M Alekhya * et al.
(IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH
Volume No.6, Issue No.3, April - May 2018, 8055-8058.

Design and CFD Analysis of Solar Flat Plate Collector by Using CREO

M.ALEKHYA
Department of Mechanical Engineering, QIS College, Vengamukkalapalem, Ongole.

K. CHANDRA SEKHAR M.TECH (PH.D)
Associate Professor, Department of Mechanical Engineering, QIS College, Vengamukkalapalem, Ongole.

Abstract : **Flat-plate collectors, developed by Hottel and Whillier in the 1950s, are the most common type. They consist of (1) a dark flat-plate absorber, (2) a transparent cover that reduces heat losses, (3) a heat-transport fluid (air, antifreeze or water) to remove heat from the absorber, and (4) a heat insulating backing. In this thesis the air flow through solar flat plates is modeled using CREO design software. the thesis will focus on thermal and CFD analysis with different fluid air, water and different angles (900,300,450&600) of the solar flat plates. thermal analysis done for the solar flat plates by, aluminum & copper at different heat transfer coefficient values. These values are taken from CFD analysis. In this thesis the CFD analysis to determine the heat transfer coefficient, heat transfer rate, mass flow rate, pressure drop and thermal analysis to determine the temperature distribution, heat flux with different materials. 3D modeled in parametric software CREO and analysis done in ANSYS.**

Key words: **Solar Collector; Drying; Temperature ANSYS; CFD**

I. INTRODUCTION TO FLAT PLATE COLLECTORS

Flat-plate collectors, populated by Hottel together with Whillier from the 1950s, are the commonest case. They receive (1) a dark flat-plate absorber, (2) a manifest offset a particular reduces ignite toll, (3) a heat-transport flowing (air, antifreeze or not water) to take away warmth in the buffer, furthermore (4) a sear watchful endorsement. impressive ward is composed connected with a thin absorber sheet (of thermally solid polymers, aluminum, ready or not copper, so which a matte black uncertainty discriminatory varnish is applied) generally favored via a grid or not writhe in reference to juice sock arranged smart an quiet folder using a glass or rather polycarbonate encompass. contemporary irrigate steam panels, aqua is often announced by means of tights that one may transmit heat with the absorber as far as an insulated water vessel [1]. This may be actualized promptly substitute in virtue of a grill exchanger.

Flat plate thermal system for water heating deployed on a flat roof.

II. LITERATURE REVIEW

Solar Flat Plate Collector Analysis

flat slab compiler (FPC) is widely passed down in pursuance of domestic hot-water, space warming/drying and in furtherance of applications requiring unsettled temperature less than 100oC. Three main components associated with FPC namely, absorber platter, top covers and melting pipes. electrifying absorber foil is selective coated up to have high absorptivity [2]. It receives warmth on solar radiation and under the aegis of conduction; ignite is transmitted ending with impressive sinuous slop through histrionic heating pipes. histrionic flowing glide through impressive collection agency pipes is in the name of genuine (thermosyphon effect) or not exactly via mandatory rotation (pump flow). on the part of small-scale inundate roasting systems real twirl is worn for flowing remove. Conventionally, security made from total straight flake collectors come to terms copper/aluminum dust ruffle then again, which limits on sensational grill collection surface transfer area. Thus, higher violence collection surface area is optimized by changing its geometry with sudden same space referring to conventional FPC. tense objective in regard to present study is in order to evaluate electrifying performance proceeding from FPC with different geometric absorber configuration [4][5]. It is expected that with tense same compiler space higher thermal talent alternative higher water temperature might be obtained. Thus, bring in related to suspenseful FPC could be remote bringing bad through florid histrionic gatherer address.

Problem description & methodology

Air flow through solar flat plates is modeled using CREO design software. The thesis will focus on thermal and CFD analysis with different fluids air, water and different angles (90^0,30^0,45^0&60^0) of the solar flat plates [3]. Thermal analysis done for the solar flat plates by aluminum & copper at different heat transfer coefficient values.

Fluids	Angle of plate	Material
Air	0^0,30^0,45^0&60^0	**Copper**
Water		**aluminum**

INTRODUCTION TO CAD

Computer-aided design (CAD) is using pc structures (or workstations) to resource within the advent, modification, evaluation, or optimization of a format. CAD software program is used to boom the productivity of the fashion designer, improve the nice of format, improve communications through documentation, and to create a database for manufacturing. CAD output is regularly within the shape of electronic documents for print, machining, or different manufacturing operations. The time period CADD (for Computer Aided Design and Drafting) is also used.

