ANALYSIS OF ENERGY LOSS ON STEPPED SPILLWAY USING OBSTRUCTIONS THROUGH ANSYS

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CERTIFICATE

I hereby certify that the Project Dissertation titled **"ANALYSIS OF ENERGY LOSS ON STEPPED SPILLWAY USING OBSTRUCTIONS THROUGH ANSYS"** by **Anshuman Gupta**, Roll No. **2K16/HFE/05**, Department of Civil Engineering, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Technology, is a record of the project work carried out by the student under my supervision. To the best of my knowledge, this work has not been submitted in parts or full for any Degree or Diploma to this University or elsewhere.

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CANDIDATE'S DECLARATION

I, Anshuman Gupta, Roll No. 2K16/HFE/05 of M.Tech. HYDRAULICS & WATER RESOURCES ENGINEERING, hereby declare that the project Dissertation titled **"ANALYSIS OF ENERGY LOSS ON STEPPED SPILLWAY USING OBSTRUCTIONS THROUGH ANSYS"** which is submitted by me to the Department of Civil Engineering, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of technology, is original and not copied from any source without proper citation. This work has not been used for the award of any Degree, Diploma Associateship, Fellowship or other similar title or recognition.

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Date:

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First, I would like to thank my family, without their love and support over the years, none of this would have been possible. They have always been there for me and I am thankful for everything they have helped me achieve.

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ABSTRACT

In order to pass surplus water and sediment particles from upstream to downstream of dams, structure called spillway is used. Spillways are among important hydraulic structures which play a significant role in stability of dams. In some cases and when the slope is too steep to build a chute, in order to transfer water from upstream to downstream, a stepped spillway which is used which improves energy dissipation as well as . In the present study, in order to ascertain the effect of different parameters such as obstruction on every step, arrangement of obstruction and percentage area of projected area on energy dissipation in the simple stepped spillway, the models of stepped spillway was used with four different types:

- Spillway with no obstruction
- Spillway with 10% obstruction
- Spillway with 20% obstruction
- Spillway with 25% obstruction

Models were studied for various energy losses, velocity distribution and pressure distribution. And thereafter optimum area of the obstruction was observed. Initially different heads and velocity were taken into consideration and thereafter arrangement of the obstruction was also taken into consideration i.e. initially obstruction created was vertical but in subsequent stages horizontal obstruction was also taken into consideration.

CONTENTS

LIST OF FIGURE

LIST OF TABLE

LIST OF EQUATIONS

CHAPTER-1

INTRODUCTION

1.1 SCOPE OF THE PROJECT

Stepped block protection has significant potential as a economical method for the construction of spillways and the protection of banks from erosion by overtopping flow. Stepped spillways are structurally stable, resistant to heavy loads and increases the rate of energy dissipation on the spillway face hence reducing the need for a large energy dissipation basin at the spillway toe. It can also be constructed for use in diversion works during dam construction and for providing additional spillway capacity to existing dams. While constructing stepped spillway over embankment dam, the stepped block is used in conjunction with an under layer which includes a free draining medium and a lower zone which has the purpose of filtering seepage flow out of the subsoil and also protecting the subsoil from erosion by flow in the draining layer. Blocks are laid in stretcher bond configuration.

While stepped spillways are constructed from ancient times, the hydraulic design of stepped spillways has interestingly been an active topic for research over the past 50 years. Studies in laboratories have added to the knowledge base in the field and have provided a greater perspective on design questions. There have been several notable papers and books that have in particular discussed hydraulic design guidance for stepped channels operating in the nappe and skimming flow regimes; Essery & Horner (1978), Pravdivets & Bramley (1989) , Chanson (1994a), Christodoulou (1999), Boes & Minor (2000), Matos (2000), Chanson (2001), Chanson (2002), Boes & Hager (2003b), Frizell (2006), Gonzalez & Chanson (2007), Hunt (2008), Renna & Fratino (2010), Meireles et al. (2012),Matos & Meireles (2014), and Chanson et al. (2015)

These works are focused on the hydraulics of stepped spillways. Many more studies have been established that focus on specific features of the flow on stepped spillways. This thesis will present generalized design guidance for stepped spillways with regards to their hydraulic characteristics and requirement. It will made from experiences at Reclamation; however, studies and experience from all over the world will be included in order to provide a broad perspective of the design and use of stepped spillways today. In terms of construction, the last few decades have likely been the most amazing period in history for stepped spillways. The guide will reflect the current state-of-the-practice, realizing that with passing time, improvements and changes in design philosophy may certainly affect the appropriateness of some of these contents.

1.2 SUITABILITY

Energy dissipation below hydraulic structures is ensured generally by single – fall hydraulic jump type stilling basins, roller buckets or trajectory buckets. However, when the kinetic energy at the toe of the spillway is high. The tail water depths in the river are never satisfactory. Then first two devices cannot be used as in the case of high head dams. In narrow curved gorges consisting of fractured rocks, buckets cannot be used. In such situations, a system of cascading falls down the side of a valley, with a stilling basin in the downstream, can be used as an alternative spillway. Cascade spillways can be used for any type of dam irrespective of the material of construction.

The only disadvantage with stepped spillway is that at large discharges, as the jet is not aerated for some distance downstream of the spillway, low pressure may occur and lead to cavitation damage.

CHAPTER 2

LITERATURE REVIEW

Stepped overflow weirs and spillways have been used for few decades. Design of these structures went on simultaneously with dam-building which, in ancient times, lacked the presence of a rational approach (Smith, 1972). With advancement of technology and the ever-increasing need for safety, the knowledge and design of dams developed into the modern sophisticated designs. However, advancement in design of appurtenant structures, such as stepped spillways, appears to have lagged dam design, and only in recent years has it become an important topic of research .The difficulty in analyzing hydraulically rough surfaces like stepped spillways is the presence of highly turbulent, air entrained flow. Classic hydraulics theory and instrumentation can only approximate characteristics such as air entrainment, depth, and velocity of the two-phase flow.

In recent years, significant amounts of time and money have been devoted to laboratory model studies in order to study these characteristics. Following is a review of selected articles on research of stepped spillway flow. Selection of the articles was based on research conducted with physical scale models or of literature that has significantly contributed to the knowledge of stepped spillway flow.

3.1Flow Regimes Defined

Research literature generally recognizes two types of flow behaviour on a stepped slope: Nappe flow regime and skimming flow regime. Research on the hydraulics of stepped spillway flow usually concentrates on one regime or the other with the type of regime dictated by a combination of step geometry and flow discharge.

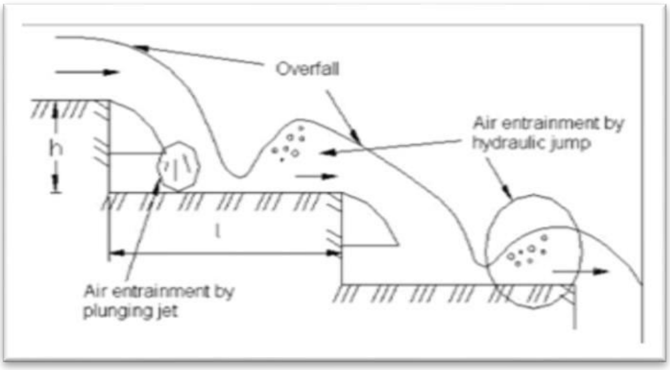


Fig.1: Nappe flow regime

Nappe flow normally occurs for low discharges and small flow depths while skimming flow occurs for high discharges and large flow depths. Nappe flow regime is distinguished by a series of plunges from one step to another with the formation of a nappe at each drop. This type of flow can be approximated by a series of single-step drop structures (Chamani and Rajaratnam 1994; Chanson 1993). The flow leaves the step as a free-falling jet and impinges on the tread of the next step. Energy dissipation occurs by jet breakup, jet mixing on the step, and the formation of a partially or fully developed hydraulic jump on the step (Chanson 1994; Rajaratnam 1990).

