passive evaporative cooler combined with a solar chimney and with no further energy consumption. Results showed reductions of 8% to 12% in the window temperatures were seen for an outdoor temperature of 30°C and radiation of 300 W/m^2 and for small chimney sizes.

SudapornSudprasert et al.[13] presented numerical study was conducted using the simulation system for digital models of the solar chimney to obtain the best performance for natural ventilation. Two models were used from one solar flue with wet air and humidity ratio (30-80%) while the second model operated with dry air. The results showed that the ventilation rate of the wet-air solar chimney was reduced by (15.4–26.2%) compared with the dry air solar chimney.

Dr. MajidHameedMajeed et al.[14] conducted an experimental investigation to solar chimney utilized as a heating .supply in Iraqi environmental condition has been done. Experimental room bound under a certain size (2.5 *1.29*1.07) m, the studying model source with a solar collector 40° tilt angle south facing. The results were taken through January and February at different positions in the test zone. The results proved that adopting walls towards sunlight can enhance the stored energy. Enhancement heat energy assists to make more motive force to flow rate air inside the supposed building.

MadhanAnand Kumar et al.[15] investigated experimentally and numerically using a model involve of an evaporative cooling opening (ECC) and a solar chimney (SC). The performance of the solar chimney model and the ability to cover people's thermal requirements and provide comfortable thermal conditions have been studied. Three different cooling pad materials such as Straw, Coconut coir, Cellulose. This result proved that the saturated efficiency at air velocity 0.1 m/s shows higher velocity at 47.5% for cellulose pads. It can be concluded performance depends upon the velocity of air passing during the pad.

Hussain H. Al-Kayiem et al.[16] conducted an experimentally study on three models of the solar chimney installed on the surface building using different designs to achieve the best performance of the system. Models operate under different operating conditions. The results showed that the 3 model, Which absorbs the largest amount of air, leads to an increase in performance (1.2-7.6%) compared to models 1 and 2.

Hussain H. Al-Kayiem et al.[17]investigated the experimental sides were carried out employing a rectangular duct comprising a flat plate-glass cover with the following dimensions: 2 m length, 0.07 m depth,0.48 m width. The measurements were done at inclination angles of 70°, 50°, and 30° to locate the optimum angle of the absorption-free convection mechanism. The optimum slope angle to achieve the better collector performance was found to be 50°.

Ahmed Abdulnabi Imran et al.[18]Presented experimental study and numerical study was used to obtain the best performance of the solar chimney under different geometric characteristics. A turbulent flux was used for natural convection. This flow was at different angles (15- 60)° and solar radiation (150-750) w/m^2 with a solar chimney with three air gap (50,100,150) mm. The results showed that the maximum ventilation rate occurs at the optimum inclination angle 60° at 750 w/m^2 intensity with 50 mm air gap.

Justin C.DeBlois et al.[19]Presented numerical study of the ventilation system with a solar chimney was provided to a primary school in Washington to provide a comfortable internal thermal environment. Several parameters were used to reach the optimal design approach using the airflow in the simulation system CFD and Energy Plus. High chimneys and openings that lead to higher working hours. The results showed the possibility of saving the consumed energy (HVAC) by 5% and up to 1200 hours of operation can be sufficient natural ventilation in the classroom.

John Kaiser Calautit et al.[20] presented a study to develop fluid dynamics for the improvement and development of wind towers. For the purpose of energy saving and air cooling, the heat transfer devices have been integrated. The results of the simulation proved that the external air speed (1-5) m /s and low air temperature 6 k. When the external wind speed is low (2-1) m/s, the air temperature is significantly reduced (9.5-12)k.

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Haghighi et al.[21] presented an analytical study on the possibility of the solar chimney was provided by provision comfortable thermal conditions for occupants of the space during winter days. A model connected to the cold outside environment was used. The results showed the ability of the solar chimney to provide adequate air conditioning even when the ambient temperature is up to 5°C and the intensity of solar radiation decreases to 215 W/m^2 .

Tan et al.[22] carried out a mathematical and an experimental study was conducted under different operational conditions to determine the performance of the solar chimney. The results showed that the temperature of the air and the speed in the classrooms and ducts of the solar chimney are not affected significantly by indoor convection, in addition to the speed of ambient air if more than 2 m/s improves the speed of air in the ducts of energy Solar.

Khanal et al. [23] investigated the pattern of airflow behavior within the chimney's solar channel with natural convection. A comparative simulation system was used with volume analysis. The thermal flow diagram is drawn along the length of the solar radiation absorber board. Thus, the flow is determined by three systems. These systems are described using the development of the thermal layer of the boundary to include the total channel width.

Al-Kayiem et al. [24] conducted an analytical study of the solar chimney model was carried out on the upper roof. The simulation of the mathematical model was performed. The results proved that the performance of the system is greatly affected by the intensity of solar radiation.

Zhang et al.[25] presented studied the integration of solar chimney to improve the thermal environment with the system of distribution of underground air (Afad) in the dynamics of computational fluid (CFD) software.Results and comparisons show that all types of solar chimneys can provide comfortable thermal conditions by providing acceptable temperature and normal ventilation, especially in the solar chimney model when the air passes through a cold passage where the temperature can be greatly improved. Decreases to reach 13°C.

Chung et al.[26] proved optimum values of parameters which influence the performance of Solar Chimney. Research worker found that optimum air breadth gap ranges from 0.6m to 1.0m, length of chimney change from 1.5m to 2m and induced air velocity from 0.04m/s to 0.22m/s. The results showed that the ventilation rate increased by 24% and also that the air gap is 10cm when the angle of inclination increases from 15 to 45 degrees.

Alzaed et al.[27] conducted experimentally the performance of a solar chimney is to induce

natural ventilation inside a test room, put in arid regions. The results showed that air width gap 5cm achieves the best ventilation compared with an a10cm air width gap.

