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A Review Paper :Study Effect Heat Transfer Convection Natural In Vertical Channel

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Abstract

The goal of the research is to increase thermal efficiency of the natural heat flow, which is a result of the high temperature differential in closed vertical channel, by optimizing the distance between the channels through a number of trials. The study looked at data on heat transmission by natural convection that was obtained in various hot plate references. Additionally, the vertical face up and the investigation of the heat source positioned in the vertical channel were covered. Heat exchangers, fuel elements, nuclear reactors, heat dissipation in electronic circuits and cooling towers are only a few examples of devices that use convective heat flow transfer with the inner body in a vertical channel. In several studies on the significance of heat transport, much computational, analytical, and experimental work has been done.

Keywords : Natural convection (free convection), vertical channel, convection heat Transfer, Induced Flow, aspect ratio.

2.1 INTRODUCTION

Many engineering applications such as cooling of electronic equipment, electrical transformers, chimneys, furnaces, the cooling of solar collectors, and geophysical fluxes, include natural convection heating. The energy exchange that occurs as a result of heat flowing through various liquids used in thermal energy conversion devices determines how well they operate. Usually, volumetric heat creation or heat transfer rate from heated surface is the cause the heating. Due to the link of fluid flow and heat transfer the process of heat transfer through free convection is a separate phenomenon of interest. Between vertical walls, it has received substantial research due to its significance in numerous technical applications as well as its applications to numerous naturally occurring systems. To reduce heat, air conditioning is frequently employed. Application simplicity and accessibility are the primary benefits of air cooling. The simplest way to cool is to use natural convection to move air. Due to its low noise and maintenance-free benefits, natural convection to cool electronics equipment continues to play a significant role in thermal management [1]. By transferring effective heat from the exterior of a copper vessel used in a pressurized water reactor to the upward flow of induced air caused by buoyancy through the space between the vessel and the external concrete wall, natural heat transfer between vertical walls is achieved. This is due to the way buoyancy affects the turbulence in boundary layer, which results in flow that develops its distinctive characteristics at the Reynolds number. By boosting convection or reducing the heat flow rate, the heat transfer weakens gradually as the buoyancy effect gets stronger. In many technological applications, including cooling electronics equipment and solar collectors, natural convection in vertical channels is crucial[2]. On a common scale for extended periods, emphasis is given on the transport phenomena and the significance of heat flow produced by buoyancy in electron shells. The location of energy sources, radiation, and the 3D effect are only a few of the numerous additional effects that are significant. In the previous years, a significant. Many researchers have now integrated some of these effects to produce extremely useful data for thermal analysis and system design [3].

2.2 Literature Review

In all nations, buildings are regarded as consuming the most heat. There is a more complicated link between the energy needed for heating in winter residential structures in places with climatic parameters

similar to those in Iraq in terms of air temperature and solar radiation. Seasonal variations in air temperature have an impact on the environment's temperature within buildings due to the process of heat transfer between external and interior walls. Some of the most popular insulating materials offer efficient insulating applications for the exterior walls of buildings. Calculations are performed on brick walls that have an insulation layer on top of them. Through improved designs for residential buildings, the results acquired serve as the foundation for constructing the wall utilizing insulating materials and selecting the equipment for cooling in the summer or heating in a reasonable winter. Heat moves from a hot wall to a cold wall when there is a temperature differential. Conduction, convection, and radiation are all methods of transferring heat between two mediums. Studying heat transfer control is crucial if we are to develop systems that effectively transfer heat energy from one medium to another.

Venugopal and Anil Lal [4] The vertical channel was used in an experimental and numerical investigation natural convective heat transfer in parallel natural heat sources .The findings demonstrated that the side constricted walls have no discernible impact on heat transfer for aspect ratios < 0.201.

Sa Nada [5] conducted an experiment on natural convection heat transfer in narrow vertical and containers a base of heat vertical fin walls. The results showed that inserting the fins with geometric shapes into the fin array increases heat transfer rate natural convection.