In the case of a fully developed hydraulic jump referred to as isolated nappe flow (Essery and Homer 1978; Peyras et. al. 1992), the flow passes through critical depth at the brink of the step forming a supercritical free-falling jet and returns to subcritical flow downstream of the jump. Flow with a partially developed hydraulic jump, referred to as nappe interference (Essery and Homer 1978) or partial nappe flow (Peyras 1992 et. al.), overshoots the next step and does not fully impinge on the step tread. For nappe flow to occur, the step horizontal tread needs to be greater than the water depth (Stephenson 1991; Lejeune et. al. 1994). In dam design, this would normally result in a relatively flat slope.

In skimming flow regime , water flows down the stepped face as a coherent stream, skimming over the steps and cushioned by the recirculating fluid trapped between them (Rajaratnam 1990). The skimming stream is supported by a psuedo-bottom formed by the external edges of the steps and horizontal-axis recirculating vortices. Energy dissipation occurs by momentum transfer, or the transmission of turbulent shear stress, between the skimming stream and the vortices (Chanson 1994).

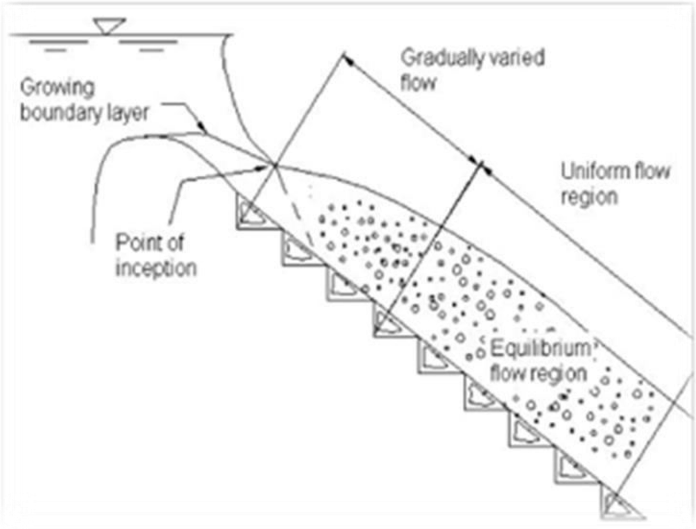


Fig.2: Skimming flow regime

Skimming flow is characterized by complete submergence of the steps with the development of fully aerated uniform flow in the downstream region (Figure 2.2). Along the upstream steps, a non-aerated flow region exists within which a turbulent boundary layer develops. Air entrainment in the flow begins where the boundary layer intersects the free surface, referred to as the point of inception. Downstream from the point of inception, the flow continues aerate and varies gradually in depth. The flow eventually becomes fully aerated, uniform flow in which the water depth, velocity, and air concentration are constant (Bindo et. al. 1993).

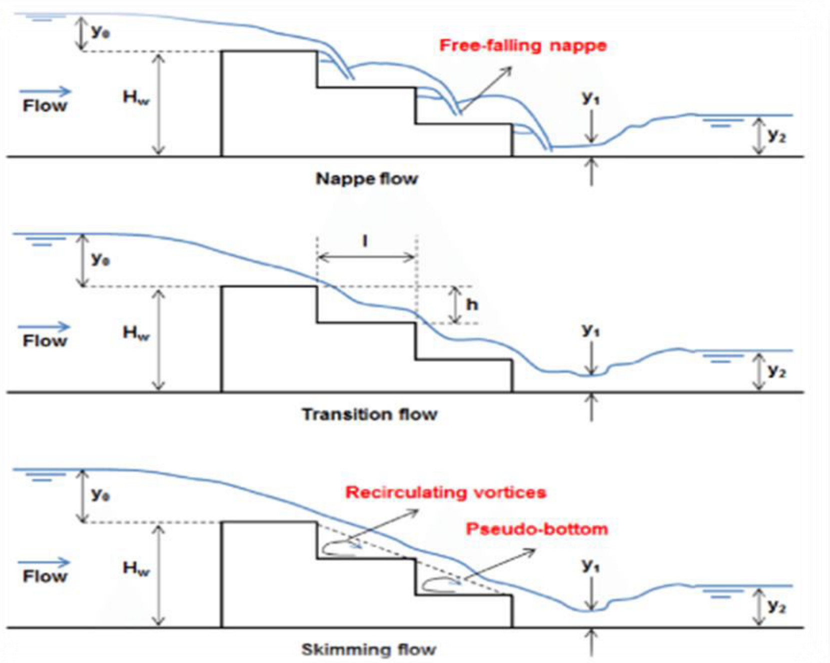


FIG.-3 FLOW REGIME

3.2HYDRAULIC STUDIES

Essery and Horner et al. (1978)

Essery and Homer (1978), of the Construction Industry Research Information Association of the U.K., appear to be the earliest researchers to thoroughly investigate the hydraulics of stepped spillways. The research was conducted by means of model studies covering a wide range of step configurations and slopes. Numerous tests were carried out varying the parameters of step height-to-length ratio (slope) JUL, step length L, inclination of the step tread B, and the number of steps N. Model parameters spanned a wide range with overall slopes from 0.421 to 1.0, step length from 0.22 ft to 0.82 ft, step inclination from 0° to 20°, and the number of steps from 10 to 30.

For each test, velocity measurements were taken using Pitot tubes placed in the: flow at a horizontal section downstream of the last step. Distance from the last step varied accordingly such that the :flow was free of air entrainment. The most important characteristics of the :flow at the horizontal section were described by specific energy Es, and specific force Fs, given by:

$$\boldsymbol{E = y + \frac{v^2}{2g}} \qquad (3.1)$$

$$\boldsymbol{F_s = \frac{v^2 y}{g} + \frac{y^2}{2}} \qquad (3.2)$$

Where: y= Mean depth; V= Mean velocity; g= Acc. due to gravity

Sorensen et al. (1985)

Sorensen (1985) conducted a model study to evaluate the proposed design of a stepped spillway for the new Monksville Dam in New Jersey. The profile of the spillway was a modification of the Waterways Experiment Station (WES) ogee crest profile. From the crest to the point of tangency, the spillway face followed the WES profile. Below the point of tangency, the spillway had a constant slope of0.78H:lV. Steps were fit into the spillway in such a manner that the envelope of their tips followed the WES profile and the downstream slope.

The prototype concrete dam and spillway were designed for 2.00 ft vertical by 1.56 ft horizontal steps below the point of tangency. Above the point of tangency, step sizes decreased in transition to the standard non-stepped ogee profile. Three scale models of the Monks Ville Dam spillway were tested. Model A consisted of a 1:10 scale model of the upper 22. 7 5 ft of the spillway tested to evaluate the flow transition over the spillway crest and the first several steps. The model extended down to seven steps below the point of tangency. Model B was a 1:25 scale model of the entire, standard, non-stepped WES profile spillway. This model was tested to provide comparison data. Model C was a 1:25 scale model of the entire stepped spillway profile. All model tests were conducted in a 1.0 ft wide flume with a maximum discharge of just less than 3.0 cfs.

Measurements of flow depth were made at several locations along the spillway for each model test over a range of discharges. When air entrainment was present, the flow depths were estimated taking into account the bulk of the flow. Spillway discharges ranged from a minimum of 0.056 cfs/ft to a maximum of 2.53 cfs/ft with corresponding upstream head measurements of 0.063 ft and 0.710 ft, respectively. Average flow velocities were calculated from continuity. It was noted that some of the velocities were checked with a stagnation tube and measurements were reported to yield results within 10-15% of the values calculated from continuity. In addition, scaled velocities from model B were 15-20% higher than the prototype data. Proposed reasoning was that air entrainment was not present in the flow during the testing of model B and in the prototype, air entrainment would be expected. This scaling effect was described to be the primary cause for the velocity differences.