A. P. Haghighi et al.[28] presented study around the possibility of solar chimney during the days of the operation of the system of heating under the ground even if the temperature of the ocean to 0 degrees Celsius and load heating 1000 w without the use of accessory devices In addition, the number of solar chimneys underground under external climatic conditions. The heating load calculation is done by equation room size/50 and 2 × (room size/50) +1.

Yongcai Li et al.[29] investigated experimental study The material is subjected to different thermal flows (500, 600 and 700) w/m^2.The results indicate that the name does not completely dissolve in the thermal flows 500 w/m^2 and 600 w/m^2 note that the charging time itself, which is 10 hours and 10 minutes. During phase transformation phase, the change in which we can reach the maximum amount of ventilation rates. The results indicate that the ideal angle of the solar chimney is 45 degrees, which can reach the maximum amount of ventilation rates. The ventilation rate is minimal when the solar chimney is vertical in all the cities studied, except the cold climate city of Tabriz.

AmrSayed Hassan Abdallah et al.[36] presented natural ventilation study was carried out through the solar chimney model with an evaporative cooling tower. The results show that solar radiation generates 130.5 m3 / h without pressure coefficient. also, The results show that the new solar chimney system with evaporative

cooling tower provides less temperature inside the building (10-11.5)°C compared with the external temperature.

Alex Yong Kwang Tan et al.[37] presented the study of the effect of several parameters of chimney dimensions (length, width, and size of the input) on the performance of the solar chimney (temperature and air velocity at a height of 1.2 m). The results showed that the factor that significantly affects the speed of air out of the solar chimney is the width of the chimney as well as the ratio of the high of solar chimney channel to the width less than 7

and ratio length of the chimney to the hydraulic diameter is greater than 15 if the flow of air is two-dimensional.

Karima E. Amori et al.[38] presented a numerical study of the heat transfer process was carried out in the solar chimney where the heat-absorber panel was placed in three different places inside the chimney (front side, center, back side). The volume method was used in calculations for different conditions of solar radiation. The results showed that the absorbent plate in the middle of the air gap gives the best thermal performance of the solar chimney.

Justin DeBlois et al.[39]Presented numerical study of the solar chimney of the roof (scf) facing the south to an independent house and four different climates using the simulated (ESP-r). The house has three bedrooms and an area of 189 m^2. The results showed that the roof chimney provides good ventilation and good cooling in all climates and seasons, and low cooling load in the baseline by 50% and ceiling 80%.

Nadia Saifi et al.[40] presented a numerical and an experimental study of natural ventilation using a solar chimney. angle solar chimney changes from (30-40) degrees, as well as the air gap between the absorber plate and glass changes (10, 20 and 30) cm This leads to the following conclusions:-

1 - The thickness of the air gap has a significant effect on increasing air flow significantly.

2- Reached to optimal thermal pull in the chimney angle of tilt of 45 degrees.

Hassanein et al. [41] conducted an experimental study of a room connected to a number of solar chimneys under different conditions and the effect of a number of parameters (height, direction, and width of the gap) for the solar chimney on natural ventilation. The results showed the use of a number of solar chimneys instead of one that increases the ventilation rates to 13% and 33% in addition to a decrease in room temperature by 10% and 10% and 12%, respectively.

Amori et al. [42] presented natural ventilation investigation was carried out using the solar chimney and the process of heat transfer and ventilation rate during the solar chimney, where the investigation ensured a numerical and experimental study. The results show that the use of BCM in the solar chimney gives a longer period of ventilation in addition to that the solar chimney with side entrance offers the best performance of ventilation. There is a considerable agreement between theoretical and experimental results.

Alex Yong Kwang Tan et al.[43] presented an experimental study of the performance of natural ventilation using the solar chimney of a three-story building in Singapore. The study was based on different geometric parameters (chimney width and chimney depth). The results showed that the solar chimney even on cold days gives good performance to hot and humid areas. The air speed in the study area is 0.4m/s and the internal air temperature to heat up slower and cold faster by (1–2) hour as compared to the reference area.

InsafMehani et al.[44]presented a numerical study of natural ventilation was carried out using a solar chimney to provide comfortable internal thermal conditions while providing energy consumption. Use simulation system ansys fluent to predict optimal air flow rate. The study was based on parameters showing the air gap and the density of solar energy. The results showed that there is an ideal ratio for displaying the solar gap of the solar chimney (0.2-0.3) m. We can obtain the best ventilation rate as well. Solar energy has a great effect on the air flow.

Leticia Neves et al.[45] investigated of a potential to optimize solar irradiation on the absorber plane and also warranty a considerable chimney height, by using a chimney expansion, which would be accountable to maintain a minimum high for the system, The results show in this research explain that using the proposed

system optimum slope angle for heigh solar irradiation with chimney extension – effectively large the performance of the chimney, enabling the use of solar collector with low inclination angles.

Amin HaghighiPoshtiri et al.[46] presented study was conducted to improve passive cooling and natural ventilation using solar energy, where two low-energy systems (SC-ECC and SC-EAHE) were used. The results showed that when the ambient temperature is high and the cooling load is high up to (1500 w), the (SC-EAHE) system is suitable to provide a comfortable indoor environment even in case of ambient temperature to 50° C and low solar radiation intensity to 100 W/m^2.Through the comparison between the two systems (SC-EAHE and SC-EAHE), Amin showed that the SC-ECC system gives better performance for natural ventilation during the night, especially in arid desert climates, while SC-EAHE is the best system for buildings that use low insulation.

Alemu T Alemu et al.[47] conducted investigation has been carried out into the inclusion of passive cooling and natural ventilation of the solar chimney an underground air tunnel connected to the area. This model has the potential to improve the ventilation of buildings with a low temperature inside the building at an acceptable rate. The results proved by comparing this model with the TRISIS COMIS program there is great agreement and good accuracy of airflow rate.

B. Belfuguais et al.[48] presented work contains an analysis of energy systems based on passive cooling of the housing system. It consists of solar chimney power performances determine environmental and geometrical considerations which affect the thermal disease of the solar chimney (entrance size, width). The results showed that the chimney display had a significant effect on the thermal performance of the solar chimney through the results obtained for the air flow rate and the distribution of the temperature of the glass and the temperature of the internal walls.

