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Cfd Analysis and Comparision of Fluid Flow through Conical Orifice Plate and Standard Orifice Plate at Different Reynolds Numbers

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Abstract: *Flow measurement is dimension of the quantity of the fluid that passes via the pipe, duct or an open channel. Flow can be measured by way of measuring the velocity of fluid over a known region. Differential pressure measuring gadgets which includes orifice plates and nozzles are considerably carried out in numerous industries to estimate the mass glide price strolling via a channel by correlating the measured strain loss. In this thesis, an orifice plates with one-of-a-kind geometry had been designed and as compared on the premise in their coefficient of discharge. This turned into completed with the help of simulations finished with okay-ε and model on CFD as a solver. Simulations have been executed on a single hollow, perforated (6 holes, eight holes, 12 holes and 14 holes) at extraordinary Reynolds numbers (8000, 10000 and 12000). In this thesis the CFD analyses to determine the stress drop turbulence depth, mass float rate, and speed. 3-D modeled in parametric software program Pro-Engineer and analysis done in ANSYS.*

I.INTRODUCTION

An orifice plate is a device used for measuring drift price, for decreasing pressure or for limiting float (within the latter two instances it is often called a limit plate). Either a volumetric or mass drift charge can be determined, relying on the calculation related to the orifice plate. It uses the equal precept as a Venturi nozzle, specifically Bernoulli's precept which states that there may be a dating between the strain of the fluid and the velocity of the fluid. When the velocity will increase, the strain decreases and vice versa.

WORKING PRINCIPLE As the fluid tactics the orifice the stress increases slightly and then drops suddenly as the orifice is surpassed. It keeps to drop until the “vena contracta” is reached and then progressively increases till at about five to eight diameters downstream a most pressure point is reached as a way to be decrease than the pressure upstream of the orifice. The lower in strain because the fluid passes through the orifice is a end result of the elevated speed of the fuel passing thru the decreased vicinity of the orifice. When the speed decreases as the fluid leaves the orifice the pressure will increase and tends to go back to its authentic stage. All of the stress loss isn't always recovered due to friction and turbulence losses within the circulate. The strain drop across the orifice increases when the charge of glide increases. When there is no float there may be no differential. The differential strain is proportional to the square of the velocity, it consequently follows that if all different factors continue to be constant, then the differential is proportional to the rectangular of the charge of glide.

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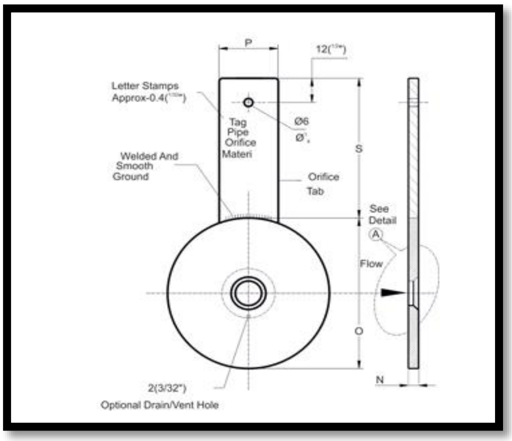

Fig:1 orifice plate

Fig: 2 orifice plate with holes

II.LITERATURE SURVEY

CFD Analysis and Comparison of Fluid Flow via a Single Hole And Multi Hole Orifice Plate. Flow size is one of the maximum vital responsibilities in lots of industries. Even today there does no longer exist a generic waft measuring tool in many go with the flow packages. The fluid go with the flow via a unmarried whole orifice plate and multi holes orifice plate have been analyzed in this paper by means of using Computational Fluid Dynamics (CFD). For evaluation water is used as fluid and is allowed to pass thru a pipe throughout the orifice plate. The geometry of the orifice plate and the pipe phase has made using PRO-E and the version has meshed the usage of HYPER MESH 11.0, the go with the flow characteristics are studied using ANSYS FLUENT 6.Three.26. This paper additionally gives the impact of orifice holes association or distribution in a plate on the overall

Cases	Reloynod numbers
Single hole	Re 8000 ,Re 10000 and Re 12000
Six holes	
Eight holes	
Twelve holes	
Fourteen holes	

performance of glide characteristics along with flow charge, stress drop, speed and turbulent intensity. The parameters used for designing the orifice plate are non wellknown conditions. The evaluation is done for four diameter ratio (d/D= zero.60, zero.30, 0.20, 0.15 for unmarried hollow, 4, 9 and 16 holes respectively). The inner diameter of the pipe used is 50 mm and the plate thickness used for evaluation is 3 mm for all the plates. The simulation results indicates that multi holes orifice plate have higher glide traits examine to unmarried hole orifice plate for the same area of departure.