Anil Lal [6] did a numerical analysis of the room's natural airflow. He created a two-dimensional space with four apertures on the sides and two sets of slanted ceilings on two floors. The air speed increases while entering the room with the increase in Rayleigh, and it is thought that the southern side surface gets heat from solar radiation and that some of it is communicated to the surface of the room. The upper hole is left and heating happens simultaneously. Only a little portion of the heated room's wall has air.

Ewing and Ching [7] An investigation of how the temperature of the upper and vertical walls affects natural stratified convection in a cavity filled with air. A cubic chamber of 206 mm in length, 206 mm in width, and 815 mm in depth was used for this study. The vertical wall is heated along with the top wall, and the vertical wall is cooled along with the bottom wall. A composite wall made of aluminum is used to construct the hot wall. A specific type of thermocouple is used to measure the temperature of the heated and cooled wall. According to the findings, the thermal boundary layer's side of the cube cavity upper and vertical wall alter temperature, as well as the temperature of the outside ambient air.

Dagtekin and Ozotop [8] studied Heated parts in a vertical channel transmit heat naturally by convection. In this study, numerical analysis was used to examine the heat transfer via natural convection and the heat flow of the heated part in the channel. Right side wall and top side wall are the same constant temperatures inside the room, and the side wall and vertical wall are thermally insulated.

Naylor and Tarasuk [9] conducted an empirical and numerical investigation for various partition plate locations on the natural convective interferometry of a three-dimensional anchored channel in an isothermal segmented vertical channel. The average Nusselt number calculated numerically turned out to be 15% less than that calculated empirically.

Naylor [10] The history of heat flow between vertical plates at constant temperatures and aspect ratios between 15 and 28 was studied numerically to understand natural convection. By adopting particular boundary conditions for the inlet heat flow in the range of Grashof No (Gr = 6 x 107), the Navier-Stokes equations and energy equation were solved. The numerical findings demonstrated that when (Gr = 107) for the length of the vertical channel to the channel width by 26, the heat flow area rotates in the inlet area.

Singh et al. [11] They research how an incompressible viscous fluid behaves during brief, naturally occurring heat-free flow in a vertical duct. The heat forces one of the vertical channel's walls upward when it travels. This is a different method of heating.

Al-Arabi and Al-Ridi [12] based on the quantity of condensation vapor collected from the containers above the surface painting, a numerical and empirical investigation in various shapes of the vertical plate was undertaken to determine the maximum and average heat transfer. The outcome demonstrated that average heat transfer from the cubic plate is very little and is equivalent to that from a horizontal plate with a diameter equal to the cubic plate's lateral length.

Stewartson [13] undertook a thorough investigation of the thermal characteristics of natural cooling, as well as the first theoretical and experimental study on the subject of natural free convection heat transfer.

Additionally, the study's findings regarding the heat transfer via natural convection from the upper surface, which revealed similarities between a semi-isothermal slab and the fluid used in the experiment contains air.

Hussar and Sparrow [14] carried out an experimental study showing the natural heat flow on a vertical hot surface with the help of electrochemical techniques. The result showed that the fluid flows along a free vertical path on the edge of a plate that continues to reach the central region of the headboard.

Sparrow and Azeved [15] The influence of the distance between the plates of a vertical channel heated from two sides was examined using experimental and numerical investigations on the features of heat transfer by natural free convection. Additionally, efforts were made to establish a 55-times gap between the vertical plate and vertical channel flowing in full phase at all times. Additionally, the fluid for Brantl No. 6 experiment was analyzed, and each case of free convection in the vertical channel and heat transfer via conduction through the wall is taken into consideration in the numerical solution. The heat transfer process is extremely sensitive to modifications in the distance between the vertical channel's narrow plates.

Chen et al. [16] For an unending vertical plate with a constant temperature or a constant wall temperature, he conducted an experimental experiment. Examining the biggest free natural boundary layer of heat transfer from a vertical plate with natural heat flow while discovering a changeable surface coating and constant temperature is a specific example.