Bansal et al.[49]established mathematical equation and shown that 2.25 m^2 area of solar collector was able to generate air flow between 140 to 330 m^3/hr at the hot and dry condition. Solar chimney gives a very large performance at maximum irradiance 604 W/m^2.

Gontikaki et al.[50] conducted an analytical study of the natural ventilation used in the multi-stores buildings in Honda was presented by determining the type of glass and thermal mass. The study included improving the design of the solar chimney and continuing the optimal design.

Kwang Ho Lee et al.[51] presented a study of the thermal performance of the solar chimney using simulations in the energy program for forecasting through describing the basic concepts and the algorithms that were implemented. The results showed that the solar chimney was used optimally in the cooling processes resulting in energy savings. In addition, the solar chimney has a greater possibility of cooling compared to heating. The climate of the site has a significant impact on the performance of the chimney.

J. Arce et al.[52] Presented an experimental model of natural ventilation to obtain the best thermal performance of the solar chimney was carried out through the implementation of an experimental model under the actual climatic conditions of the meteorological station. The results showed that the maximum solar radiation is 604 and w/m^2 and occurs at 13:00 in addition to the increase in the maximum temperature during the chimney 7c. The airflow rate (50-374) m^3/ h and the average airflow rate is about 177 m^3/h from 0:00 to 24:00 hour. Also, the discharge coefficient(Cd) was 0.52.

Bassiouny at el.[53] presented numerical and analytical study was carried out to predict the behavior of the solar chimney and to provide natural ventilation in indoor using the specific element method. The study depended on the change of some of the engineering parameters (input size, width) of the chimney. The results showed that the chimney width increases the rate of air change in the hour (ACH) compared to the size of the entrance. Increase by 11% while increasing by a percentage of 25% when increasing the width of the chimney while keeping the size of the entrance unchanged.

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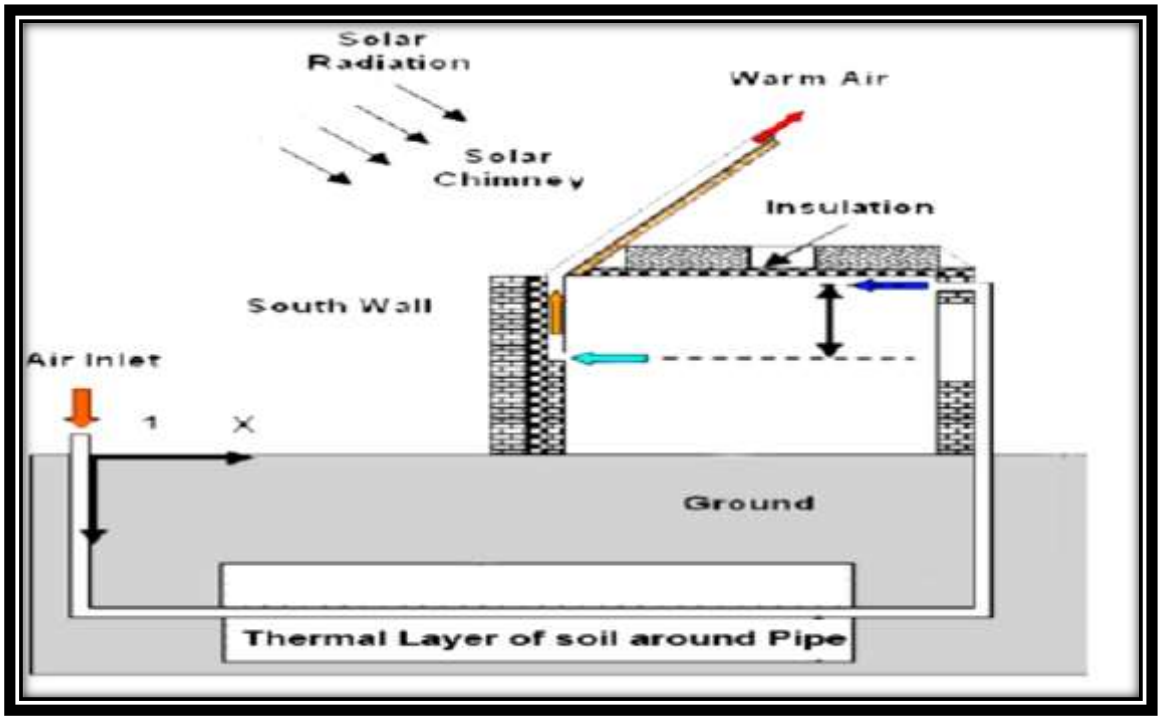

Fig:3 Schematic diagram of integrated earth to air heat exchanger and solar chimney [Maerefat and Haghighi 2010]