It was found that the kinetic energy of the flow at the stepped spillway toe varied from about 6-12% of the energy at the standard spillway toe for the range of model discharges. For the prototype design, toe velocities were scaled up using Froude scaling ratios and velocities for model B were compared with prototype velocities found on similar spillways using "experience" data from Bradley and Peterka (1957). It was estimated that the stepped spillway for the Monksville dam may provide up to 84% kinetic energy dissipation at design discharges. Sorensen also recorded the step number, from the top, at which air entrainment commenced for each run. It was noted that typically, the depth decreased as the flow descended from the crest to the point at which air entrainment commenced. Beyond that point, the depth continually increased due to bulking of the flow by air entrainment.

Houston et al. (1987)

The U.S. Bureau of Reclamation conducted hydraulic model studies for design of the spillway for the Upper Stillwater dam in Utah. The dam incorporates Roller Compacted Concrete (RCC) construction techniques used for the dam into construction of the stepped spillway. The principle objective of the study was to design and analyze the configuration of the stepped spillway to provide information on sizing the stilling basin. Providing increased energy dissipation using steps resulted in reduction in size and cost of the stilling basin. Several sectional models of the spillway were tested ranging in scale from 1:5 to 1:10.

The final spillway design follows the theoretical nappe shape for an ogee crest. Several small steps began at the crest and gradually protruded into the profile downstream. The profile intersected a point of tangency where the slope became constant at 0.32H: lV. Following the shape of the dam, the slope changed to 0.6H: 1V approximately one-third of the full distance down the face. The beginning steps varied in size and were determined based on model results. Step size was selected to prevent the jet produced from a protruding step from springing free of the spillway. The final design maintained a uniform flow against the spillway face. The stilling basin was designed using the model of the final spillway design. Based on stilling basin velocities at the design discharge, it was estimated that 72% energy dissipation was provided by the spillway.

Rajaratnam et al. (1990)

Rajaratnam (1990) presented a method for predicting shear stress and frictional energy loss for a skimming flow regime. It was proposed that the average Reynolds shear stress between the skimming stream and the recirculating fluid underneath can be estimated by finding the coefficient of fluid friction for a given set of flow conditions.

For a stepped spillway of constant slope $S_0 = \sin\alpha$ and fully developed flow with a constant mean velocity V_0, and normal depth y_0, the shear stress may given by:

$$\tau = y_0 \, \gamma \, \sin\alpha \qquad (3.3)$$

Where: γ= weight per unit volume of water; τ = average Reynolds shear stress between the skimming flow and the recirculating fluid.

It was also assumed that the turbulent shear stress could be approximated by:

$$\tau = \frac{C_f(\rho {V_0}^2)}{2} \qquad (3.4)$$

Where: C_f = coefficient of fluid friction; p = mass density of water.

Rajaratnam evaluated values of C_f for skimming flow using experimental data from Sorensen (1985) on a 1:25 scale model of Monksville dam. Using the experimental data from Sorensen's model test, Cl-C8, Rajaratnam found vary from 0.11 to 0.20with an average value of 0.18. He states that this is an estimate due to the aeration occurring in the flow and that flow depths measured by Sorensen are approximate. An estimate of the energy loss for skimming flow on a stepped spillway was found by comparing energy loss caused by the steps E, to that caused by a smooth spillway $E^{'}$ given by:

$$\Delta E = E' - E$$

Relative energy loss was defined as ΔE/E 'and is given by the expression:

$$\frac{\Delta E}{E'} = \frac{(1-A) + \frac{F_o'^2}{2}\frac{(A^2-1)}{A^2}}{1+\frac{F_o'^2}{2}} \qquad (3.5)$$

$$\& \quad A = (C_f/C_f^{'})^{1/3}$$

Where: $C_f^{'}$ = coefficient of skin friction for a smooth spillway.

F_0' = Froude number at the toe of a smooth spillway.

Taking, $C_f \approx 0.18$, $C_f' \approx 0.0065$, $A \approx 3$, and for a relatively large value of F_0', $\Delta E/E'$ is approximately equal to $(A^2-1)/A^2$, which further reduces to a value of 8/9 or 89%. It was concluded from this that a considerable energy loss could be produced by the steps. Rajaratnam also performed an analysis with data from Essery and Homer (1978). He found that the type of flow regime existing on a stepped spillway depends on the ratio y_c/h, where Y_c is critical depth and h is the vertical height of the step. For a ratio of y/h greater than 0.8, skimming flow occurs and for a ratio less than 0.8, nappe flow exists.

Tozzi et.al. (1994)

Tozzi (1994) performed model studies on a 1:15 scale, 1V:0.75H slope, stepped spillway chute. Five step heights were tested in the model: 0.016, 0.033, 0.066, 0.098, and 0.197 ft. A method was proposed for determining the non-aerated flow depth, *h,* along the chute. This depth could then be used to find the residual energy at the spillway toe.

It was proposed to find the depth through computation of the gradually varied flow profile using the Standard Step Method.Determining the flow depth analytically requires determination of the Darcy-Weisbach friction factor f In order to apply the friction factor concept to steps, the roughness height k was defined as the step height from the spillway chute to the step tip, perpendicular to the flow. The friction factor was first investigated using air flow in a closed conduit. For h/k < 1.80,/became constant at 0.163, for h/k >1.80, the following relationship was found:

$$\frac{1}{\sqrt{f}} = 2.16 + 1.24 \log\left(\frac{h}{k}\right) \tag{3.6}$$

Similar relationships were found for slopes 1 V :2H and 1 V :6.69H.

Analytically determined depths were compared with experimentally determined depths and were found to differ by around 7% regardless of step height. The friction factor relationship appeared to adequately represent water flow. For water, the depth of flow was defined as the normal depth from the step tip to the point of maximum velocity (using a Pitot-static tube) above which the velocity was essentially constant.

The analytically computed non-aerated flow depth was found for the toe of the spillway for different flow-rates and step heights (roughness). The residual energy was then calculated by:

$$E_t=q^2+ q^2/2gh^2 \qquad (3.7)$$

Results from the stepped test found the residual energy to be 25-50% of the total head for unit discharges varying between 53.8 and 129.2 cfs/ft. For comparison, the model tests were run with a hydraulically smooth chute. Results showed that the stepped spillway was able to dissipate three to four times more energy than the smooth chute.

Further investigations were carried out to define the development of the turbulent boundary layer. The thickness of the layer was considered the flow depth at the point of inception of aeration, as computed by the Standard Step Method.

The data was shown to fit well to an equation developed by Campbell (1963):

$$\frac{h}{L_A} = 0.08\left(\frac{\mathrm{L_A}}{\mathrm{K}}\right) - 0.233 \qquad (3.8)$$

Where: L_a= the total length of the spillway.

The steps at which inception of air entrainment took place, found by the analytical method, were compared to the model data from Sorensen (1985) and were found to check very closely.

CHAPTER-3

NUMERICAL SIMULATION

Weirs with finite crest width in the direction of flow are called Broad crested weirs. They are also called as weirs with finite crest width and find extensive applications as control structures and flow measuring devices.

