INTEND AND INVESTIGATION OF NORMAL CONVECTIVE HEAT RELOCATE FROM TWO ADJACENT NARROW PLATES

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ABSTRACT

Natural Convection flow in a vertical channel with internal objects is encountered in several technological applications of particular interest of heat dissipation from electronic circuits, refrigerators, heat exchangers, nuclear reactors fuel elements, dry cooling towers, and home ventilation etc.In this paper the air flow through vertical narrow plates is modeled using CREO design software. We will focus on thermal and CFD analysis with different Reynolds number (2×10^6& 4×10^6) and different angles (0^0,30^0,45^0) of the vertical narrow plates. Thermal analysis done for the vertical narrow plates by steel, aluminum & copper at different heat transfer coefficient values.finally we observed which material is best for heat transfercoeffient and which angle is best for heat transfer.

KEY WORDS: laminarflow, Reynoldsno, Heat fux, temperature

I .INTRODUCTION

Natural convection occurs when the fluid circulates by virtue of the natural differences in densities of hot & cold fluid; the denser portion of the fluid moves downwards because of a greater force of gravity, as compared with the force on the less dense. Heat transfer by natural convection between a system and surrounding can be increased by using an extended thin strip of metal called fin. Fins are utilized where the accessible surface is discovered lacking to move the necessary amount of heat with the accessible temperature drop and where the heat move coefficient is low. The determination of balance relies upon various parameters like geometrical shape, blade dispersing, balance stature, base thickness, sort of material, surface completion, and so on. There are diverse blade geometries like a uniform straight balance, annular balance, splines, pin balance, and so forth are utilized to expand the heat move rate from the surface. Fins direction and geometry of blades cluster are the primary parameters which influence the improvement proportion of heat move.

Natural Convection From A Vertical Plate

Right now is moved from a vertical plate to a liquid moving corresponding to it by natural convection. This will happen in any framework wherein the thickness of the moving liquid changes with position. These marvels might be of essentialness when the moving liquid is negligibly influenced by constrained convection. While considering the progression of liquid is an aftereffect of warming, the accompanying connections can be utilized, expecting the liquid is a perfect diatomic, has neighboring a vertical plate at consistent temperature and the progression of the liquid is totally laminar.

$Nu_m = 0.478(Gr^{0.25})$

Mean Nusselt Number = $Nu_m = h_m L/k$

Where

h_m = mean coefficient applicable between the lower edge of the plate and any point in a distance L (W/m^2. K)

L = height of the vertical surface (m)

k = thermal conductivity (W/m. K)

Grashof Number = Gr = $[gL^3(t_s - t_\infty)]/v^2 T$

Where

g = gravitational acceleration (m/s^2)

L = distance above the lower edge (m)

t_s = temperature of the wall (K)

t∞ = fluid temperature outside the thermal boundary layer (K)

v = kinematic viscosity of the fluid (m^2/s)

T = absolute temperature (K)

When the flow is turbulent different correlations involving the Rayleigh Number (a function of both the Grashof Number and the Prandtl Number) must be used.

II. LITERATURE REVIEW

Dr.i.satyanarayana[1] investigate steady-state natural convection from heat sink with limited plate-fins having equal game plan mounted on a slanted base by utilizing creep device. The impacts of balance stature, the tendency of the base with a similar limit conditions for two distinct materials were broke down thermally and progressively utilizing cae instrument. The outcomes inferred that al-amalgam and steel the two materials keep up a similar measure of all out temperature conveyance however heat motion is high for alalloy. What's more, when builds the blades length, temperature dispersion continue as before for the two materials yet the complete heat motion has been expanded contrasted with the current model. B. Gandusandeep [2] researched normal convective heat move from level plates slanted at a point to the vertical in laminar stream districts systematically. The tendencies were 15˚, 30˚, 45˚ and 60˚. The liquid stream qualities considering laminar stream under natural convection was investigated utilizing cfd examination. The heat move rates by utilizing various materials (copper and aluminum amalgam 6061) for plates were investigated utilizing warm examination. By watching the cfd investigation results, the weights, speed, nusselt's number were expanded with increment in tendency edges. By warm examination results, the heat move rates were practically comparative for 30˚ and 45˚ tendency edges and expanded for the 60˚ edge. So most extreme plate tendency will bring about higher heat move rates. C. Pallavarapuhari [3] researched heat move and liquid stream attributes for two cases under normal convection. In one case, the plates were on a level plane nearby one another, the plates being on a level plane isolated while in the other case, one plate was evenly set over the other plate the plates being vertically isolated. 3d models were set up by utilizing Pro/Engineer. Warm examination has been accomplished for both the cases utilizing two distinct materials like Aluminum and Copper. Consideration has been given with the impacts of the tendency edge of the plates to the vertical, with the impacts of the vertical or level dimensionless hole between the warmed plates, and with the impacts of the dimensionless plate width on the mean heat move rates from the two warmed plates for a wide scope of Rayleigh numbers. Results demonstrated that the heat move rate was more for on a level plane isolated plates than vertically isolated and copper had high heat move rates. D. AbdulrahimKalendar [4]Natural convective heat move from a two restricted nearby rectangular isothermal level plates of a similar size inserted in a plane adiabatic surface, the adiabatic surface being in a similar plane as the surfaces of the warmed plates, has been numerically researched. The two plates have a similar surface temperature and they were lined up with one another yet were isolated from one another by a moderately little hole. Results for the situation where the plates were vertical and where they were slanted at positive or negative points to the vertical have been gotten. It has been accepted that the liquid properties were consistent aside from the thickness change with temperature which offers ascend to the lightness powers, this having been dealt with utilizing the Boussinesq approach. It has likewise been accepted that the stream was even about the vertical place plane between the two plates. The arrangement has been gotten by numerically explaining the full three-dimensional type of overseeing conditions, these conditions were written in dimensionless structure. The arrangement was gotten utilizing the business limited volume strategy based CFD code, FLUENT. The arrangement has the Rayleigh number, the dimensionless plate width, the edge of tendency, the dimensionless hole between two level plates, and the Prandtl number as parameters. Results have just been gotten for a Prandtl number of 0.7 Results have been acquired for Rayleigh numbers somewhere in the range of 103 and 107 for plate width-to-stature proportions of somewhere in the range of 0.15 and 0.6, for a hole between the nearby edges to plate tallness proportions of somewhere in the range of 0 and 0.2, for points of tendency somewhere in the range of +45° and −45°. E. VankarDurgesh [5] built up the model of parts of the slanted plate's motor by utilizing strong works and changed over into IGES (mixes graphical component framework). The investigation was done on an ace pole of modular examination and static basic investigation was finished and conduct of the ace was inspected from this investigation and the characteristic frequencies, proportionate pressure and complete distortion were determined. Warm investigation was finished and complete heat transition and directional heat motion were determined by utilizing Ansys 14.0 workbench.