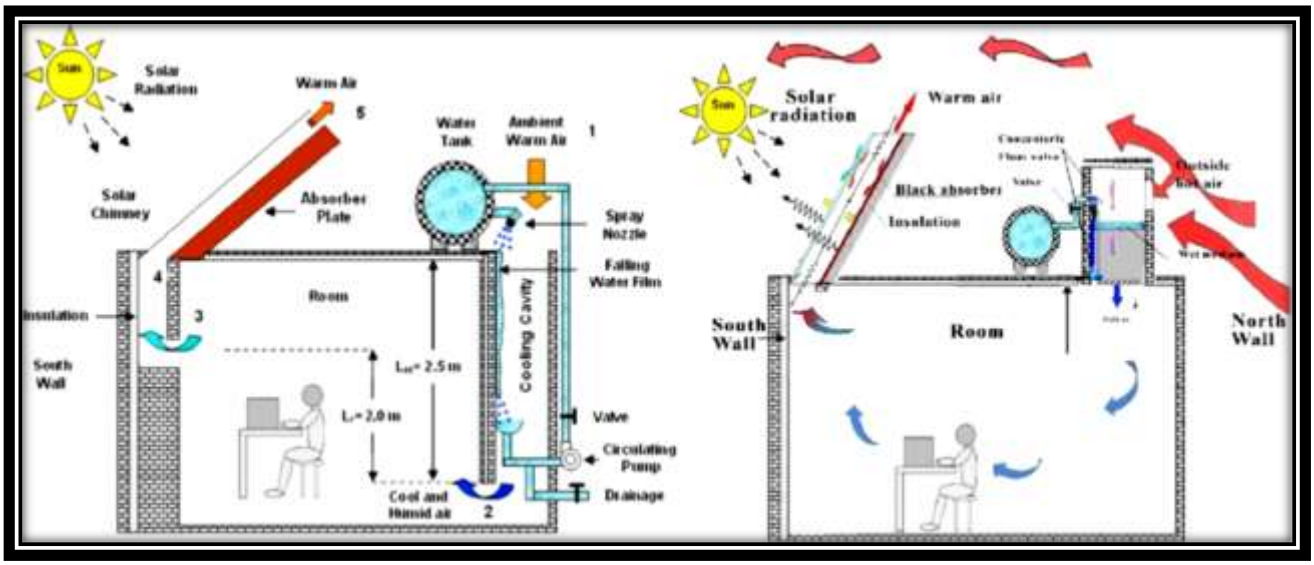

Fig:4Diagram of solar chimney with evaporative cooler[37]

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Table: Literature Review on Performance of Solar Chimney as a Passive Ventilation and cooling System

S no	RefNo	Name of the author	Title	Year	Methodology	Parameter Studied	Finding
1	3	Jun Lu et al	Thermal Storage Capacity and Night Ventilation Performance of a Solar Chimney Combined with Different PCMs	2017	Numerical study	PCMs with phase change temperatures of 38°C, 44°C, 50°C, and 63°C	A large ventilation rate of 610 kg/m^2 and maximum thermal storage of 4750 kJ/m^2 are carried out in the phase change temperature of 38°C.
2	4	Catherine Baxevanou et al	Numerical Study of Solar Chimney Operation In a Two Story Building	2017	Numerical study	Test three geometric designs 2D	The optimal design for the best performance is the one hole that connects the solar chimney with the ventilation chamber
3	5	Jitendra Kumar et al	Enhancement of Natural Ventilation using Solar Chimney: A Numerical Investigation	2017	Numerical Investigation	Horizontal and Vertical design	The ventilation rate is improved with the vertical solar chimney model compared to the horizontal chimney where the ventilation rate increases by 27%. Also, The rate of air speed increases 22 times
4	6	BoubekeurDokkar et al	Contribution in reducing energy consumption of telecom shelter	2016	Numerical study	Three different methods have been used for cooling transceiver stations	significant energy saving using the third type is the most energy.
5	7	TusharBhavsar et al	Experimental study of room air ventilation in summer by using solar chimney	2016	Experimental study	Temperature Variatio	the solar chimney does not provide optimum discharge at cloudy times
6	8	M.A.Hosien et al	Effects of the geometrical and operational parameters and alternative outer cover materials on the performance of solar chimney used for natural ventilation	2016	Mathematical analysis	•the wind speed •the dimensions (height, gap and width) •Different chimney cover materials	•air change rate (ACH) increases with increasing wind speed , the dimensions. • Use of different materials as cover for solar chimney (aluminum, glass, gypsum, concrete). The glass cover achieves the highest flow rate 6 over the desired flow rate.

7	9	Gehad M. Mekkwi et al	Solar chimney for enhanced natural ventilation based on CFD – simulation for a housing prototype in Alexandria, Egypt	2016	numerical study	speed of ventilation	The thermal performance of the solar chimney is reduced when the air speed drops by 50% and the effective air temperature is reduced by (0.18°C).
8	10	NaciKalkanet al	Passive cooling technology by using solar chimney for mild or warm climates	2016	numerical study	Direction building, temperature	solar direction led to changes in the temperature of the building
9	11	Ahmed AbdeenSaleem et al	Solar Chimney Design for Standard Ventilation Rate of Residential Buildings in a Hot-Arid Climate	2016	Mathematical analysis	wide range of geometry parameters	When the size of the chimney (1.4 m length * 0.6 m width * 0.1 m air gap) and the solar chimney angle of 45 °. the optimal air flow increases from 0.09 to 0.033 m3 / y or 88.2% during the daytime
10	12	A. Al Touma et al	Passive Cooling of Glazing Surfaces Using Solar Chimneys	2016	Mathematical models	• outdoor air Temperature • solar radiation	reductions of 8% to 12% in the window temperatures were seen for an outdoor temperature of 30oC and a solar radiation of 300Wm2 and for small chimney sizes.
11	13	SudapornSudprasert et al	Numerical study of vertical solar chimneys with moist air in a hot and humid climate	2016	Numerical study	Fluid flow and heat transfer process for dry air and wet air	When the temperature of the wall of the solar chimney is fixed, the wet air flow rate is lower compared to dry air flow 15.4–26.2%.
12	14	Dr. MajidHameedMajeed et al	Passive solar heating of a space	2016	Experimentally studied	different locations in test zone	The results showed that adopting walls towards sun light will improve the stored energy. Improving heat energy helps to make more motive force to flow air inside supposed building.
13	15	M.A. Kumar et al	Anyalysis of solar chimney with Evaporative Cooling Cavity to improve idoor air quality	2015	investigated numerically and experimentally	different cooling pad materials	This result shows that the saturated efficiency at air velocity 0.10m/s shows higher velocity at 47.5% for cellulose pads
14	16	Hussain H. Al-Kayiem et al	Experimentalinvestigation of rooftop solar chimney for natural ventilation	2015	Experimentally studied	Three designs were tested and compared	The results showed that the solar chimney on the surface with