How to calculate Cd for different conditions:

- For long-crested weir (H_1/B_W <0.1)(**B_W=L_{CREST}**)

$$\mathbf{C_D = 0.561(H_1/B_W)^{0.222}} \quad (3.9)$$

- For broad crested weir(0.1 < H_1/B_W < 0.35)

$$\mathbf{C_D = 0.28(H_1/B_W) + 0.521} \quad (3.10)$$

- For narrow crested weir (0.45<H_1/B_W < about 1.5)

$$\mathbf{C_D = 0.12(H_1/B_W) + 0.492} \quad (3.11)$$

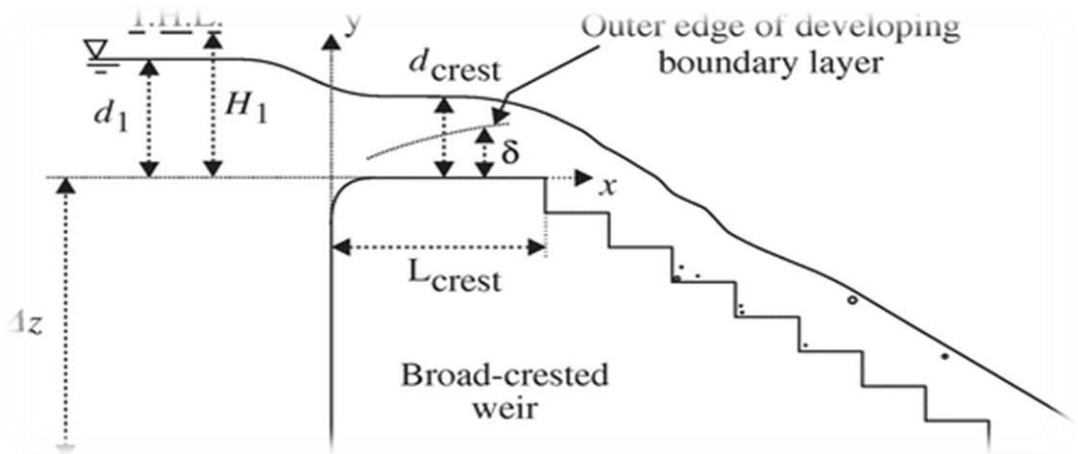


FIG.-4 DEFINITION SKETCH OF BROAD CRESTED WEIR

TO CALCULATE THE VELOCITY CORRESPONDING TO HEAD OF 3cm

L= transverse to the direction of flow

L=0.3m B_w=0.16m H_1 =0.03m

SO $H_1/B_W < 0.35$

$C_D = 0.28(H_1/B_W) + 0.521$

$= 0.28 * 0.1875 + 0.521 = .52625$

$$Q = 2/3 * C_D * \sqrt{2g} * L * (H_1)^{3/2} \quad (3.12)$$

$= 0.666 * 0.52625 * 4.42718 * 0.3 * (0.03)^{3/2}$

$= 0.00239\ m^3/s$

To calculate velocity

Q=A*V

0.00239=(0.3*0.03)*V

V=0.266m/s

TO CALCULATE THE VELOCITY CORRESPONDING TO HEAD OF 5cm

L= transverse to the direction of flow

$L=0.3m$ $B_w=0.16m$ $H_1=0.05m$

SO $H_1/B_W < 0.35$

$C_D=0.28(H_1/B_W)+0.521$

$=0.28*0.3125+0.521=.52975$

$Q=2/3*C_D*\sqrt{2g}*L*(H_1)^{3/2}$

$=0.666*0.52975*4.42718*0.3*(0.05)^{3/2}$

$=0.00519\ m^3/s$

To calculate velocity

$Q=A*V$

$0.00519=(0.3*0.05)*V$

$V=0.3461m/s$

TO CALCULATE THE VELOCITY CORRESPONDING TO HEAD OF 8cm

L= transverse to the direction of flow

$L=0.3m$ $B_w=0.16m$ $H_1=0.08m$

SO $H_1/B_w > 0.45$

$C_D = 0.12(H_1/B_W) + 0.492$

$= 0.12 * 0.2 + 0.492 = .516$

$Q = 2/3 * C_D * \sqrt{2g} * L * (H_1)^{3/2}$

$= 0.666*0.516*4.42718*0.3*(0.08)^{3/2}$

$= 0.01023\ m^3/s$

To calculate velocity

$Q = A*V$

$0.01023 = (0.3*0.08)*V$

$V = 0.4263 m/s$

CHAPTER-4

SIMULATION STUDIES