Kitamura and Kimura [17] experimental studies of natural convective heat transfer from a thin cubic plate with uniform heat flow in the prepared liquid with a fixed surface to stimulate lateral flow were given. The heat flow field above the surface was thus evaluated. the headgear. Additionally, he investigated fluid thermodynamic measurements, which shed light on fluid flows and plate surface temperatures. It comprises of a variety of defining systems, including a transition zone characterized by the 3D flow and the binding of the fluid around the plate surface away from the heat flow channel and a border region of the 3D layer that is close to the leading edge.

Yilmaz [18] For a wall with vertical walls and the geometric shapes of a cube, triangle, and parallelogram, a numerical research was done to determine the appropriate shapes and dimensions for heat transmission by natural convection of vertical laminar flow at constant temperatures. The approximation equations are calculated in terms of the Prandtl number and the maximal normal heat flux without dimensions (Pr).

Silva et al. [19] They conducted an experimental investigation to determine how to better allocate wall space for discrete heat sources at the rates at which those sources are produced by natural and forced convection. and to lower the temperatures on the heated walls, they applied the structural theory.

Ochende et al. [20] By combining overlapping portions of cubic ducts with both natural and forced convection, they quantitatively conceptualized new ideas to enhance the structural design and boost the intensity of heat transfer. Along with the density of the increased heating transfer rate, the outcome of the numerical simulation is provided.

Matos et al . [21] They conducted numerical and experimental studies of heat transport via forced and natural convection. The aspect ratio was primarily utilized to investigate the thermal effect, and the efficiency of heat conduction in transferring heat by natural and forced convection within the vertical channel allowed air to be employed as external cooling.

Nasiruddin [22] He employed techniques to enhance heat transmission in a variety of industrial, engineering, and process applications, including heat. Gas and steam boiler cooling systems, heat exchangers, and air solar collectors. The three-dimensional walls of the vertical channels' natural heat flow are studied.

Anand [23] created a vertical canal in the thrust zone with a single bulkhead. The impact of Brandtl, Reynolds, barrier height, and vertical wall thermal conductivity ratio was then investigated. In general, when the heat flux Reynolds number rises, wavelengths expand and can be recycled around the barriers. Additionally, as the thermal conductivity of the vertical channel's outside walls increased, the average Nusselt number increased as well.

Nada [24] conducted both similar and distinct conventional tests in the disciplines of velocity and heat flow by natural convection in a heated vertical channel. One plate is kept above ambient temperature in

the vertical heated channel while the second plate is heated differently at the bottom. In the turbulent layer region, velocity measurements for the two Rayleigh numbers ($Ra = 3 \times 10^8$ and 5×10^8) were made.

Kaya et al. [25] studied for the purpose of calculating average air temperatures and air mass flow along the vertical channel to cool the area, it was investigated how to construct a mathematical model that depicts the phenomenon of heat transfer via natural convection and fluid flow. The effectiveness of the cooling structure's cooling channels depends significantly on geometry. One of the elements that influences how well the thermal power production device cools the processed materials. The most crucial elements that engineers and designers may influence are shape and size.

Boukhatam and colleagues [26] Studies of thin vertical hot plate is located in a room that is closed off on all sides and filled with fluid and air in an investigation for the numerical analysis of heat transfer by natural convection. Whereas the horizontal room walls have constant temperatures, it preserves the consistent temperatures of the vertical room walls. Use the finite difference equation to solve the heat and energy flow equations in the test chamber. The temperature of the horizontal slab is greater than the adiabatic wall when a vertical thin slab with an aspect ratio of 0.6 is put inside a cubic room. Calculations for the Rayleigh number fall between 10^6 and 10^8. The findings demonstrate that the Rayleigh number rises as the temperature rises.

Elenbaas [27] The researcher uses both experimental and analytical methods to look at how similar fins cool a space. The changing heat flow in the vertical channel and the heat transfer between the symmetrically heated, constant-temperature plates were both examined. The minimum width and vertical wall channel lengths necessary to achieve the evolution of the full flow.

Silva & Gosselin [28] were able to get improved aspect ratio results for the highest thermal performance in the vertical channel. The chimney effect is evident and the fluid temperature reaches the wall temperature after the end of the chimney effect arises when the aspect ratio (the aspect ratio of the channel gap) is smaller than the ideal height to aspect ratio, as was noted in their study. Before reaching the vertical end of the duct, the fluid also reaches the wall temperature. Therefore, there is very little heat transfer on the lower side of the vertical channel.