Problem description

Air flow through vertical narrow plates is modeled using PRO-E design software. We will focus on thermal and CFD analysis with different Reynolds number (2×10^6& 4×10^6) and different angles (0^0,30^0 and 45^0) of the vertical narrow plates. Thermal analysis done for the vertical narrow plates by steel, aluminum & copper at different heat transfer coefficient values.

III.PROBLEM DESCRIPTION &METHODOLOGY

Air flow through vertical narrow plates is modeled using CREOdesign software. The thesis will focus on thermal and CFD analysis with different Reynolds number (2×10^6& 4×10^6) and different angles (0^0,30^0,45^0&60^0) of the vertical narrow plates. Thermal analysis done for the vertical narrow plates by steel, aluminum & copper at different heat transfer coefficient values.

WORKING PARAMETER

Reynolds numbers	**Angle of plate**	**material**
2×10^6	**0^0,30^0,45^0&60^0**	**Copper**
4×10^6		**aluminum**
		steel

MODELLING AND ANALYSIS

REYNOLDS NUMBER 2×10^6 and 4×10^6

Fluid –Air Material Properties Of Air

Thermal conductivity = 0.024w/m-k

Density=1.225kg/m^3

Viscosity =1.98×10^{-5} kg/m-s

3. RESULT AND DISCUSSION

A) VERTICAL NARROW PLATE AT 0^0

1) REYNOLDS NUMBER - 2×10^6

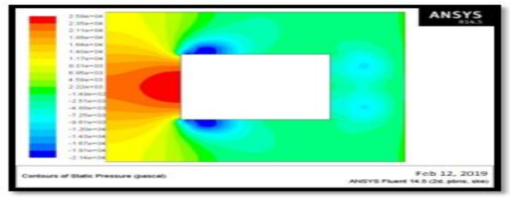


Fig 1: Static pressure

According to the above contour plot, the maximum static pressure at inlet of the narrow plate because the applying the boundary conditions at inlet of the boundary and minimum static pressure at the adjacent sides of the narrow plate.According to the above contour plot, the maximum pressure is 2.50e+04Pa and minimum static pressure is -2.14e+04Pa.

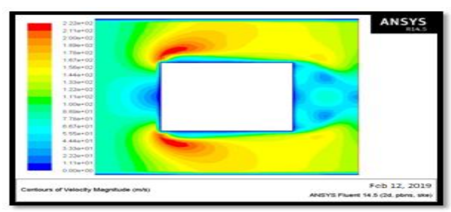


Fig 2: Velocity variation

According to the above contour plot, the maximum velocity magnitude of the air at corners of narrow plate, because the applying the boundary conditions at inlet of the boundary of the narrow plate and minimum velocity magnitude at around edges of the narrow plate.According to the above contour plot, the maximum velocity is 2.22e+02m/s and minimum velocity is 1.11e+01m/s.

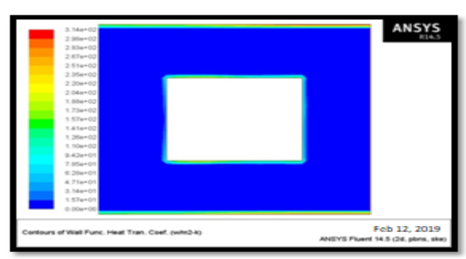


Fig 3:Heat transfer coefficient

According to the above contour plot, the maximum heat transfer coefficient of the air at edges of the narrow plate and minimum heat transfer coefficient between around the boundary edges and narrow plate edges.According to the above contour plot, the maximum heat transfer coefficient is 3.14e+02w/m^2-k and minimum heat transfer coefficient is 1.57e+01w/m^2-k