CASE 1: Spillway without obstruction

GEOMETRY

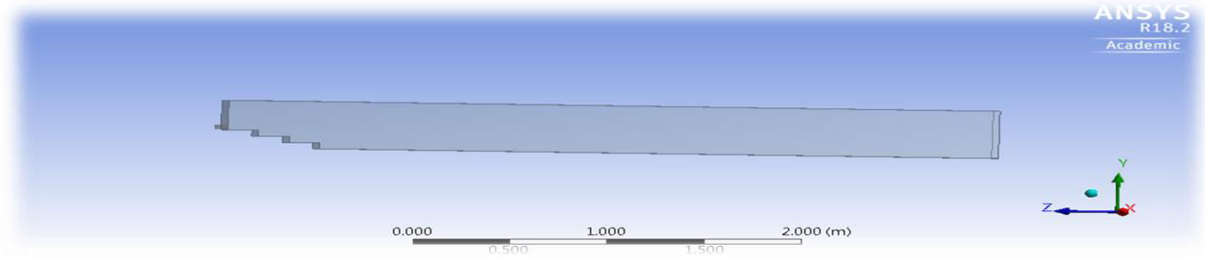


FIG.-5   GEOMETRY FOR NO OBSTRUCTION

MESHING

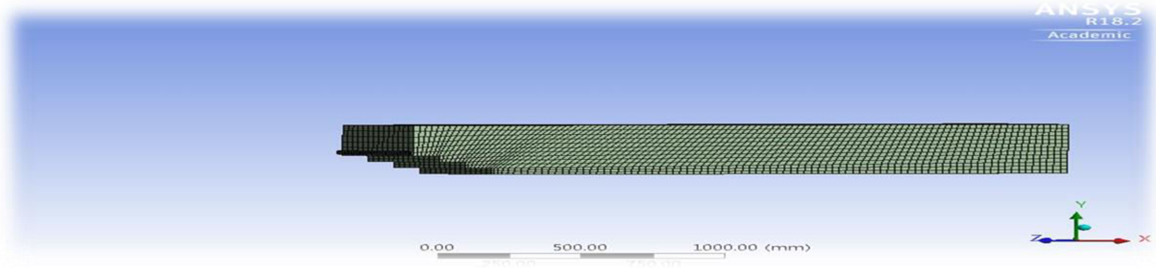


FIG.-6   MESHING FOR NO OBSTRUCTION

WALL SHEAR

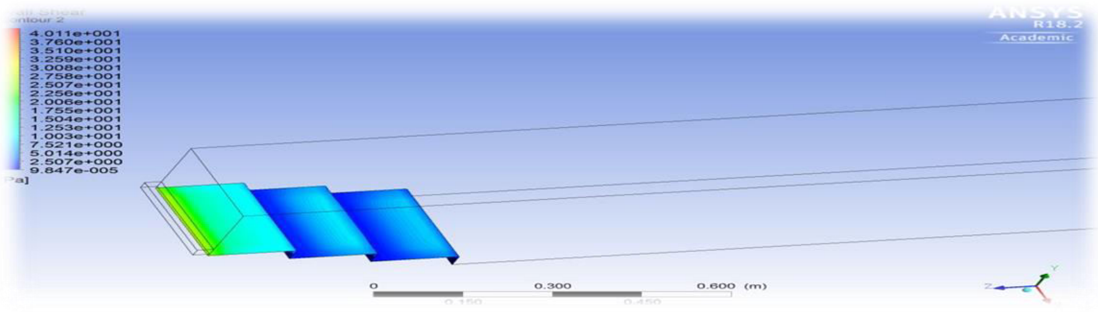


FIG.-7   WALL SHEAR FOR NO OBSTRUCTION

CASE II: Spillway with 10% obstruction

GEOMETRY

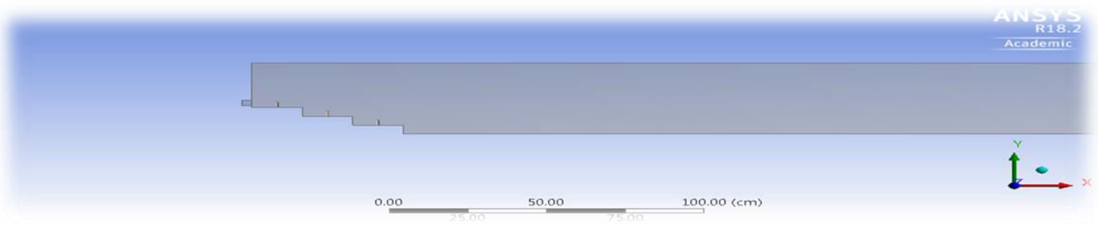


FIG.-8 GEOMETRY FOR 10% OBSTRUCTION

MESHING

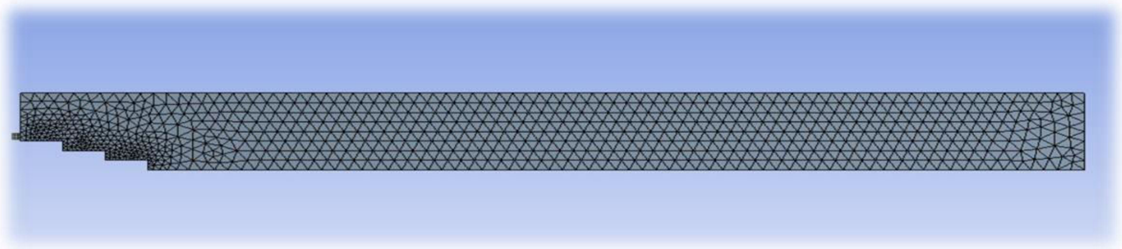


FIG.-9 MESHING FOR 10% OBSTRUCTION

WALL SHEAR

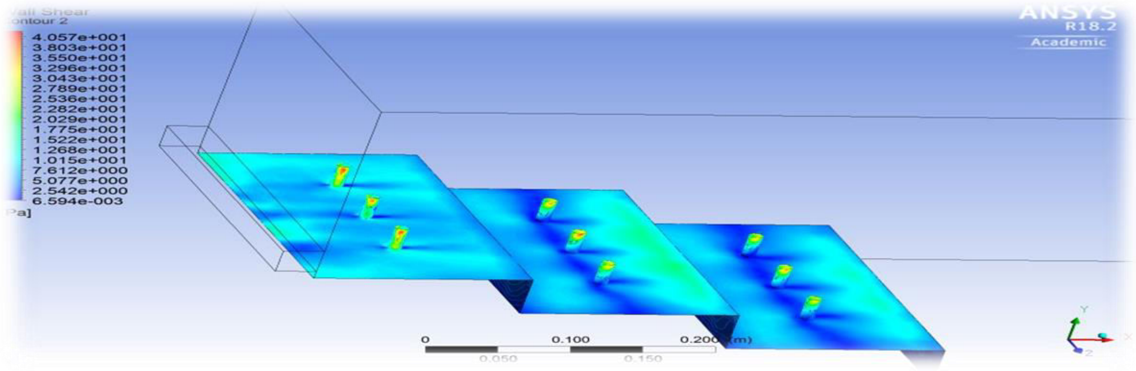


FIG.-10 WALL SHEAR FOR 10% OBSTRUCTION

STREAMLINES

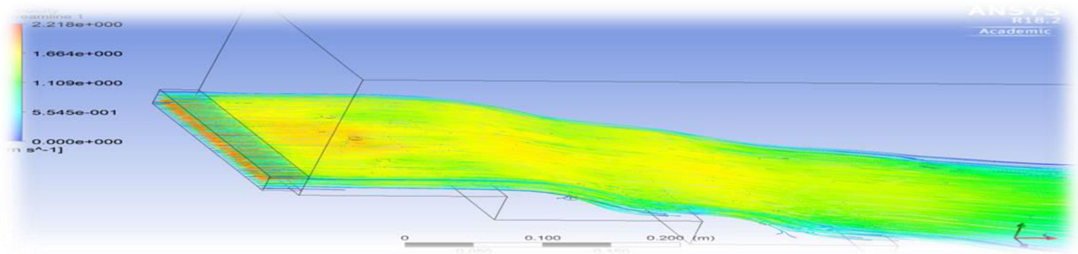


FIG.-11 STREAMLINES FOR 10% OBSTRUCTION

VECTOR

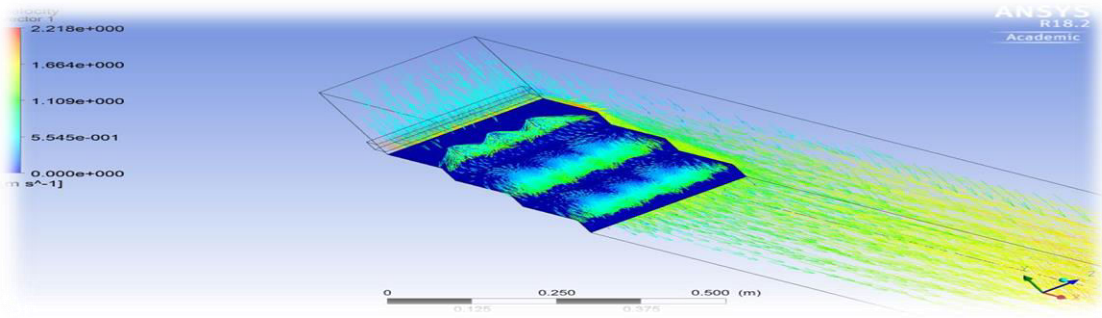


FIG.-12 VECTOR FOR 10% OBSTRUCTION

CASE III: Spillway with 20% obstruction

GEOMETRY

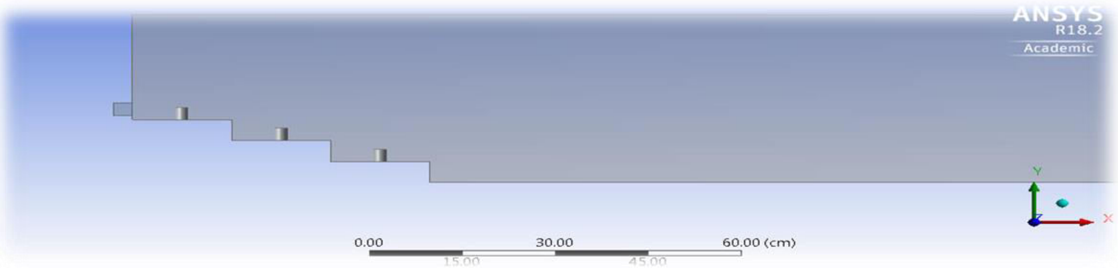


FIG.-13 GEOMETRY FOR 20% OBSTRUCTION

MESHING

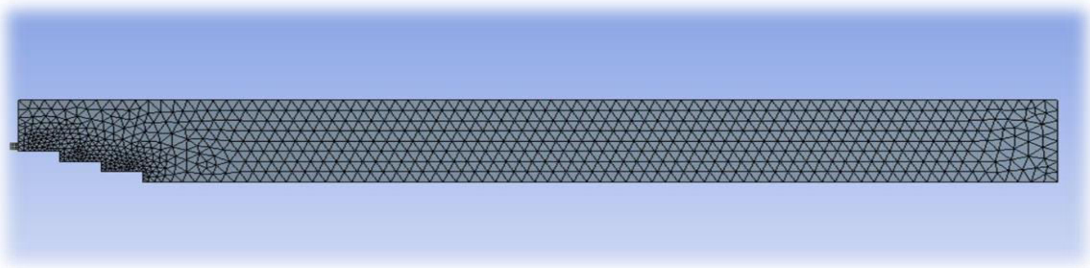


FIG.-14 MESHING FOR 20% OBSTRUCTION

STREAMLINE

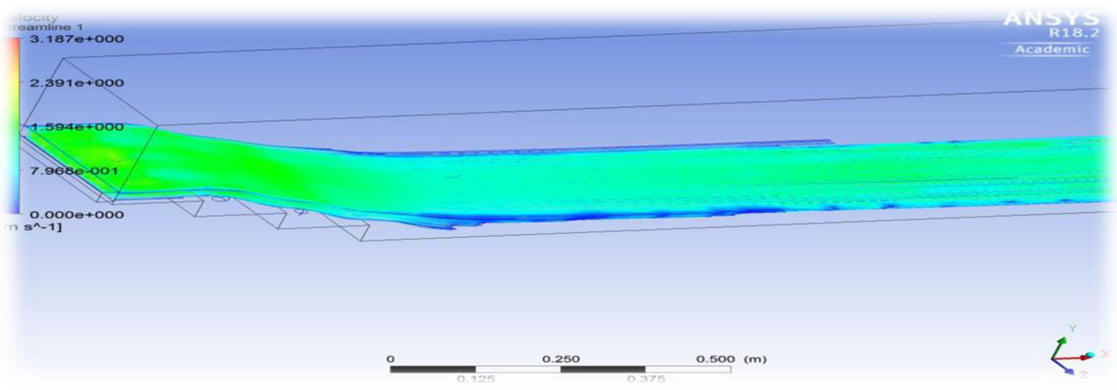


FIG.-15 STREAMLINE FOR 20% OBSTRUCTION

VECTOR

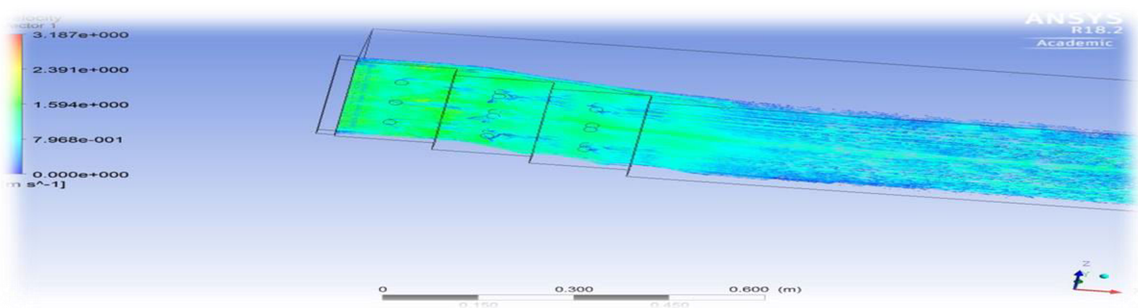


FIG.-16 VECTOR FOR 20% OBSTRUCTION

WALL SHEAR

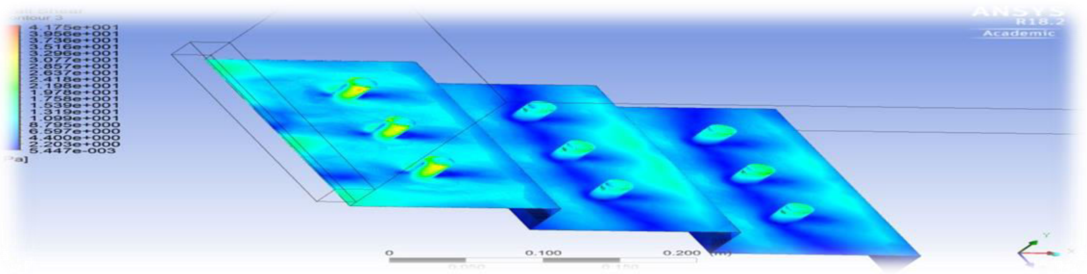


FIG.-17 WALL SHEAR FOR 20% OBSTRUCTION

VELOCITY

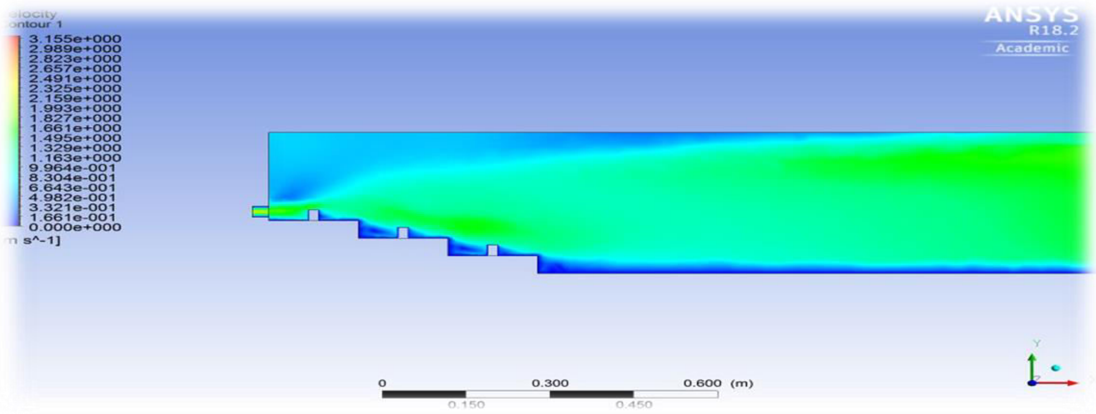


FIG.-18 VELOCITY FOR 20% OBSTRUCTION

CASE IV: Spillway with 30 % obstruction

GEOMETRY

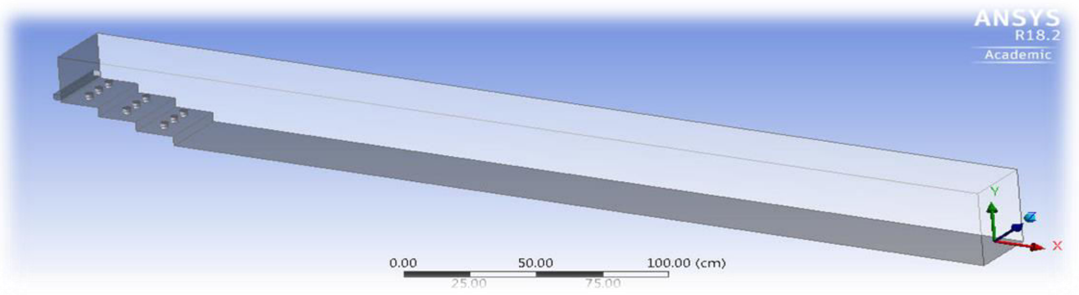


FIG.-19 GEOMETRY FOR 30% OBSTRUCTION

MESHING

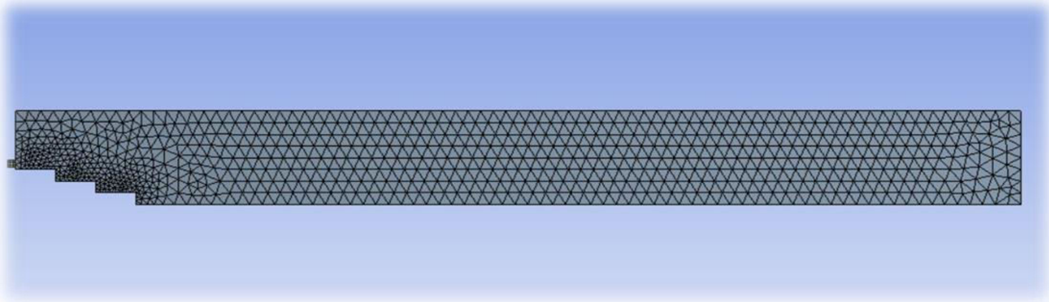


FIG.-20 MESHING FOR 30% OBSTRUCTION

STREAMLINES

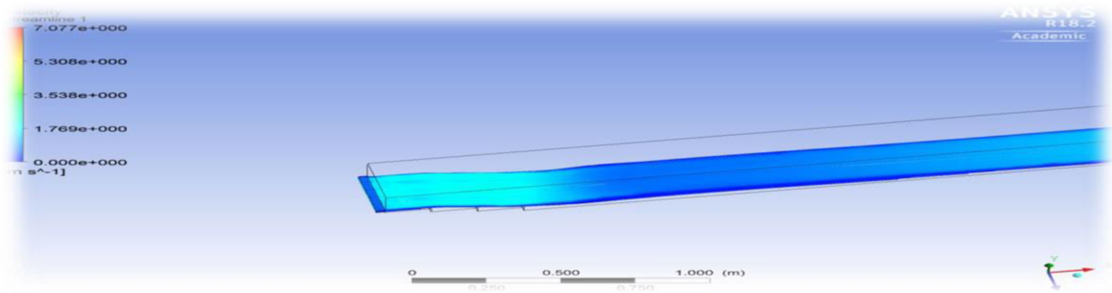