III. PROBLEM DISCRIPTION

This became accomplished with the help of simulations executed with k-ε and model on CFD as a solver. Simulations have been performed on a unmarried hole, perforated (6 holes, 8 holes, 12 holes and 14 holes) at special Reynolds numbers (8000, ten thousand and 12000). In this thesis the CFD analyses to decide the strain drop turbulence depth, mass waft charge, and speed. Three-D modeled in parametric software program Pro-Engineer and evaluation accomplished in ANSYS.

IV. INTRODUCTION TO CAD/CAE:

Computer-aided design (CAD) is described as the utility of computers and graphics Software to resource or decorate the product layout from conceptualization to documentation. CAD is maximum usually related to using an interactive laptop images gadget, referred to As a CAD machine. Computer-aided design systems are effective gear and within the mechanical Design and geometric modeling of products and components.

INTRODUCTION TO PRO-ENGINEER

Pro/ENGINEER Wildfire is the usual in three-D product design, offering industry-leading productiveness gear that sell quality practices in design whilst making sure compliance along with

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your industry and organization standards. Integrated Pro/ENGINEER CAD/CAM/CAE answers can help you layout faster than ever, whilst maximizing innovation and fine to in the end create terrific products.

Different modules in pro/engineer

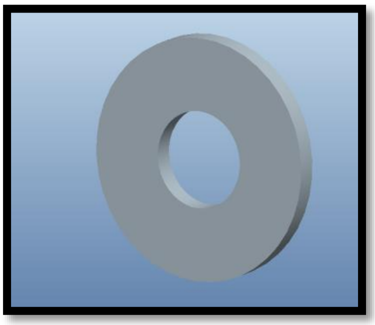
Part design, Assembly, Drawing& Sheet metallic.

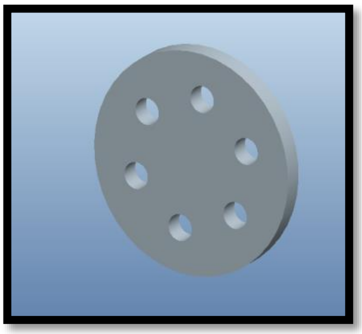
INTRODUCTION TO FINITE ELEMENT METHOD:

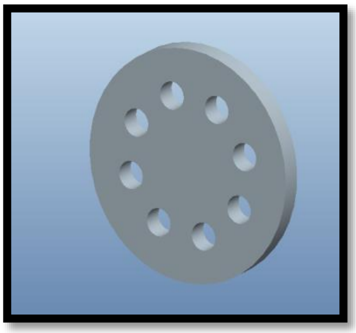
Finite Element Method (FEM) is also referred to as as Finite Element Analysis (FEA). Finite Element Method is a simple analysis method for resolving and substituting complex issues with the aid of less difficult ones, obtaining approximate answers Finite detail technique being a flexible tool is utilized in various industries to clear up numerous realistic engineering issues. In finite detail method it is feasible to generate the relative consequences.