Mass Flow Rate	(kg/s)
inlet	79.311401
interior-_trm_srf	196.93365
outlet	-79.3256
wall-_trm_srf	0
Net	-0.014198303

Fig 4: Mass flow rate

Total Heat Transfer Rate	(w)
inlet	5974630.5
outlet	-6031706
wall-_trm_srf	0
Net	-57075.5

Fig 5: Heat transfer rate

2)REYNOLDS NUMBER - 4×10^6

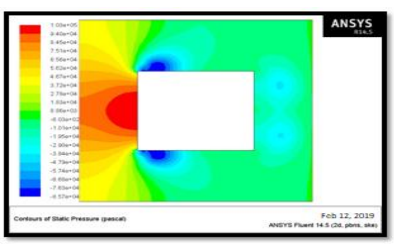


Fig 6:Static pressure

According to the above contour plot, the maximum static pressure at inlet of the narrow plate because the applying the boundary conditions at inlet of the boundary and minimum static pressure at the adjacent sides of the narrow plate.According to the above contour plot, the maximum pressure is 1.03e+05Pa and minimum static pressure is -8.57e+04Pa.

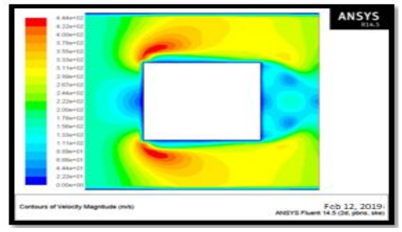


Fig 7: Velocity variation

According to the above contour plot, the maximum velocity magnitude of the air at corners of narrow plate, because the applying the boundary conditions at inlet of the boundary of the narrow plate and minimum velocity magnitude at around edges of the narrow plate.According to the above contour plot, the maximum velocity is 4.44e+02m/s and minimum velocity is 2.22e+01m/s.

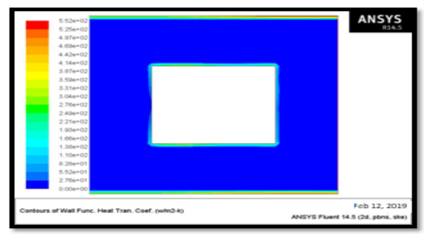


Fig 8: Heat transfer coefficient

According to the above contour plot, the maximum heat transfer coefficient of the air at edges of the narrow plate and minimum heat transfer coefficient between around the boundary edges and narrow plate edges.According to the above contour plot, the maximum heat transfer coefficient is 5.52e+02w/m^2-k and minimum heat transfer coefficient is 2.76e+01w/m^2-k.

Mass Flow Rate	(kg/s)
inlet	158.63991
interior-_trm_srf	393.53253
outlet	-158.66556
wall-_trm_srf	0
Net	-0.025650024

Fig 8: Mass flow rate

Total Heat Transfer Rate	(w)
inlet	11950556
outlet	-12070637
wall-_trm_srf	0
Net	-120081

Fig 9: Heat transfer rate

B) VERTICAL NARROW PLATE AT 30^0

1) REYNOLDS NUMBER - 2×10^6

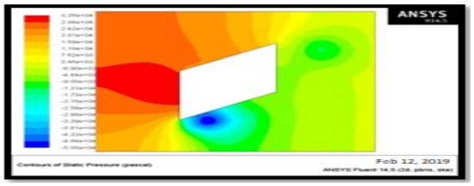


Fig 10: Static pressure

According to the above contour plot, the maximum static pressure at inlet of the narrow plate because the applying the boundary conditions at inlet of the boundary and minimum static pressure at the adjacent sides of the narrow plate.According to the above contour plot, the maximum pressure is 3.25e+04Pa and minimum static pressure is -5.05e+04Pa.

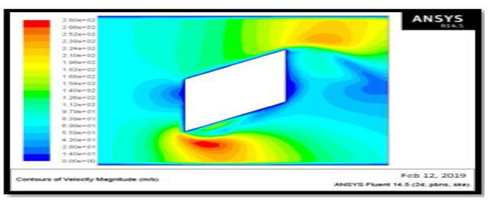


Fig 11:Velocity variation

According to the above contour plot, the maximum velocity magnitude of the air at corners of narrow plate, because the applying the boundary conditions at inlet of the boundary of the narrow plate and minimum velocity magnitude at around edges of the narrow plate.According to the above contour plot, the maximum velocity is 2.80e+02m/s and minimum velocity is 1.40e+01m/s.

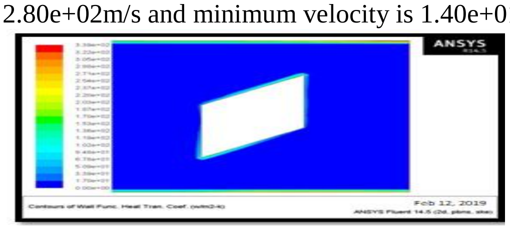


Fig 12:Heat transfer coefficient

According to the above contour plot, the maximum heat transfer coefficient of the air at edges of the narrow plate and minimum heat transfer coefficient between around the boundary edges and narrow plate edges.According to the above contour plot, the maximum heat transfer coefficient is 3.39e+02w/m^2-k and minimum heat transfer coefficient is 1.70e+01w/m^2-k

Mass Flow Rate	(kg/s)
inlet	99.139221
interior-_trm_srf	-54.444607
outlet	-99.00412
wall-_trm_srf	0
Net	0.13510132