FIG.-21 STREAMLINES FOR 30% OBSTRUCTION

VECTOR

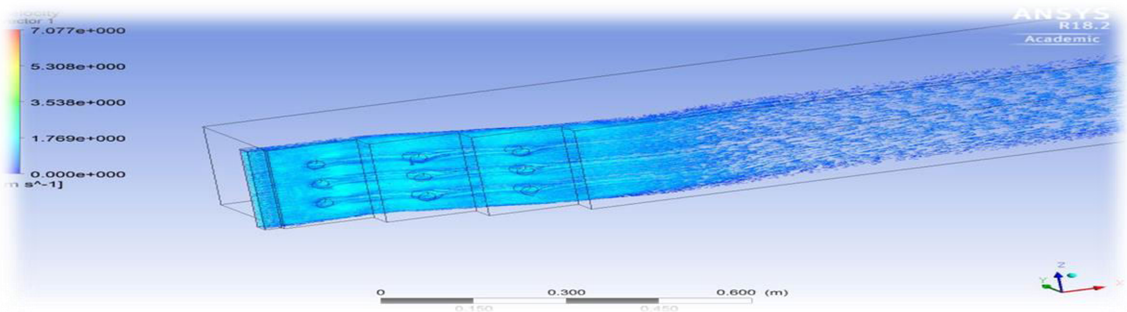


FIG.-22 VECTOR FOR 30% OBSTRUCTION

CHAPTER-5

RESULTS & DISCUSSIONS

WHERE Z=along the diection of flow

X=perpendicular to the direction of flow

Y=against the gravity

V=velocity measured along the direction of flow

VELOCITY HEAD=V*V/2g

= V*V/19.6

PRESSURE= Static pressure

PRESSURE HEAD=P/9810

DATUM HEAD=Distance from the bottom of the flume

USING BERNOULLI'S EQUATION:

PRESSURE HEAD+VELOCITY HEAD+DATUM HEAD=CONSTANT

$(E_1-E_0)/E_0$=Energy difference

E_1= Energy at the downstream before the hydraulic jump FORMATION.

E_0= Energy at the upstream

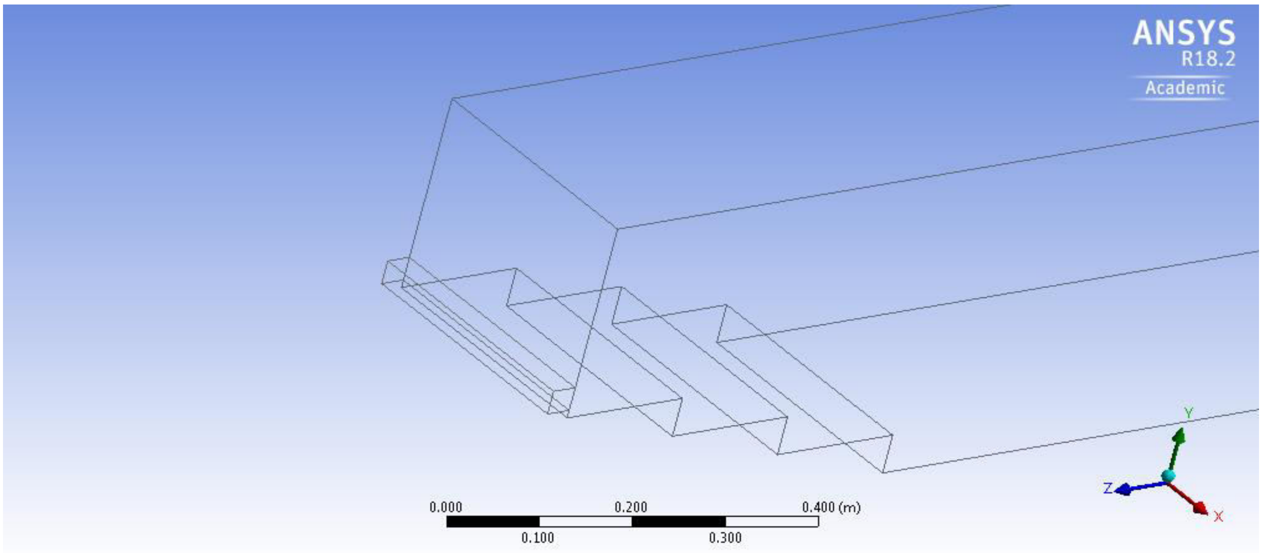


FIG.-23 PROJECTION OF AXIS

TABLE-1 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION vertical (v=.266 m/s)(h=3 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1419	0.001027327	1632.63	0.166425076	0.18	0.347452403	0.261615044
2	0.15	0.18	3.97	0.1216	0.000754416	1637.29	0.166900102	0.18	0.347654518	0.224188791
3	0.15	0.18	3.96	0.099	0.000500051	1640.21	0.167197757	0.18	0.347697808	0.182522124
4	0.15	0.18	3.95	0.0786	0.000315202	1643.11	0.167493374	0.18	0.347808576	0.144911504
5	0.15	0.18	3.94	0.0651	0.000216225	1643.98	0.167582059	0.18	0.347798284	0.120022124
6	0.15	0.18	3.93	0.0545	0.000151543	1643.7	0.167553517	0.18	0.34770506	0.100479351
7	0.15	0.18	3.92	0.0444	0.00010058	1643.43	0.167525994	0.18	0.347626573	0.081858407
8	0.15	0.18	3.91	0.0362	6.68592E-05	1642.9	0.167471967	0.18	0.347538827	0.066740413
9	0.15	0.18	3.9	0.0285	4.14413E-05	1642.35	0.167415902	0.18	0.347457343	0.052544248
10	0.15	0.18	3.89	0.0225	2.58291E-05	1642.23	0.16740367	0.18	0.347429499	0.041482301