							the vertical absorption leads to an increase in performance by 1.2 and 7.6 % . model 3 Compared to models 1 and 2.
15	17	Husain H. Al-Kayiem et al	On the natural convection heat transfer in a rectangular passage solar air heater	2015	Experimentally studied	angles of solar chimney (30°, (50° and 70°	inclination angle 50° is the ideal angle to get the best performance of the solar chimney
16	18	Ahmed Abd Ulnabi Imran et al	Induced flow for ventilation and cooling by a solar chimney	2015	experimental and numerical study	different angles (15-60)° solar radiation (150-750) air gap (50 , 100, 150)	the maximum ventilation rate occurs at the optimum inclination angle 60° at 750 w/m^2 intensity with 50 mm air gap.
17	19	Justin C. DeBlois et al	CFD-Assisted design and optimization of solar chimheys for elementary school classrooms	2015	numerical study	High chimneys and openings that lead to higher working hours	the possibilityof saving the consumed energy (HVAC) by 5 % and up to 1200 hours of operation can be sufficient natural ventilation in the classroom.
18	20	John Kaiser Calautit et al	CFD Simulation and Optimisation of a Low Energy Ventilation and Cooling System	2015	numerical study	wind speed	The air temperature is reduced by 6 k when the external air speed (1-5) m /s and reduced by a large amount (9.5-12) k when the air speed is low (1-2) m /s.
19	21	Haghighi et al	Solar ventilation and heating of buildings in sunny winter days using solar chimney	2014	Theoretical study	• air gap depth size of the •entrance •External air temperature • Solar radiation	Even in the case of low solar radiation density to 215 W/m^2 and low ambient air temperature. The system is able to provide a comfortable indoor environment during the day.
20	22	Tan et al	Influences of ambient air speed and internal heat load on the performance of solar chimney in the tropics	2014	experimental and computational studies	ambient air speed	Effect of convection in the classroom on the speed and temperature of the air inside the solar chimney.
21	23	Khanal et al	A scaling investigation of the laminar convective flow in a solar chimney for natural ventilation	2014	Theoretical study	three distinct designs for airflow	Based on Rayleigh number the first design used with the thermal boundary layer while the other designs do not use the thermal boundary layer.

22	24	Al-Kayiem et al	Mathematical analysis of the influence of the chimney height and collector area on the performance of a roof top solar chimney	2014	Mathematical analysis	• various collector areas • various chimney heights	the performance of the system is large effect by the solar intensity
23	25	Zhang et al	Numerical study on the thermal environment of UFAD system with solar chimney for the data center	2014	Numerical study	Three different designs for solar chimney	Design of the solar chimney on the cold channel can reduce the air entering the building 13 °C.
24	26	Chung et al.	Effective solar chimney cross section ventilation performance in Malaysia terraced house	2014	Solar chimney optimization carried out by CFD.	•.Air width gap •Chimney Length • Air Velocity	• Optimum width gap ranges from 0.6m to 1.0m, • Length from 1.5 to 2m • Induced air speed from 04m/s to 0.223m/s
25	27	Alzaed et al	Experimental study of solar chimney for ventilation in hot arid region	2014	Experimentally studied	Air Gap	Air gap 5cm achieves best ventilation compared with 10cm air gap.
26	28	A. P. Haghighi et al	Design guideline for application of earth-toair heat exchanger coupled with solar chimney as a natural heating system	2014	Experimental and mathematical modeling	influence of no of buried pipe and solar chimney	Solar chimneys associated with underground air canals are significantly affected by external environmental conditions.
27	29	Yongcai Li et al	Experimental study on thermal performance of a solar chimney combined with PCM	2014	Experimentally studied	different heat fluxes	The maximum thermal efficiency of the solar chimney is about 80% for all cases when the ventilation is early. The minimum efficiency reaches 63% when the radiation is 500 W/m^2.
28	30	PornsawanTongbai et al	Enhancements of Roof Solar Chimney Performance for Building Ventilation	2014	Numerical study	Different parameters (air gap, solar radiation, inclination angle, chimney height)	The rate of ventilation in the solar chimney increases with the increase of the air gap, the roof slope and the height of the chimney. The width of the air gap significantly affects the ventilation increase up to 250% with a width increase of 10 to 60 cm.

29	31	**P. J. Bansod et al**	Solar Chimney Power Plant-A Review	2014	Paper review	Review previous studies	Non-optimal use of solar technology due to different conditions
30	32	AmrSayed Hassan Abdallah et al	Parametric investigation of solar chimney with new cooling tower integrated in a single room for New Assiut city, Egypt climate	2014	numerical study	wind tower, angle of inclination and the air gap	Solar chimney system achieves the best performance in days when the temperature is high.
31	33	Shiv Lal	CFD simulation for the feasibility study of a modified solar chimney applied for building space heating	2014	numerical study	temperature	the lowest air temperature (20-30) °C in the middle of the solar chimney's air gap is high near the absorbent plate (45-65)°C. Also, the internal temperature of the experimental chamber (10-20) °C when the ambient temperature (3-10) °C .
32	34	Amori et al.	Numerical study of solar chimney with absorber at different location	2013	CFD Analysis	Various position of absorber	• Solar chimney with absorber at middle of air gaps shows optimum performance. • The highest thermal efficiency with absorber at the back side during
33	35	Mahdavinejad et al.	The study on optimum tilt angle in solar chimney as a mechanical eco concept	2013	Simulation based study	Tilt Angle	Maximum ventilation rate and best performance of solar chimney with angle of inclination 45°.
34	36	AmrSayed Hassan Abdallah et al	Integration of evaporative cooling technique with solar chimney to improve indoor thermal environment in the New Assiut City, Egypt	2013	Simulation based study	commercial couple multi-zone airflow	•can be obtain 2 ACH without pressure coefficient which gives minimum ventilation requirements. • The flow rate is up to 130 m3/h under the influence of radiation only. • Indoor temperature drops (10-11.5) ° C compared with external air temperature.
35	37	Alex Yong Kwang Tan et al	Parameterization Studies of Solar Chimneys in the Tropics	2013	Experimental Study	chimney's height, depth, width and inlet position	For ensure of increasing the flow rate and improving the performance of the solar chimney, the ratio of the hydraulic