Fig 13:Mass flow rate

Total Heat Transfer Rate	(w)
inlet	1481683.6
outlet	-1479661.3
wall-_trm_srf	0
Net	2022.375

Fig 14: Heat transfer rate

2)REYNOLDS NUMBER - 4×10^6

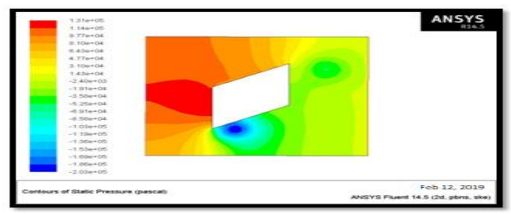


Fig 15:Static pressure

According to the above contour plot, the maximum static pressure at inlet of the narrow plate because the applying the boundary conditions at inlet of the boundary and minimum static pressure at the adjacent sides of the narrow plate.According to the above contour plot, the maximum pressure is 1.31e+05Pa and minimum static pressure is -2.03e+05Pa.

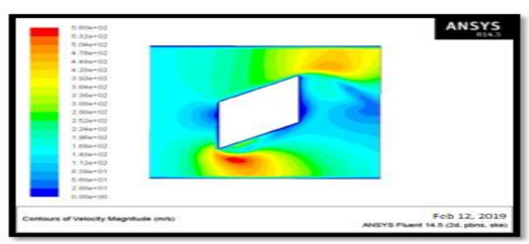


Fig 16: Velocity variation

According to the above contour plot, the maximum velocity magnitude of the air at corners of narrow plate, because the applying the boundary conditions at inlet of the boundary of the narrow plate and minimum velocity magnitude at around edges of the narrow plate.According to the above contour plot, the maximum velocity is 5.60e+02m/s and minimum velocity is 2.80e+01m/s.

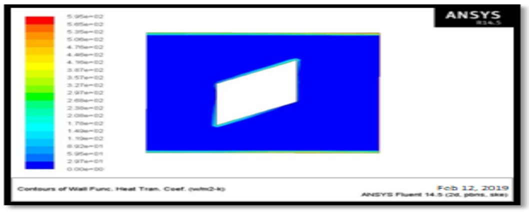


Fig 17: Heat transfer coefficient

According to the above contour plot, the maximum heat transfer coefficient of the air at edges of the narrow plate and minimum heat transfer coefficient between around the boundary edges and narrow plate edges.According to the above contour plot, the maximum heat transfer coefficient is 5.95e+02w/m^2-k and minimum heat transfer coefficient is 2.97 e+01w/m^2-k.

Mass Flow Rate	(kg/s)
inlet	198.29997
interior-_trm_srf	-105.51134
outlet	-197.43877
wall-_trm_srf	0
Net	0.86120605

Fig 18: Mass flow rate

Total Heat Transfer Rate	(w)
inlet	2963688.3
outlet	-2950814
wall-_trm_srf	0
Net	12874.25

Fig 19: Heat transfer

20C) VERTICAL NARROW PLATE AT 45^0

1) REYNOLDS NUMBER - 2×10^6

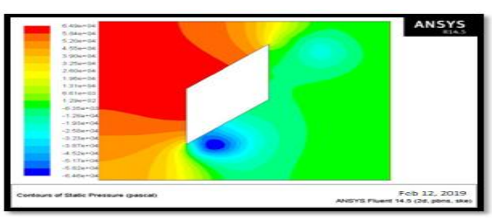


Fig 20: Static pressure

According to the above contour plot, the maximum static pressure at inlet of the narrow plate because the applying the boundary conditions at inlet of the boundary and minimum static pressure at the adjacent sides of the narrow plate.According to the above contour plot, the maximum pressure is 6.49e+04Pa and minimum static pressure is -6.45e+04Pa.

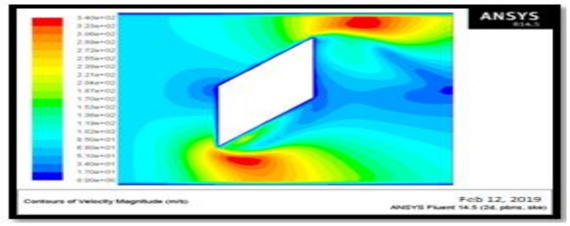


Fig 21: Velocity variation

According to the above contour plot, the maximum velocity magnitude of the air at corners of narrow plate, because the applying the boundary conditions at inlet of the boundary of the narrow plate and minimum velocity magnitude at around edges of the narrow plate.According to the above contour plot, the maximum velocity is 3.40 e+02m/s and minimum velocity is 1.70e+01m/s.

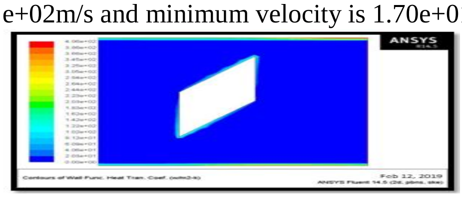


Fig 22:Heat transfer coefficient

According to the above contour plot, the maximum heat transfer coefficient of the air at edges of the narrow plate and minimum heat transfer coefficient between around the boundary edges and narrow plate edges.According to the above contour plot, the maximum heat transfer coefficient is 4.06e+02w/m^2-k and minimum heat transfer coefficient is 2.03e+01w/m^2-k.