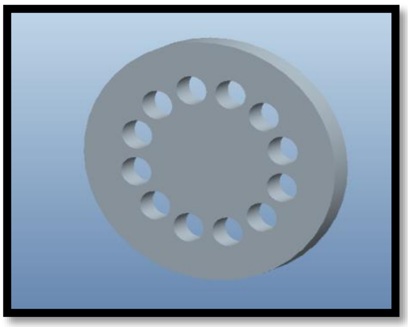
V MODELING AND ANALYSIS

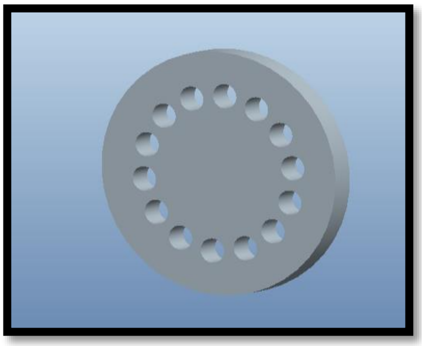
3D MODEL OF ORIFICE PLATE



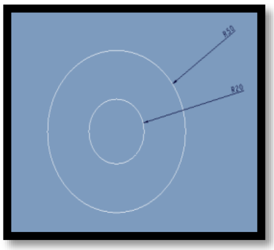








2D MODEL OF ORIFICE PLATE



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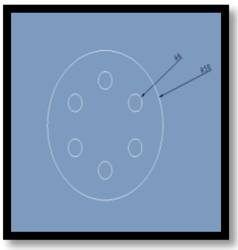
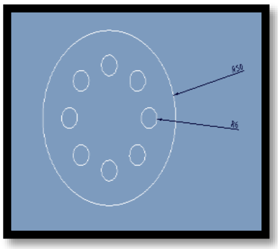
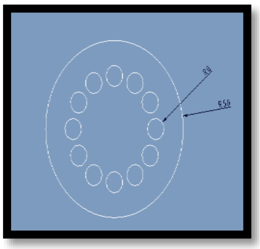
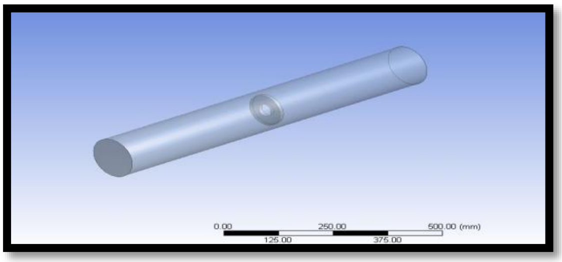




Fig: 8 single hole fig: 9 6 holes fig: 10 single hole fig: 11 single hole

CFD ANALYSIS OF ORIFICE PLATE

CASE 1-SINGLE HOLE

CONDITION 1- AT REYNOLDS NUMBER-8000



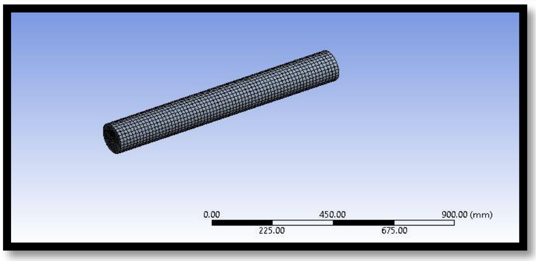
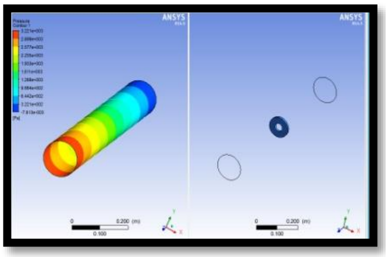
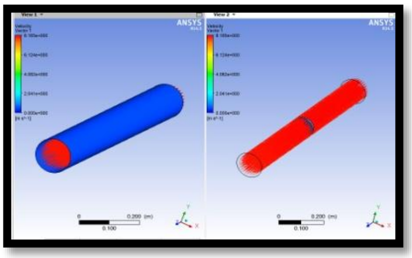
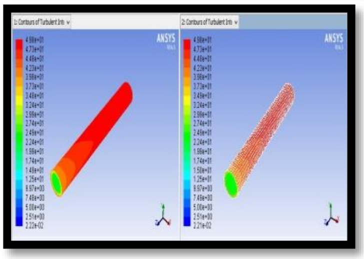


Fig: 12 imported model
Fig: 13 meshed model

Turbulence intensity

Mass Flow Rate	(kg/s)
inlet	98.91497
interior-____msbr	-3.1907804e-10
interior-solid	6629.834
outlet	-98.920853
wall-____msbr	0
wall-solid	0
Net	-0.0058822632

Total Heat Transfer Rate	(w)
inlet	22689378
outlet	-22690730
wall-____msbr	0
wall-solid	0
Net	-1352

VI RESULT TABLES

CONDITION 1- AT REYNOLDS NUMBER-8000

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Cases	Pressure (Pa)	Velocity (m/s)	Mass flow rate(kg /sec)	Heat transfer rate(w)	Turbulence intensity(%)
1 hole	3.222 e+03	8.16 5	0.0058 8	1352	4.98e+0 1
6 holes	3.917 e+03	8.18 4	0.0089 18	2036	4.99e+0 1
8 holes	3.919 e+03	8.18 6	0.0093 383	2157	5.0e+01
12 holes	3.965 e+03	8.18 6	0.0101 5	2322	5.21e+0 1
14holes	3.715 e+03	8.18 5	0.0066 07	1526	5.10e+0 1