11	0.15	0.18	3.88	0.0188	1.80327E-05	1642.75	0.167456677	0.18	0.34747471	0.034660767
12	0.15	0.18	3.87	0.0156	1.24163E-05	1643.26	0.167508665	0.18	0.347521081	0.028761062
13	0.15	0.18	3.86	0.0157	1.2576E-05	1645.08	0.16769419	0.18	0.347706766	0.028945428
14	0.15	0.18	3.85	0.0174	1.54469E-05	1646.93	0.167882773	0.18	0.34789822	0.032079646

TABLE-2 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION vertical (v=.266 m/s)(h=3 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0258	3.39612E-05	3256.98	0.332006116	0.03	0.362040077	0.047566372
2	0.15	0.03	3.49	0.0284	4.1151E-05	3259.2	0.332232416	0.03	0.362273567	0.052359882
3	0.15	0.03	3.48	0.0353	6.3576E-05	3261.42	0.332458716	0.03	0.362522292	0.065081121
4	0.15	0.03	3.47	0.0411	8.61842E-05	3263.91	0.332712538	0.03	0.362798722	0.075774336
5	0.15	0.03	3.46	0.046	0.000107959	3266.52	0.332978593	0.03	0.363086552	0.08480826
6	0.15	0.03	3.45	0.0512	0.000133747	3269.14	0.333245668	0.03	0.363379415	0.09439528
7	0.15	0.03	3.44	0.0554	0.00015659	3272.44	0.333582059	0.03	0.363738649	0.102138643
8	0.15	0.03	3.43	0.0595	0.000180625	3275.8	0.333924567	0.03	0.364105192	0.10969764
9	0.15	0.03	3.42	0.0636	0.000206376	3279.18	0.334269113	0.03	0.364475489	0.117256637
10	0.15	0.03	3.41	0.0674	0.000231773	3282.84	0.334642202	0.03	0.364873975	0.124262537
11	0.15	0.03	3.4	0.0708	0.000255747	3286.84	0.335049949	0.03	0.365305696	0.130530973
12	0.15	0.03	3.39	0.0742	0.0002809	3290.81	0.335454638	0.03	0.365735538	0.13679941
13	0.15	0.03	3.38	0.0777	0.000308025	3294.78	0.335859327	0.03	0.366167352	0.143252212
14	0.15	0.03	3.37	0.0809	0.000333919	3298.79	0.336268094	0.03	0.366602013	0.149151917