Mass Flow Rate	(kg/s)
inlet	99.139221
interior-_trm_srf	1081.3646
outlet	-98.893143
wall-_trm_srf	0
Net	0.24607849

Fig2 3: Mass flow rate

Total Heat Transfer Rate	(w)
inlet	1481683.6
outlet	-1478005.8
wall-_trm_srf	0
Net	3677.875

Fig24:Heat transfer rate

2) REYNOLDS NUMBER - 4×10^{6}

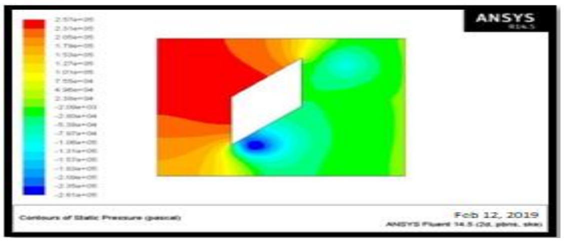


Fig 25:Static pressure

According to the above contour plot, the maximum static pressure at inlet of the narrow plate because the applying the boundary conditions at inlet of the boundary and minimum static pressure at the adjacent sides of the narrow plate.According to the above contour plot, the maximum pressure is 2.57e+05Pa and minimum static pressure is -2.61e+05Pa.

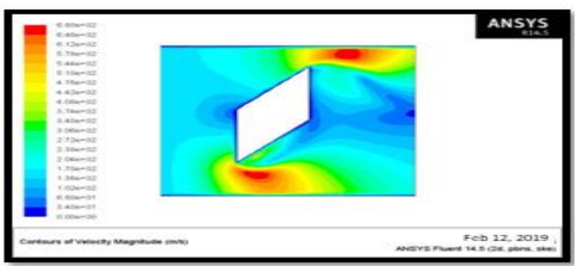


Fig 26: Velocity variation

According to the above contour plot, the maximum velocity magnitude of the air at corners of narrow plate, because the applying the boundary conditions at inlet of the boundary of the narrow plate and minimum velocity magnitude at around edges of the narrow plate.According to the above contour plot, the maximum velocity is 6.80e+02m/s and minimum velocity is 3.40e+01m/s.

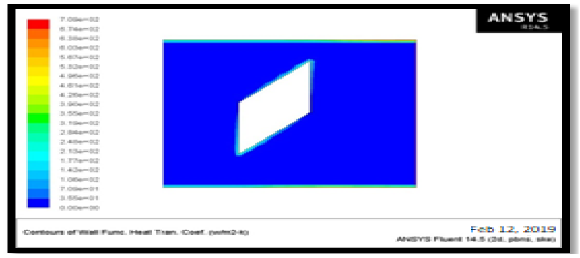


Fig 27:Heat transfer coefficient

According to the above contour plot, the maximum heat transfer coefficient of the air at edges of the narrow plate and minimum heat transfer coefficient between around the boundary edges and narrow plate edges. According to the above contour plot, the maximum heat transfercoefficient is 7.09e+02w/m^2-k and minimum heat transfer coefficient is 3.55e+01w/m^2-k

Mass Flow Rate	(kg/s)
inlet	198.29997
interior-_trm_srf	2164.0718
outlet	-197.68851
wall-_trm_srf	0
Net	0.61146545

Fig 28: Mass flow rate

Total Heat Transfer Rate	(w)
inlet	2963688.3
outlet	-2954559.3
wall-_trm_srf	0
Net	9129

Fig 29:Heat transfer rate

THERMAL ANALYSIS OF VERTICAL NARROW FLAT PLATE

Copper, Aluminum alloy 6061 & aluminum alloy 7075

Copper material properties

Thermal conductivity = 385w/m-k

Aluminum alloy material properties

Thermal conductivity = 30.0w/m-k

Steel material properties

Thermal conductivity = 50.2w/m-k

BOUNDARY CONDITIONS

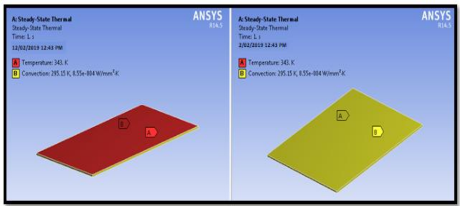


Fig 30: Applying boundary condition

T =343K

A)VERTICAL NARROW PLATE AT 0^0

1)MATERIAL – COPPER

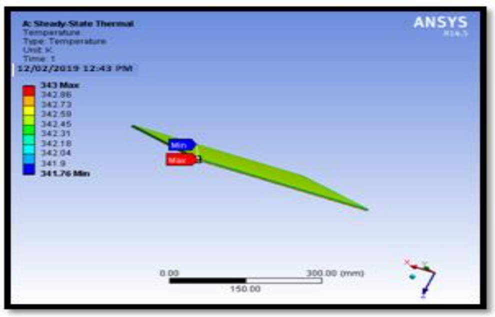


Fig3 1:Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

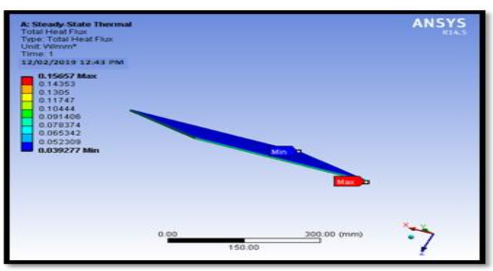


Fig 32: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates. According to the above contour plot, the maximum heat flux is 0.15657w/mm^2 and minimum heat flux is 0.039277w/mm^2.