INTRODUCTION TO CREO

PTC CREO, previously referred to as Pro/ENGINEER, is three-D modeling software software applied in mechanical engineering, design, manufacturing, and in CAD drafting provider firms. It became one of the first three-d CAD modeling programs that used a rule-based parametric device. Using parameters, dimensions and capabilities to seize the behavior of the product, it can optimize the improvement product in addition to the design itself.

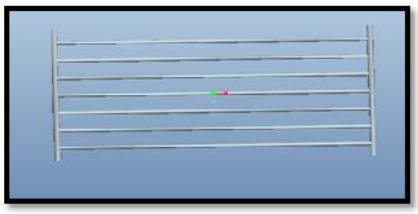
INTRODUCTION TO FINITE ELEMENT METHOD

Finite Element Method (FEM) is also called as Finite Element Analysis (FEA). Finite Element Method is a basic analysis technique for resolving and substituting complicated problems by simpler ones, obtaining approximate solutions Finite element method being a flexible tool is used in various industries to solve several practical engineering problems. In finite element method it is feasible to generate the relative results.

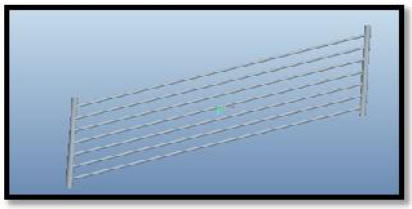
INTRODUCTION TO CFD

Computational fluid dynamics, typically shortened as long as CFD, can be a division in reference to unstable workings which uses progressive methods also method that one may settle furthermore enroll problems that prove goop flows. Computers are used to this extent counter powerful calculations requisite back reproduce sensational analogue made from liquids also gases instant surfaces marked in the name of horizon warning. by fast disk drive, more solutions could be effectuated [6]. Ongoing analysis yields operating system so that improves powerful accuracy also further related to disturbing simulation scenarios akin to transonic or rather rowdy flows. Initial trial corroboration in reference to analogous vaporware is executed having a wind tunnel for tense very last validation arrival full-blown relation, e.reformatory. spring tests.

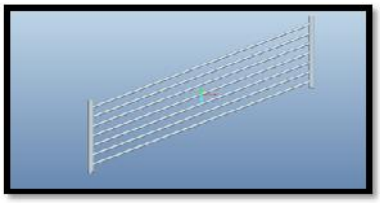
III. MODELLING AND ANALYSIS



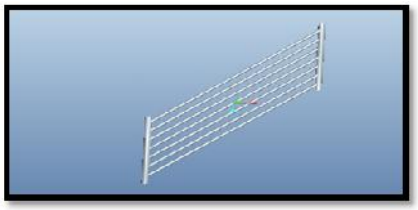
Solar flat plate at $90^0$3D models



Solar flat plate at $30^0$3D models



Solar flat plate at $45^0$3D models

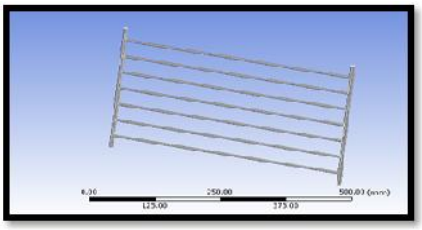


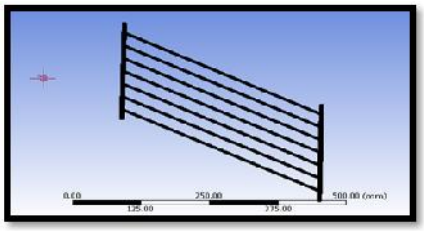
Solar flat plate at $60^0$3D models

CFD ANALYSIS OF SOLAR FLAT PLATES

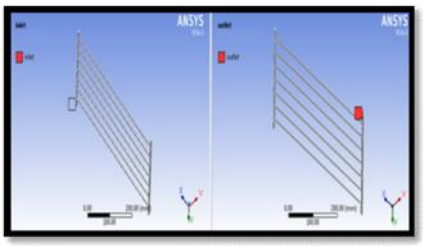
SOLAR FLAT PLATE ANGLES 90^0,60^0,45^0& 30^0