Elenbaas [29] Analyzed the heat flux evolving in a natural convective vertical transfer between isothermal and asymmetrically heated plates using a numerical approach to predict the vertical channel length necessary to achieve the mass evolved flow as a function of temperature width and the vertical channel of the wall.

WS Fu et al. [30] Provide suitable boundary conditions for open non-reflective barriers in naturally compressible heat flow across the vertical channel using unbranched one-dimensional equations. The boundary condition can be determined based on local flow conditions and does not require any prior knowledge of heat flow at the inlet and outflow. Additionally, it prevents flow pressure-induced sound waves from reflecting at the inlet and outflow.

Brangon et al. [31] The significance of choosing boundary conditions to achieve the numerical flow of normal load in a system of vertical duct stacks at open channel entrances and exits was brought to light. Some numerical research have focused on natural turbulent convection in vertical plate convection that is heated symmetrically and asymmetrically.

Chen and et al. [32] To alter the aspect ratio of the vertical channel, an experimental study employing a solar chimney model with uniform heat flow was conducted. The study dealt with the stratified convection of the vertical channel, and the coolant flow path in nuclear fuel plate-type reactors required a symmetrically large aspect ratio of the vertical channel.

Fishenden and Saunders [33] Examined how convective heat transmission occurs at the vertical surface of a vertical channel that faces downhill and has room for a floating cubic panel.

Sparrow & Carlson [34] carried conducted an experiment on a vertical plate that had been uniformly heated, with parallel surfaces and constant temperatures in both covered and uncovered conditions. The surrounding area of the vertical heating plates was free of impediments and maintained a steady temperature, which helps prevent air from being sucked in from above.

Jackson [35] Performed numerical fluid flow tests because of the vertical channel's inherent buoyancy from heat transfer. The simulations are run with Ansys CFX. In these trials, as the rate of generated heat flow increases, the natural heat load through the system rises.

Hassan and Mohamed [36] calculated the average heat transfer coefficient along the surface of the flat plate in numerical and experimental studies of the natural convection of a vertical plate pointing downhill. during convection. The outcome demonstrated that a convective flow took place along the vertical plate's outer surface before the boundary layer changed into a turbulent liquid.

Merrikh & Lage [37] . examined the lateral hot casing of the vertical channel case, which has cubic blocks in a solid with uniform spacing. The treatment of the solid and liquid components separately was done using a continuum model. The results were achieved for many different values of the conductivity ratio of the liquid materials to the channel's solids as well as a wide range Ra numbers, from (10^6 to 10^9).

Kihm. et al. [38] presented a study that used experiments to examine the phenomenon of convective heat flow reversal between two isothermal barriers. The findings indicated that the growth of the heat flow area to be circulated at the inlets occurs when the Rayleigh number rises above a particular critical value, which results in an insufficient rate of volume flow through the vertical channel. The reason for the increase in the Rayleigh number causes a decrease in the increase in heat transfer.

Daloglu and T.Ayhan [39] Researchers discussed the topic of natural convection in a channel with periodically finned verticals as well as the experimental findings of natural convection in a vertical channel with a cubic cross-section. In both instances, the heat flow is maintained, and the fins are fastened to the vertical channel. The natural convection in the vertical channel is physically examined and contrasted with the smooth channel, and it is proven that the plates are periodically put on the channel.

Wei & colleagues [40] Air was employed as the working fluid in studied computational tests on heat transfer by natural convection in agreement with a thin plate perpendicular both sides at equal temperatures.

Martorellet al [41] Conducted typical natural convection heat transfer studies using square plates with the bottoms facing up and duct air in the vertical position.