2)MATERIAL – ALUMINUM ALLOY

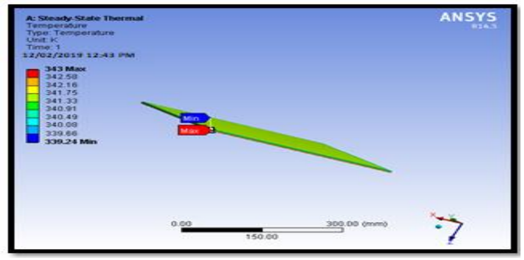


Fig 33: Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

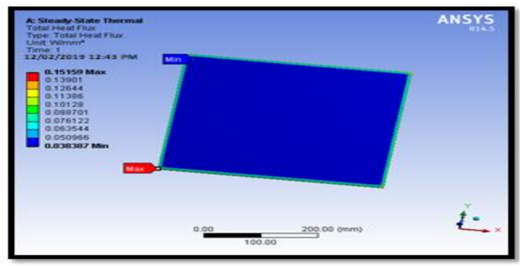


Fig 34: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.15159w/mm^2 and minimum heat flux is 0.038387w/mm^2.

3) MATERIAL – STEEL

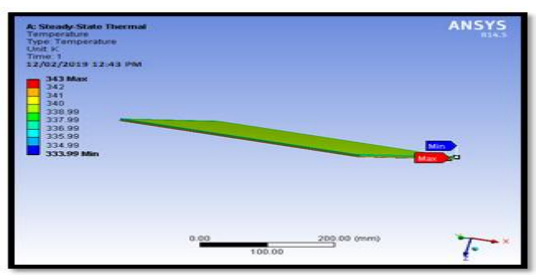


Fig 35 :Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

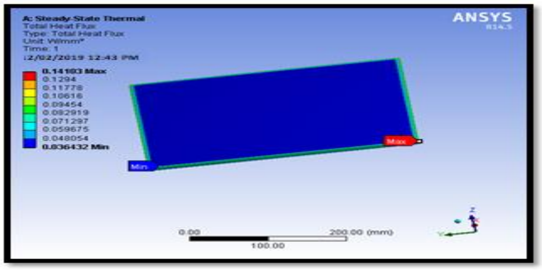


Fig 36: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.14103w/mm^2 and minimum heat flux is 0.036432w/mm^2.

B) VERTICAL NARROW PLATE AT 30^0

1) MATERIAL – COPPER

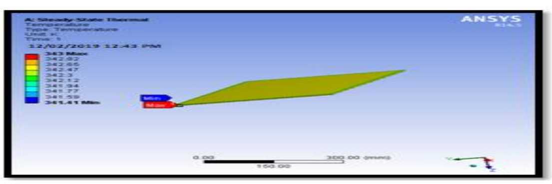


Fig 37:Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

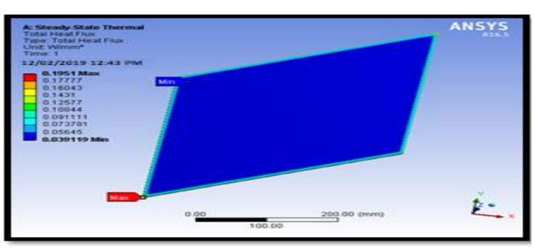


Fig 38: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.1951w/mm^2 and minimum heat flux is 0.039119w/mm^2

2)MATERIAL – ALUMINUM ALLOY

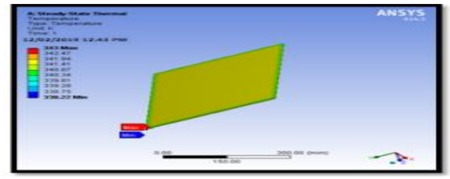


Fig 39: Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate

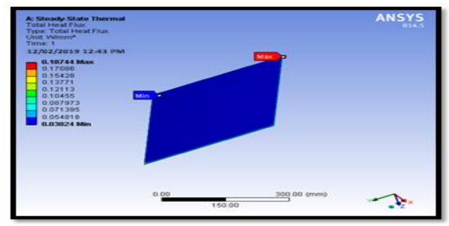


Fig 40: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.18744w/mm^2 and minimum heat flux is 0.03824w/mm^2

3)MATERIAL – STEEL

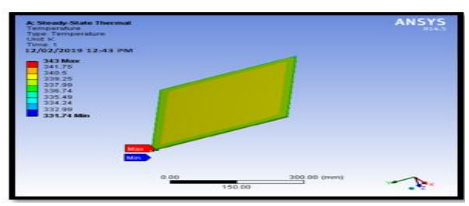


Fig 41:Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

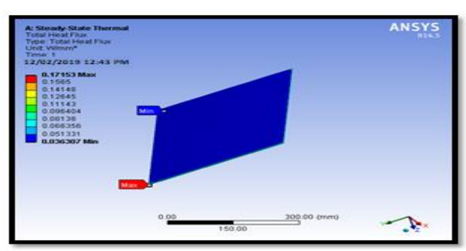


Fig 42: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.17153w/mm^2 and minimum heat flux is 0.036307w/mm^2