							diameter to the length shall be greater than 15 and the ratio of the chimney height to the width is less than 7 if air flow two-dimensional.
36	38	Karima E. Amori et al	Numerical Study of Solar Chimney with Absorber at Different Locations	2013	Numerical study	three different places in the solar chimney	the absorbent surface in the middle of the chimney's air gap gave the best performance
37	39	Justin DeBlois et al	Simulating home cooling load reductions for a novel opaque roof solar chimney configuration	2013	numerical study	four different climates	provides good ventilation and good cooling in all climates and seasons, and low cooling load in the baseline by 50% and ceiling 80%.
38	40	Nadia Saifi et al	Experimental study and simulation of airflow in solar chimneys	2012	mathematical simulation and experimental	• chimney slopes • and air thickness lying	• The air gap thickness of the solar chimney has an important effect in increasing airflow. • Inclination angle 45° is the ideal angle to get the highest flow and thus pull heat to out.
39	41	Hassanein et al	Improvement of natural ventilation in building using multi solar chimneys at different direction	2012	Experimental work	Effect of no of chimney	•Using two to three chimney rise air flow rate to 13 to 33%. •lower the room center temperature by 6%, 10%, and 12 % respectively
40	42	Amoriet al	Experimental and numerical studies of solar chimney for natural ventilation in Iraq	2012	Experimental and numerical studies	•location of air inlet section •integrating this SC with PCM	• The best thermal performance of the solar chimney can be obtained with a side entrance to the air • Use of tow-phase material (PCM) with a solar chimney leads to an extended ventilation period after the evening.
41	43	Alex Yong Kwang Tan et al	Natural ventilation performance of classroom with solar chimney system	2012	Experimental study	chimney width, chimney depth	Good performance of the solar chimney in hot and humid areas even on cold days and The air velocity in the study area is 0.4 m/s and the internal air heating is slow and cooler faster (1-2) h compared to reference

							area
42	44	InsafMehani et al	Passive Cooling of Building by using Solar Chimney	2012	numerical simulation	the air gap width and solar intensity	an ideal ratio for the width of the air gap through which we can get the best ventilation rate of (0.2- 0.3)m. Also, solar energy has a great effect on airflow
43	45	Leticia Neves et al	Modeling solar chimney for maximum solar irradiation and maximum air flow ,for low latitude locations	2011	Simulation based study	chimney extension	increase daily volumetric flow rate of the suggest system was increased by 31%, comparing to a solar chimney with slope angle calculated for maximum airflow
44	46	Amin HaghighiPoshtiri et al	Comparative survey on using two passive cooling systems, solar chimney-earth to air heat exchanger and solar chimney-evaporative cooling cavity	2011	Mathematical model	two design of solar systems (SC-EAHE and SC-ECC)	The optimal design for construction with low insulation during the day is the use of the SC-EAHE system.
45	47	Alemu T Alemu et al	A coupled bulding ventilation and thermal model incorporating passive air flow components	2011	Theoretical study	Wind caused by underground air tunnel associated with multiple ventilation areas and air flow rate components	Featured design to improve natural ventilation in buildings with passive cooling.
46	48	B. Belfuguais et al	Passive Ventilation System Analysis using Solar Chimney in South of Algeria	2011	Theoretical study	the size and inlet width to solar chimney	The width of the solar chimney increases ventilation rates significantly compared to air entry size.
47	49	Bansal et al.	Solar chimney for enhanced stack ventilation	2010	Mathematical model	Size of opening of solar chimney with change discharge coefficient.	2.25 m^2 area of solar collector was capable to generate air flow between 140 to 330 m3/hr at dry and hot condition
48	50	Gontikaki et al	Optimization of a solar chimney design to enhance natural ventilation in a multi-story office building, Proceedings of the Tenth International Conference for Enhanced Building Operations	2010	Simulation based study	• wall height, gap width • type of glass, insulation • solar radiation, wind	•the annual energy savings. •the optimization of the SC design.
49	51	Kwang Ho Lee et al	Enhancement of natural ventilation in buildings	2009	Simulation based study	Absorbing solar energy	•Thermal chimney heavily dependent on

			using a thermal chimney			from the wall, chimney height ,the air gap width and solar transmittance of the glass cover	the climate of location. •Thermal chimney efficiency in cooling more than heating
50	52	**J. Arce et al**	Experimental study for natural ventilation on a solar chimney	2009	Experimental study	the actual climatic conditions	the maximum solar radiation is 604 w/m ^{2} and occurs at 13:00 in addition to the increase in the maximum temperature during the chimney 7°c. The airflow rate (50-374) m^3/ h and the average airflow rate is about 177 m^3 /h from 0:00 to 24:00 hour. Also, the discharge coefficient(Cd) was 0.52.
51	53	Bassiouny et al	An analytical and numerical study of solar chimney use for room natural ventilation	2008	an analyticaland numerical study	• chimney inlet size •width	Improves ACH by 11% when the entrance size of solar chimney increases three times • When the solar radiation increases by a factor of five, the temperature increases by 2.25°c. • Keeping the size of the entrance constant with the increased width of the chimney leads to an improvement of ACH by 25%.

1.7RESULT AND DISCUSSION

This chapter presents a reference to the thermal performance of solar chimneys air pipe heat exchanger (EAPHE) system which are more commonly used as a passive cooling system. Integrated EAPHE and SC system can replace the classical AC system. It lowers the building energy load. The results showed a combination of passive and active cooling leads to energy saving and good thermal comfort without causing increased pollution.

1.8CONCLUSIONS

The method of increasing natural ventilation and achieving the best performance of the solar chimney The main purpose of this paper was to promote ventilation-related accelerators and low energy cooling systems in buildings. Large air ventilation can be generated because of the difference in temperature caused by the use of renewable energy (solar energy) if the solar chimneys are used properly in buildings. The solar chimney uses

convection currents to pull air out of buildings by creating a hot or warm area with an external exhaust outlet, thereby improving indoor air quality and providing comfortable thermal conditions. We can build the thermal chimneys in a narrow order (chimney-like) with a heat-treated black metal plate that warms the air inside the chimney and is located behind the glass façade and is insulated from the building. The thermal chimney can be equipped to a one-story building or a building consisting of several floors or integrated with an independent building or with a group of buildings in addition to the possibility of generating electricity by solar towers. The technology of solar towers can be the cheapest way to generate electricity on a large scale.