Table 1: Summary studies

Reference	Study of Type	Insulation Material	Result of The Study
Venugopal and Anil Lal [4]	Experimental and Numerical	. Fluid	The results findings demonstrated that the side constricted walls have no discernible impact on heat transfer for aspect ratios < 0.201.
Sa Nada [5]	Experimental	Fluid	The results showed that inserting the fins with geometric shapes into the fin array increases the heat transfer rate natural convection.
Ewin and Ching [7]	Experimental	Air	A specific type of thermocouple is used to measure the temperature of the heated and cooled wall. According to the findings, the thermal boundary layer's side of the cube cavity upper and vertical wall alter temperature, as well as the temperature of the outside ambient air.
Naylor & Tarasuk [9]	Numerical , Empirical and Experimental	Fluid	The results average Nusselt number calculated numerically turned out to be 15% less than that calculated empirically.
Al-Arabi and Al-Ridi [12]	Numerical and Empirical	Air	The result showed outcome demonstrated that average heat transfer from the cubic plate very little and is equivalent to that from a horizontal plate with a diameter equal to the cubic plate's lateral length.

Reference	Study of Type	Insulation Material	Result of The Study
Hussar and Sparrow [14]	Experimental	. Fluid	The result showed that the fluid flows along a free vertical path on the edge of a plate that continues to reach the central region of the headboard.
Ochende et al. [20]	Experimental	Fluid	The result Along with the density of the increased heating transfer rate, the outcome of the numerical simulation is provided.
Hassan and Mohamed [36]	Experimental and Numerical	Air	The result showed outcome demonstrated that a convective flow took place along the vertical plate's outer surface before the boundary layer changed into a turbulent liquid.
Merrikh & Lage [37]	Experimental	Solid and Fluid	The results obtained treatment the solid and liquid components separately was done using a continuum model. The results were achieved for many different values of the conductivity ratio the liquid materials to the channel's solids as well as wide range Ra numbers, from (10^6 to 10^9).
Kihm. et al. [38]	Experimental	Air	The results insufficient rate of volume flow through vertical channel. The reason for the increase in the Rayleigh number causes a decrease in the increase in heat transfer.