C)VERTICAL NARROW PLATE AT 45^0

1)MATERIAL – COPPER

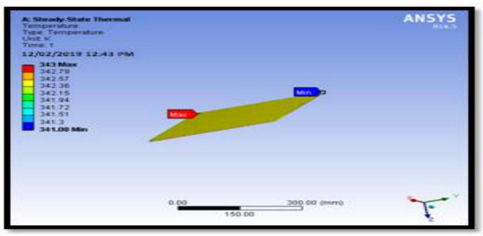


Fig 43: Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

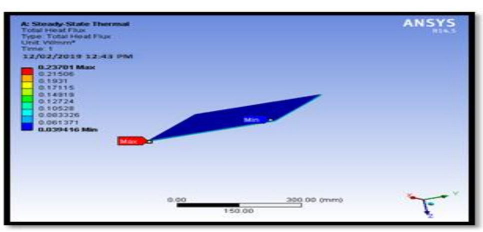


Fig 44:Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.23701w/mm^2 and minimum heat flux is 0.039416w/mm^2.

2)MATERIAL – ALUMINUM ALLOY

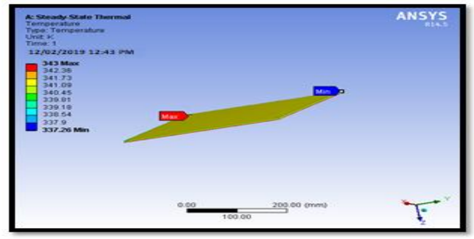


Fig 45: Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate.

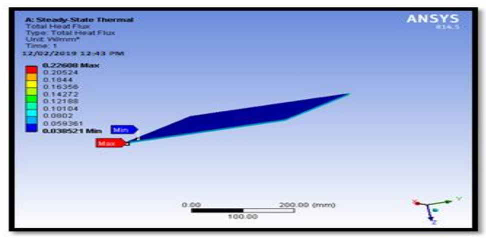


Fig 46: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.22608w/mm^2 and minimum heat flux is 0.038521w/mm^2

3) MATERIAL – STEEL

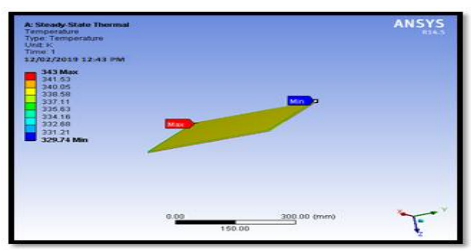


Fig47: Temperature distribution

According to the contour plot, the temperature distribution maximum temperature at bottom of the narrow plate because the temperature passing from the bottom of the plate. So we are applying the temperature bottom of the plate and applying the convection except bottom of the plate

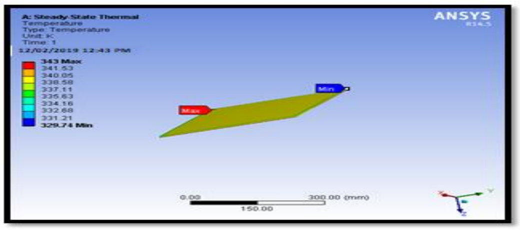


Fig 48: Heat flux

According to the contour plot, the maximum heat flux at corner portion of the narrow plates. Minimum heat flux except corners of the narrow plates.According to the above contour plot, the maximum heat flux is 0.20385w/mm^2 and minimum heat flux is 0.03655w/mm^2.

IV.RESULT AND DISCUSSION

REYNOLDS NO2×10^6

Models	Pressure (pa)	Velocity (m/s)	H.T Coffient (w/m^2-k)	M.F rate	H.T rate (w)
0^0	**2.59e+04**	**2.22e+02**	**3.14e+02**	**0.0141983**	**57075.5**
30^0	**3.25e+04**	**2.80e+02**	**3.39e+02**	**0.13510132**	**2022.375**
45^0	**6.49e+04**	**3.40e+02**	**4.06e+02**	**0.246078**	**3677.875**

TABLE 1

REYNOLDSNO: 4×10^6

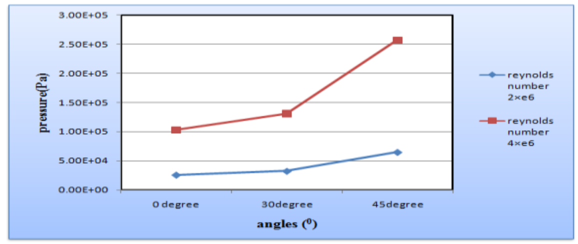
models	Pressure (Pa)	Velocity (m/s)	H.T Coffient (W/M^2-K)	M.F Rate	H.T Rate (w)
0^0	**1.03e+05**	**4.44e+02**	**5.52e+02**	**0.02565**	**120081**
30^0	**1.31e+05**	**5.60e+02**	**5.96e+02**	**0.86120605**	**12874.25**
45^0	**2.57e+05**	**6.80e+02**	**7.09e+02**	**0.611465**	**9129**

TABLE :2

CFD ANALYSIS GRAPHS

By observing the CFD analysis the pressure drop & velocity increases by increasing the inlet Reynolds numbers and increasing the plate angles. The heat transfer rate increasing the inlet Reynolds numbers, more heat transfer rate at 0^0 angles.