REFERENCES

[1]http://www.touchstoneenergy.com
[2]American Society of Heating, Refrigerating and Air-conditioning Enginee[ASHRAE],2001a.
[3]Jun Lu, XiaolongGao, Qianru Li, Yongcai Li,"Thermal Storage Capacity and NightVentilation Performance of a Solar Chimney Combined with Different PCMs,International Journal of Photoenergy Volume 2017 (2017), Article ID 8363190, 10pages.
[4] Catherine B,Dimitris F, Numerical Study of Solar Chimney Operation in a Two story Building, Procedia Environmental Sciences 38 (2017) 68 – 76.
[5]J. Kumar, A. Raj, H.M. Sharma, Enhancement of Natural Ventilation using Solar Chimney:ANumericalInvestigation,International Journal of Advanced Engineering.Research and Science(IJAERS) Vol-4, Issue-3, Mar- 2017.
[6]BoubekeurDokkar,NasreddineChennouf, AbdelghaniDokkar, AbderrahmaneGouareh,MadjedDokkar, Contribution in reducing energy consumption of telecom shelter.
[7]Tushar Bhavsar1, Dr. V. N. Bartaria, Rajeev Singh Chouhan, Experimental study ofroom air ventilation in summer by using solar chimney, International JournalInnovative Engineering Research (E-ISSN: 2349-882X), Vol 4, Issue 6, June 2016.
[8]M. A. Hosien ,S .M .Selim, Effects of the geometrical and operational parameters and
alternative outer cover materials on the performance of solar chimney used for natural ventilation,Energy and BuildingsVolume 138, 1 March 2017, Pages 355-367.
[9]Gehad M. Mekkwi , Rana Ali Elgendy, Solar chimney for enhanced natural ventilationbasedon CFD–simulation for a housing prototype in Alexandria, Egypt, Proceedings of 25th IASTEMInternational Conference, Berlin, Germany, 16th July 2016, ISBN: 978-93-86083-57-9.
[10]NaciKalkan, IhsanDagtekin,Passive cooling technology by using solar chimneyfor mild or warm climates, THERMAL SCIENCE,Year 2016, Vol. 20, No. 6, pp. 2125-2136.
[11] Ahmed .A.S, Mahmoud .B, Shinichi .O, Ali K. A, Solar Chimney Design for StandardVentilationRate of Residential Buildings in a Hot-Arid Climate, International ConferenceonIndoorAir Quality Ventilation & Energy Conservation In Buildings2016.
[12]A. Al Touma1, K. Ghali, N. Ghaddar, Passive Cooling of Glazing Surfaces Using SolarChimneys, International Conference on Renewable Energies and Power Quality(ICREPQ'16) ISSN 2172-038 X, No.14 May 2016.
[13]S. Sudprasert,C. Chinsorranant, P. Rattanadechob , Numerical study of verticalsolar chimneys with moist air in a hot and humid climate, International Journal of Heatand Mass TransferVolume 102, November 2016, Pages 645-656.
[14]Dr. Majid. H. M, Ali .A. M , Passive solar heating of a space, IOSR Journal ofandCivilEngineering Volume 13, Issue 6 Ver .V (Nov. -Dec. 2016), PP101-107.
[15] M. A. Kumar, U. Krishnaveni, Analysis of solar chimney with evaporative coolingcavity to improve indoor air quality, Journal of Chemical and Pharmaceutical SciencIssue 6: March 2015 .
[16]Hussain H. Al-Kayiem, Yit Man Heng, Experimental investigation of rooftop solarchimneyfor natural ventilation, ARPN Journal of Engineering and Applied Sciences VOL. 10, NO 21, NOVEMBER, 2015.
[17]Hussain H. Al-Kayiem, TadahmunA.Yassen, On the natural convection heat transferin arectangularpassage solar air heater, Solar EnergyVolume 112, February 2015,Pages 310-318.
[18]Ahmed Abdulnabi Imran, Jalal M. Jalil, Sabah T. Ahmed, Induced flow for ventilationandcooling by a solar chimney,Renewable Energy 78 (2015) 236e244.
[19]Justin C. DeBlois, DembaNdiaye, CFD-Assisted design and optimization of solarchimheysfor elementary school classrooms.14th Conference of International BuildingPerformanceSimulation Association, Hyderabad, India, Dec. 7-9, 2015.

[20]John Kaiser Calautit, Dominic O'Connor, PolytimiSofotasiou, Ben RichardHughes,CFDSimulation and Optimisation of a Low Energy Ventilation and CoolingSystem.Computation2015, 3, 128-149; doi:10.3390/computation3020128.

[21] A.P.Haghighi, M. Maerefat, Solar ventilation and heating of buildings in sunnywinterdaysusing solar chimney, Sustainable Cities and Society 10 (2014)72–79.

[22]A. Y. K. Tan, N. H. Wong, Influences of ambient air speed and internal heat load on the performance of solar chimney in the tropics, Solar Energy 102 (2014)116–125.

[23] R. Khanal, C. Lei, A scaling investigation of the laminar convective flow in a solarchimneyfor natural ventilation, International Journal of Heat and Fluid Flow 45 (2014)98–108.

[24] H.H. Al-Kayiem, K.V. Sreejaya,S. I. U.H. Gilani, Mathematical analysis of theinfluence ofthe chimney height and collector area on the performance of a roof topsolar chimney, Energy and Buildings 68 (2014) 305–311.

[25]K. Zhang,X. Zhang,S. Li,G. Wang,Numerical study on the thermal environment of UFADsystem with solar chimney for the data center, Energy Procedia 48 (2014) 1047– 1054-SHC.