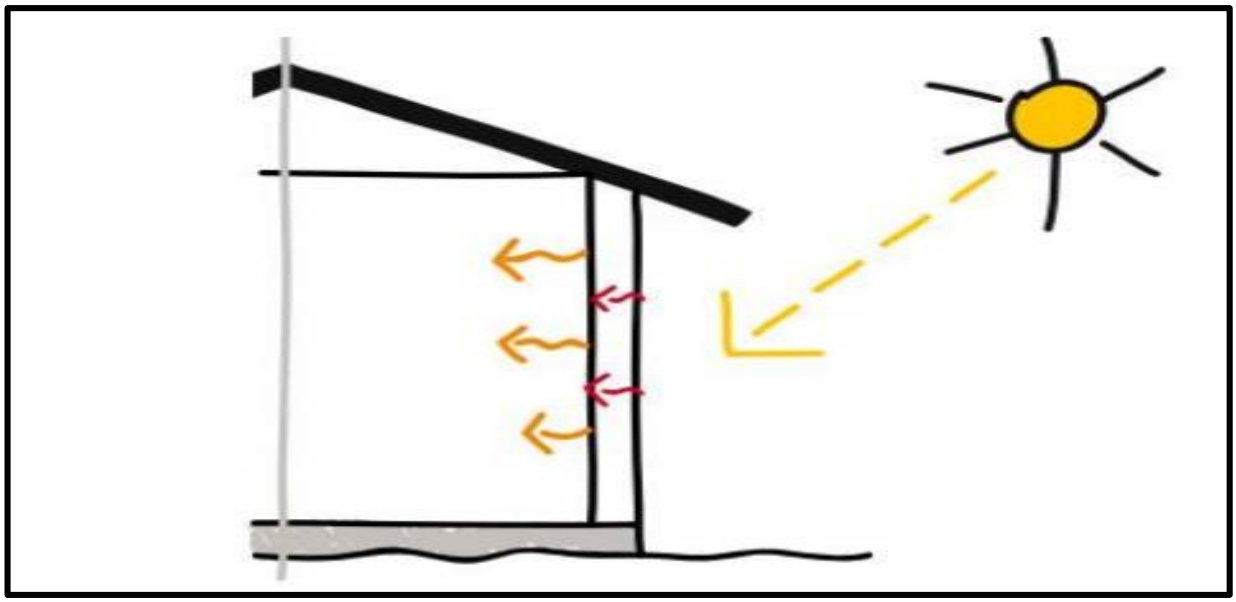

Figure.1. Describes process of heating transfer through wall the room

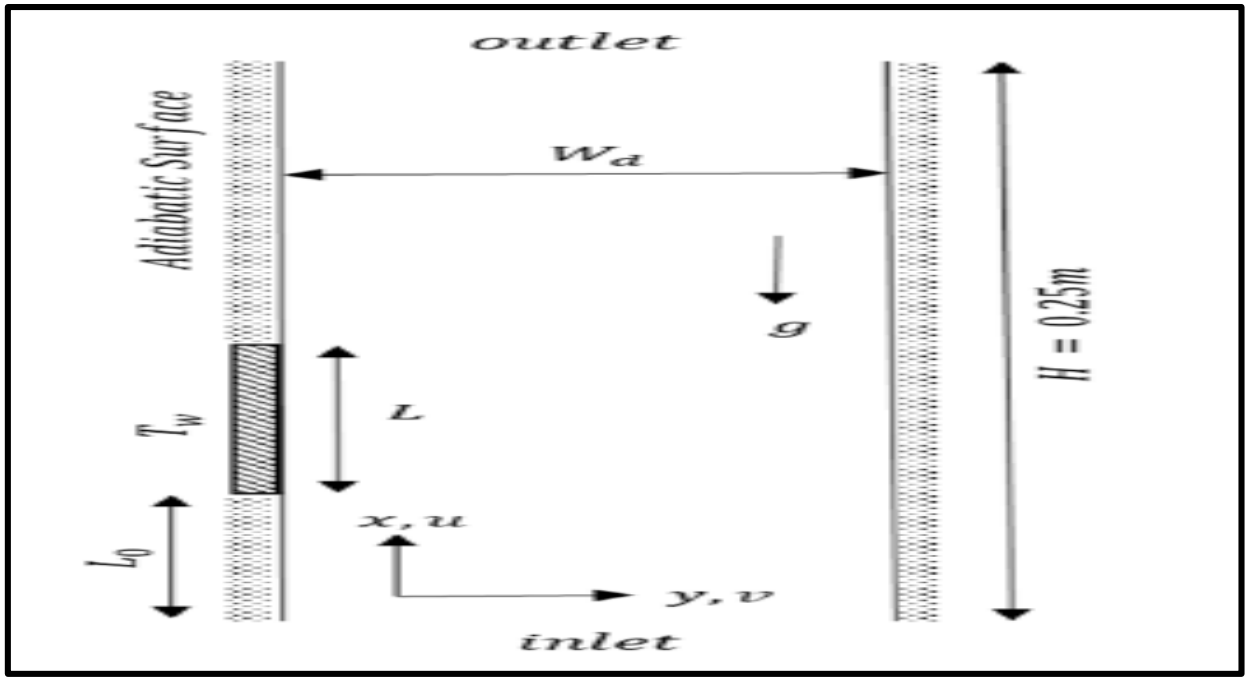

Figure. 2. Engineering design of the open vertical channel [82] .

Conclusion

The Previous studies the phenomenon natural convection in vertical heating channel of downward and upward facing channel have been fully reviewed. The study is carried out in heat transfer through the phenomenon of free convection through different geometric shapes in several different ways such as numerical and experimental analysis and Through these studies, is possible understand the natural convection the engineering of heating vertical plates, and it has received a great deal of interest and many applications of thermal engineering. Also, a number of researchers presented the correlation that has been developed for the phenomenon of thermal convection of the vertical channel.

Nomenclature

Nu : Nusselt Number.

Gr : Grashoff Number.

Pr : Prandtl Number.

T0 : Ambient temperature (C).

Ra : Rayleigh number.

P : density of fluid (kg/m).

H : height of duct (m).

TC: Temperature of cold surface (C) .

h : Coefficient heat transfer Convection .

k : Thermal Conductivity.

TH : Temperature hot surface (C).

Q : Heat Flux .

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