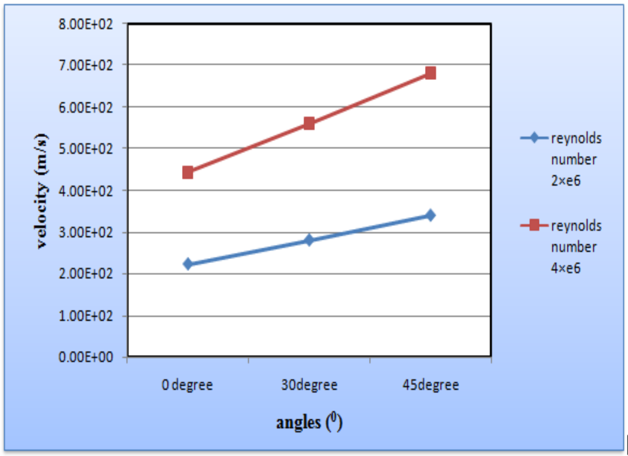
Pressure Plot



Graph: 1

Models	**Pressure at Reynolds no 2×10^6 (pa)**	**Pressure at Renolds no: 4×10^6 (pa)**
0^0	**2.59e+04**	**4.44e+02**
30^0	**3.25e+04**	**5.60e+02**
45^0	**6.49e+04**	**6.80e+02**

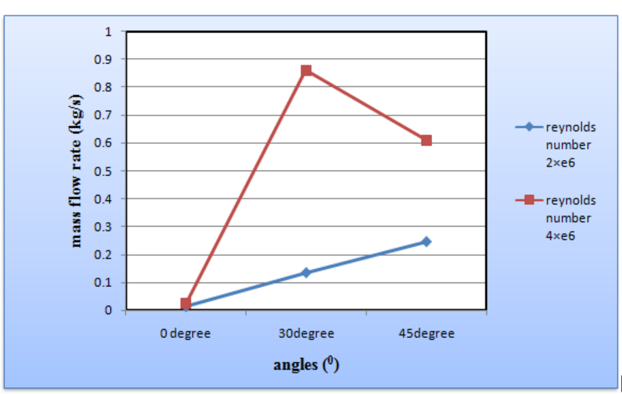
Velocity Plot



Graph :2

Models	Velocity at Reynolds no 2×10^6 (pa)	Velocity at Renolds no: 4×10^6 (pa)
0^0	2.22e+02	4.44e+02
30^0	2.80e+02	5.60e+02
45^0	3.40e+02	6.80e+02

Mass Flow Rate Plot

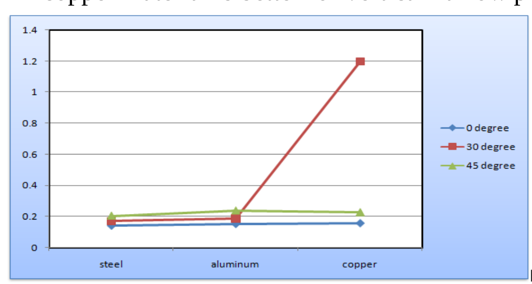


Graph: 3

Models	Mass Flow rate at Reynolds no 2×10^6 (pa)	Mass flow rate at Renolds no: 4×10^6 (pa)
0^0	0.0141983	0.02565
30^0	0.13510132	0.86120605
45^0	0.246078	0.611465

THERMAL ANALYSIS GRAPH

By observing the CFD analysis the pressure drop & velocity increases by increasing the inlet Reynolds numbers and increasing the plate angles. The heat transfer rate increasing the inlet Reynolds numbers, more heat transfer rate at 0^0 angles.By observing the thermal analysis, the taken different heat transfer coefficient values are from CFD analysis. Heat flux value is more for copper material than steel& aluminum.So we can conclude the copper material is better for vertical narrow plates.



Graph :4

THERMAL ANALYSIS TABLE

Models	Materials	Temperature (^{0}C) Max	Min	Heat flux (w/mm^2)
0^0	Steel	343	333.99	0.14103
0^0	Aluminum	343	339.2	0.15159
0^0	Copper	343	341.76	0.15657

30^0	Steel	343	331.7	0.17153
30^0	Aluminum	343	338.22	0.18744
30^0	Copper	343	341.41	1.1951
45^0	Steel	343	331.7	0.17153
45^0	Aluminum	343	338.22	0.18744
45^0	Copper	343	341.41	1.1951

V. CONCLUSION

The air flow through vertical narrow plates is modeled using CREOdesign software. **We will focus on thermal and CFD analysis with different Reynolds number (2×10^6& 4×10^6) and different plate angles (0^0,$30^0$and 45^0)of the vertical narrow plates**. Thermal analysis done for the different vertical narrow plates like steel, aluminum & copper at different heat transfer coefficient values. These values are taken from CFD analysis at different Reynolds numbers, By observing the CFD analysis the **pressure drop &velocity increases** by **increasing the inlet Reynolds numbers and increasing the plate angles**. **The heat transfer rate increasing the inlet Reynolds numbers, more heat transfer rate (57075.5) at 0^0angles.** By observing the thermal analysis, the taken different heat transfer coefficient values are from CFD analysis. **Heat flux value (1.1951)is more for copper material than steel&aluminum**.So we can conclude the copper material is better for vertical narrow plates.

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