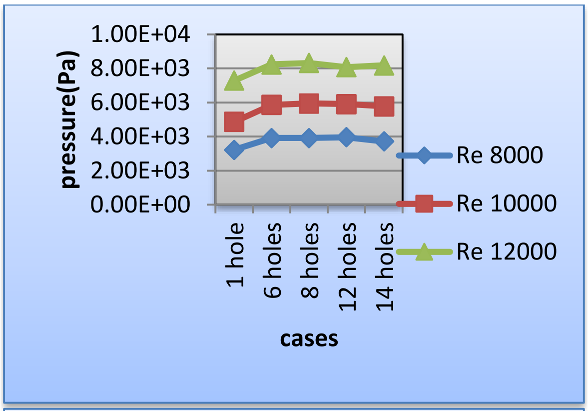
CONDITION 2- AT REYNOLDS NUMBER-10000

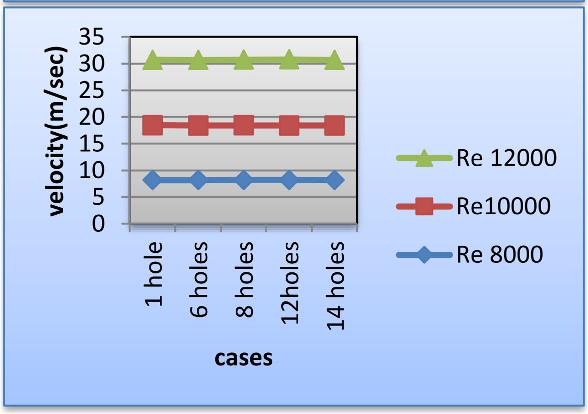
Cases	Pressure (Pa)	Velocity (m/s)	Mass flow rate(kg/sec)	Heat transfer rate (w)	Turbulence intensity(%)
1 hole	4.86e +03	1.03e+ 01	0.0073	1702	6.10e+ 01
6 holes	5.859 e+03	1.023e +01	0.0083 4	1894	6.11e+ 01
8 holes	5.940 e+03	1.024e +01	0.0161 5	3696	6.12e+ 01
12 holes	5.909 e+03	1.023e +01	0.0032 9	734	6.14e+ 01
14holes	5.774 e+03	1.0232 e+01	0.0124	2852	6.11e+ 01

CONDITION 3- AT REYNOLDS NUMBER-12000

Cases	Pressure (Pa)	Velocity (m/s)	Mass flow rate(kg/sec)	Heat transfer rate(w)	Turbulence intensity(%)
1 hole	7.288 e+03	1.224 e+01	0.0344	7896	7.21e+ 01
6 holes	8.234 e+03	1.227 e+01	0.0081 1765	1876	7.22e+ 01
8 holes	8.319 e+03	1.23e +01	0.0205	4712	7.23e+ 01
12 holes	8.07e +03	1.237 e+01	0.0044 63	1056	7.26e+ 01
14holes	8.18e +03	1.226 e+01	0.0044 63	1024	7.229e +01

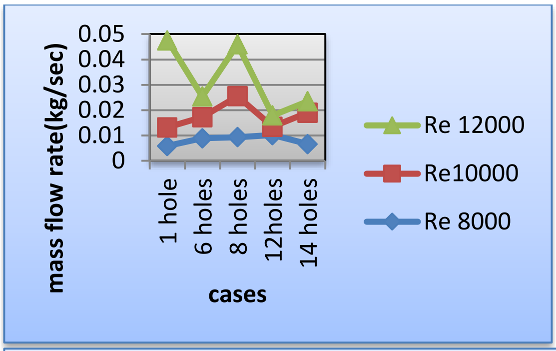
GRAPHS

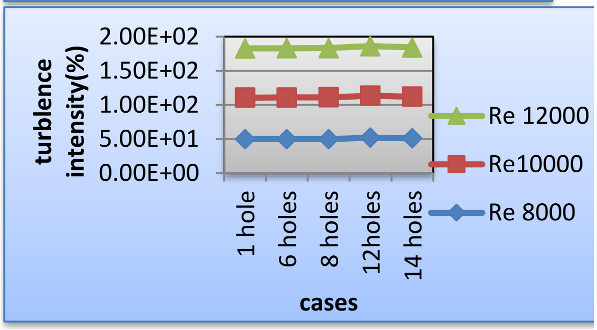




Pressure plot

Velocity plot





Mass flow rate

Turbulence intensity

VII. CONCLUSION

In this thesis, an orifice plates with distinctive geometry have been designed and compared on the premise of their coefficient of discharge. This turned into executed with the help of simulations carried out with k-ε and version on CFD as a solver. Simulations had been finished on a single hole, perforated (6 holes, 8 holes, 12 holes and 14 holes) at unique Reynolds's numbers (8000, ten thousand and 12000).

By looking at the CFD analysis results, the strain and turbulent intensity increases through increasing the orifice plate holes and Reynolds numbers. Mass drift charge value extra for unmarried hole of the orifice plate.

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