[26] L. P.Chung, H. Ahmad, D. R. Ossen, M. Hamid, Effective solar chimney crosssectionventilationperformance in Malaysia terraced house, Social and BehavioraSciences 179(2015) (2014) 276-289.

[27]A. N. Alzaed, H. A. Mohamed, Experimental study of solar chimney for ventilation inhot arid region, International Journal of Engineering and Innovative Technology (IJEIT), 4(4) (2014) 140-144.

[28] A. P. Haghighi, M. Maerefat, Design guideline for application of earth to air heatexchangcoupled with solar chimney as natural heating system, International Journalof Low Carbon Technologies Advance Access, (2014), 1-11.

[29]Yongcai. Li, Shuli .Liu, Experimental study on thermal performance of a solarchimney combined with PCM,Applied Energy, Volume 114, February 2014, Pages172-178.

[30] P.Tongbai, T. Chitsomboon, Enhancements of Roof Solar Chimney Performance for Building Ventilation, Journal of Power and Energy Engineering, 2014, 2, 22-29.

[31]P. J. Bansod,S. B. Thakre, N. A Wankhade, Solar Chimney Power Plant-A Review
International OPEN ACCESS Journal Of Modern Engineering Research (IJMER), | Vol.4 | Iss.11| Nov. 2014 | 18 |.

[32] AmrSayed Hassan Abdallah, Yoshino Hiroshi, TomonobuGoto, Napoleon Enteria,MagdyM. Radwan, M. AbdelsameiEid, Parametric investigation of solarchimney with new cooling tower integrated in a single room for New Assiut city, Egyptclimate , Int J Energy Environ Eng (2014) 5:92.

[33] Shiv Lal, CFD simulation for the feasibility study of a modified solar chimney appliedfor building space heating, ISSN 1 746-7233, England, UK , World Journal ofModelling and Simulation, Vol. 10 (2014) No. 4, pp. 293-307.

[34]K. E. Amori, K. N. Hamood, Numerical study of solar chimney with absorber atdifferent locations, Journal of Engineering, 19(4) (2013) 485-491.

[35]M. Mahdavinejad, M. Fakhari, F. Alipoor, The study on optimum tilt angle in solarchimney as a mechanical eco concept,Frontiers of Engineering Mechanics Research2(3) (2013) 71-80.

[36]A.S.H. Abdallah,H.Yoshino,T. Goto,N. Enteria,M. M Radwan, M AbdelsameiEid, Integration of evaporative cooling technique with solar chimney to improveindoor thermal environment in the New Assiut City, Egypt, International Journal ofEnergy and EnvironmentalEngineering (IJEEE),(2013).

[37]A.K.Tan,N.H.Wong,Parametrization studies of solar chimney in the tropics,Energies, 6 (2013) 145-163.

[38]Karima E. Amori,KhawlaNaeemHmood, Numerical Study of Solar Chimney withAbsorber at Different Locations, Number 4 Volume 19 April 2013 Journal ofEngineering.

[39]Justin DeBlois, Melissa Bilec, Laura Schaefer,Simulating home cooling loadreductions for a novel opaque roof solar chimney configuration.Applied Energy 112(2013) 142–151.

[41] S. A. Hassanein, W. A. Fadeel, Improvement of natural ventilation in building usingmultisolar chimneys at different location, Journal of Engineering Sciences, AssuitUniversity, 40(6) (2012) 1661-1677.

[40] N.Saifi, N.Settou, B.Dokkar, B. Negrou, N.Chennouf, Experimental study andsimulation of airflow in solar chimneys, Energy Procedia 18 (2012) 1289 – 1298.

[42]K.E.Amori, S. W. Mohammed, Experimental and numerical studies of solar chimneyfor natural ventilation in Iraq,Energy and BuildingsVolume 47, April 2012, Pages450-457.

[43]Alex Yong Kwang Tan, NyukHien Wong, Natural ventilation performance ofclassroom with solar chimney system, Energy and Buildings 53 (2012) 19–27.

[44]InsafMehani, N. Settou, Passive Cooling of Building by using Solar Chimney,International Journal of Civil, Environmental, Structural, Construction andArchitectural EngineerinVol:6, No:9, 2012.

[45] L. Neves , M. Roriz , F. Marques da Silva, Modeling solar chimney for maximumsolar irradiation and maximum air flow ,for low latitude locations, Proceedings ofBuilding Simulation 2011.

[46]A. H. Poshtiri, N. GIlani, F. Zamiri, Comparative survey on using two passivecoolingsystems, solar chimney-earth air heat exchanger and solar chimney-evaporativecooling cavity, World Renewable Energy Congress, 8-13 may (2011).
[47]A.TAlemu,W.SamanBelusko, A coupled building ventilation and thermalmodel incorporating passive air flow components, Proceedings of Building Simulation2011.
[48]B. Belfuguais, S. Larbi, Passive Ventilation System Analysis using Solar Chimney inSouth of Algeria, International Journal of Mechanical, Aerospace, Industrial,Mechatronic andManufacturing Engineering Vol:5, No:10, 2011.
[49]N. K. Bansal, R. Mathur, M. S. Bhandari, Solar chimney for enhanced stackventilation, Building and Enviornment, 28(3) (1993) 373-377.
[50] M. Gontikaki, M. Trcka, J. Hensen, P.J. Hoes, Optimization of a solar chimneydesign toenhance natural ventilation in a multi-story office building, Proceedings oftheTenthInternational Conference for Enhanced Building Operations, Kuwait,October26-28 (2010).
[51] K. Ho Lee , R. K. Strand, Enhancement of natural ventilation in buildings using athermal chimney, Energy and Buildings 41 (2009) 615–621.
[52] J. Arce, M.J. Jime´nez, J.D. Guzma´n, M.R. Heras, G. Alvarez, J. Xama´n,Experimental study for natural ventilation on a solar chimney, Renewable Energy 34(2009) 2928–2934.
[53] R. Bassiouny, N. S. A. Koura, An analytical numerical study of solar chimney use for room natural ventilation , Energy and Buildings, 40(5) (2008) 865-873.