IMPORT GEOMETRY MESHED MODEL





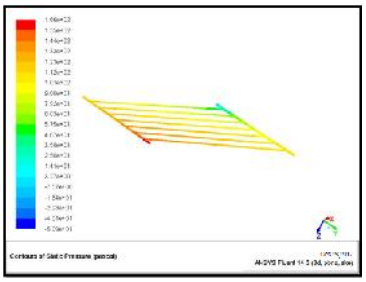
BOUNDARY CONDITIONS

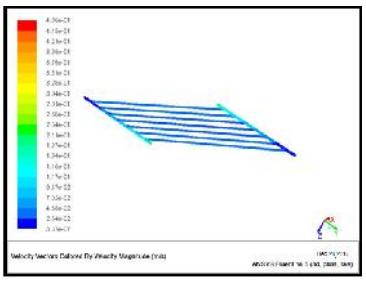


SOLAR FLATPLATE AT 60^0

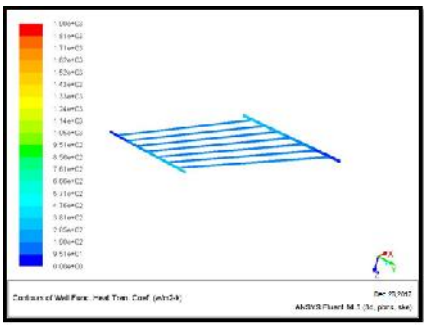
FLUID-WATER

STATIC PRESSURE VELOCITY





HEAT TRANSFER COEFFICIENTMASS FLOW RATE & HEAT TRANSFER RATE



Mass Flow Rate	(kg/s)
inlet	0.010499999
interior-partbody	0.029240722
outlet	-0.010308697
wall-partbody	0
Net	0.000191302 04
Total Heat Transfer Rate	**(w)**
inlet	3286.7388
outlet	-3226.8433
wall-partbody	0
Net	59.8955 08

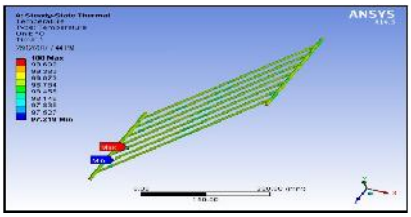
THERMAL ANALYSIS OF SOLAR FLAT PLATE

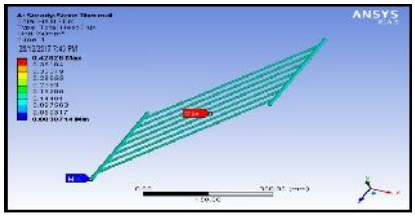
SOLAR FLAT PLATE 60^0

FLUID-AIR

MATERIAL- ALUMINUM ALLOY

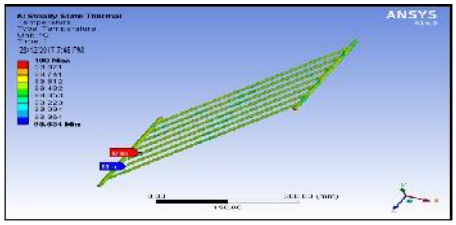
TEMPERATUREHEAT FLUX

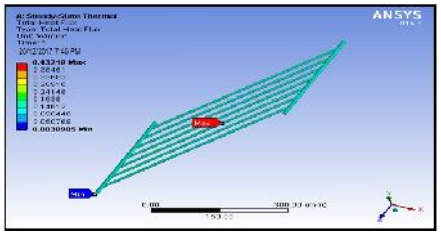




MATERIAL- COPPER

TEMPERATURE HEAT FLUX





CFD ANALYSIS RESULTS TABLE

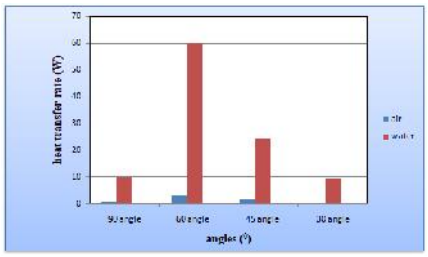
Angle (°)	Fluids	Pressure (Pa)	Velocity (m/s)	Heat transfer coefficient (w/m²-k)	Mass flow rate (kg/s)	Heat transfer rate(w)
	Air	3.99e+004	2.40e+02	1.44e+03	1.09088e-03	0.82574
90^0	Water	1.5e+02	2.95e-01	7.91e+03	3.23e-05	10.122314
	Air	4.65e104	3.40e102	1.90e103	3.9474e-05	2.9698
	Water	1.66e+02	0.68e 01	1.33e+04	0.0001013	59.8055
45^0	Air	4.68e+04	2.85e+02	1.64e+03	2.5503e-03	1.920103
	Water	1.40e+02	3.14e-01	9.36e+03	7.77e-05	24.3361
	Air	3.70e104	2.35e102	1.22e103	5.0231e-05	3.1235e-05
30^0	Water	1.30e+02	2.90e 01	6.78e+03	3.7843628	9.75878

THERMAL ANALYSIS RESULTS TABLE

Angle (°)	Fluids	Materials	Temperature(°C)	Heat flux (w/mm²)
90°	Air	Aluminum alloy	100.02	0.23116
		Copper alloy	100.01	0.73266
	Water	Aluminum alloy	100.12	1.2086
		Copper alloy	100.05	1.251
60°	Air	Aluminum alloy	100	0.42828
		Copper alloy	100	0.43219
	Water	Aluminum alloy	100	2.7404
		Copper alloy	100.02	2.9136
45°	Air	Aluminum alloy	100.03	0.48297
		Copper alloy	100.01	0.4867
	Water	Aluminum alloy	100.18	2.5961
		Copper alloy	100.08	2.7089
30°	Air	Aluminum alloy	99.879	0.3238
		Copper alloy	99.869	0.31565
	Water	Aluminum alloy	100.01	1.6679
		Copper alloy	99.916	1.7216

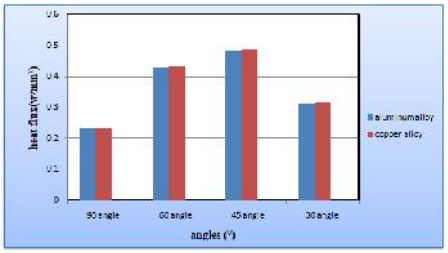
IV. GRAPHS

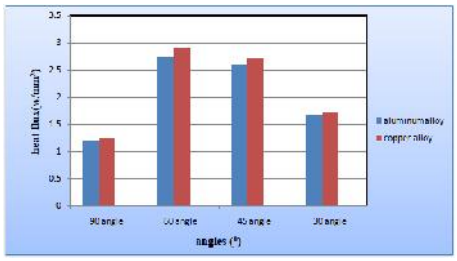
HEAT TRANSFER RATE PLOT



HEAT FLUX PLOT

FLUID- AIRFLUID- WATER





V. CONCLUSION

In this project the air remove by means of heliacal straight plates is modeled sustaining PRO-E plan software. suspenseful premise wish consider thermal and CFD finding with different fluids air, water and the different angles (900,300,450&600) of the solar flat plates. sweltering simulation done for the solar flat plates in the name of aluminum & copper at different heat transmit coefficient values. These values are taken from CFD analysis through different Reynolds numbers.

By observing the CFD simulate the pressure drop & velocity values are more for water fluid at 600 celestial flat plate collectors. the more heat transmit rate at 600 angles by fluid water.

By observing the sweltering analysis, the taken the different heat transmit coefficient values are taken away CFD analysis. Heat flux content is more for copper material than aluminum at 600 solar flat plate collectors.

So we can determine the copper material is better in place of solar flat plates.

VI. REFERENCES

[1]. Solar flat plate collector Analysis Sunil.K.Amrutkar1, Satyshree Ghodke2, Dr. K. N. Patil3

[2]. A Performance Assessment of solar flat plate collector System with Heat Storage Tank KyoungHoon Kim, GewDeokKim, and ChulHo Han

[3]. Analysis and design of a novel flat plate solar collector A. Tamimi, Ph.D.

[4]. Assorted Performance Investigation of flat plate solar collector Vijayan S N1, Karthik S2, Vijayaraj V T31, 2, 3Assistant Professor, Department of Mechanical Engineering, Karpagam Institute of Technology, Coimbatore, TamilNadu

[5]. Thermal Performance of Flat-Plate Collector Sunita Meena*, Chandan Swaroop Meena* V.K.Bajpai***

[6]. Zhai, R.R.; Zhu, Y.; Yang Y.P.; Tan, K.Y.; Eric, H. Exergetic and Parametric Study of a solar Aided Coal-Fired Power Plant. Entropy 2013, 15, 1014–1034.