TABLE-3 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION VERTICAL (v=.266 m/s)(h=3 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1455	0.001080115	1507.03	0.153621814	0.18	0.334701929	0.232428115
2	0.15	0.18	3.97	0.1386	0.0009801	1501.23	0.153030581	0.18	0.334010681	0.221405751
3	0.15	0.18	3.96	0.1408	0.001011461	1502.06	0.153115189	0.18	0.33412665	0.224920128
4	0.15	0.18	3.95	0.1471	0.001104001	1503.81	0.153293578	0.18	0.334397578	0.234984026
5	0.15	0.18	3.94	0.1538	0.001206859	1507.15	0.153634047	0.18	0.334840906	0.245686901
6	0.15	0.18	3.93	0.1464	0.001093518	1547.08	0.157704383	0.18	0.338797902	0.233865815
7	0.15	0.18	3.92	0	0	0	0	0.18	0.18	0
8	0.15	0.18	3.91	0.1622	0.001342288	1520.5	0.154994903	0.18	0.336337191	0.259105431
9	0.15	0.18	3.9	0.1781	0.001618347	1567.27	0.159762487	0.18	0.341380835	0.284504792
10	0.15	0.18	3.89	0.1768	0.001594808	1574.81	0.160531091	0.18	0.342125899	0.282428115
11	0.15	0.18	3.88	0.1744	0.001551804	1575.54	0.160605505	0.18	0.342157309	0.278594249
12	0.15	0.18	3.87	0.172	0.001509388	1575.38	0.160589195	0.18	0.342098582	0.274760383
13	0.15	0.18	3.86	0.1716	0.001502376	1576.77	0.160730887	0.18	0.342233262	0.274121406
14	0.15	0.18	3.85	0.1719	0.001507633	1579.74	0.161033639	0.18	0.342541272	0.274600639

TABLE- 4 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION VERTICAL (v=.266 m/s)(h=3 cm)										
S.NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0342	0.001744898	3267.3	0.333058104	0.03	0.364803002	0.054632588
2	0.15	0.03	3.49	0.0421	0.002147959	3279.58	0.334309888	0.03	0.366457847	0.067252396
3	0.15	0.03	3.48	0.0606	0.003091837	3275.71	0.333915392	0.03	0.367007229	0.096805112
4	0.15	0.03	3.47	0.0725	0.00369898	3267.3	0.333058104	0.03	0.366757084	0.115814696
5	0.15	0.03	3.46	0.0772	0.003938776	3274.33	0.33377472	0.03	0.367713495	0.123322684
6	0.15	0.03	3.45	0.08	0.004081633	3286.27	0.334991845	0.03	0.369073478	0.127795527
7	0.15	0.03	3.44	0.0824	0.004204082	3300.97	0.336490316	0.03	0.370694398	0.131629393
8	0.15	0.03	3.43	0.0872	0.00444898	3306.11	0.337014271	0.03	0.371463251	0.139297125
9	0.15	0.03	3.42	0.093	0.004744898	3303.8	0.336778797	0.03	0.371523695	0.1485623
10	0.15	0.03	3.41	0.0989	0.005045918	3301.48	0.336542304	0.03	0.371588222	0.15798722
11	0.15	0.03	3.4	0.1035	0.005280612	3301.08	0.336501529	0.03	0.371782141	0.165335463
12	0.15	0.03	3.39	0.1044	0.005326531	3309.44	0.337353721	0.03	0.372680251	0.166773163
13	0.15	0.03	3.38	0.099	0.00505102	3319.97	0.338427115	0.03	0.373478136	0.158146965
14	0.15	0.03	3.37	0.0937	0.004780612	3330.5	0.33950051	0.03	0.374281122	0.149680511

TABLE-5 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION VERTICAL (v=.266 m/s)(h=3 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1437	0.001053556	1705.53	0.173856269	0.18	0.354909825	0.229552716
2	0.15	0.18	3.97	0.1385	0.000978686	1710.97	0.174410805	0.18	0.355389492	0.221246006
3	0.15	0.18	3.96	0.1407	0.001010025	1716.42	0.174966361	0.18	0.355976386	0.224760383
4	0.15	0.18	3.95	0.145	0.001072704	1722.42	0.175577982	0.18	0.356650686	0.231629393
5	0.15	0.18	3.94	0.1429	0.001041858	1744.48	0.177826707	0.18	0.358868565	0.22827476
6	0.15	0.18	3.93	0.0013	8.62245E-08	1945.98	0.198366972	0.18	0.378367059	0.002076677
7	0.15	0.18	3.92	0	0	1802.25	0.183715596	0.18	0.363715596	0
8	0.15	0.18	3.91	0.0005	1.27551E-08	1615.16	0.164644241	0.18	0.344644253	0.000798722
9	0.15	0.18	3.9	0.1778	0.0016129	1772.28	0.18066055	0.18	0.36227345	0.284025559
10	0.15	0.18	3.89	0.1932	0.0019044	1791.53	0.182622834	0.18	0.364527234	0.308626198
11	0.15	0.18	3.88	0.1992	0.002024522	1801.18	0.183606524	0.18	0.365631046	0.318210863
12	0.15	0.18	3.87	0.2048	0.002139951	1795.39	0.18301631	0.18	0.365156261	0.32715655
13	0.15	0.18	3.86	0.2064	0.002173518	1806.65	0.184164118	0.18	0.366337637	0.32971246
14	0.15	0.18	3.85	0.2139	0.002334347	1797.93	0.183275229	0.18	0.365609577	0.341693291

TABLE-6 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION VERTICAL (v=.266 m/s)(h=3 cm)										
S.NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0465	0.002372449	3417.41	0.348359837	0.03	0.380732286	0.07428115
2	0.15	0.03	3.49	0.0724	0.003693878	3423.8	0.349011213	0.03	0.382705091	0.115654952
3	0.15	0.03	3.48	0.0925	0.004719388	3434.78	0.350130479	0.03	0.384849867	0.147763578
4	0.15	0.03	3.47	0.0993	0.005066327	3443.45	0.351014271	0.03	0.386080598	0.158626198
5	0.15	0.03	3.46	0.1089	0.005556122	3448.96	0.351575943	0.03	0.387132065	0.173961661
6	0.15	0.03	3.45	0.1206	0.006153061	3454.7	0.35216106	0.03	0.388314121	0.192651757
7	0.15	0.03	3.44	0.1241	0.006331633	3466.68	0.353382263	0.03	0.389713896	0.198242812
8	0.15	0.03	3.43	0.1335	0.006811224	3467.83	0.35349949	0.03	0.390310715	0.213258786
9	0.15	0.03	3.42	0.1424	0.007265306	3467.51	0.353466871	0.03	0.390732177	0.227476038
10	0.15	0.03	3.41	0.1478	0.007540816	3468	0.35351682	0.03	0.391057636	0.236102236
11	0.15	0.03	3.4	0.1558	0.00794898	3468.98	0.353616718	0.03	0.391565697	0.248881789
12	0.15	0.03	3.39	0.1637	0.008352041	3469.76	0.353696228	0.03	0.392048269	0.261501597
13	0.15	0.03	3.38	0.1679	0.008566327	3474.53	0.354182467	0.03	0.392748793	0.268210863
14	0.15	0.03	3.37	0.1717	0.008760204	3481.04	0.354846075	0.03	0.39360628	0.27428115

TABLE-7 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION VERTICAL (v=.266 m/s)(h=3 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1341	0.00091749	1565	0.159531091	0.18	0.340448581	0.214217252
2	0.15	0.18	3.97	0.1147	0.000671229	1570.14	0.160055046	0.18	0.340726275	0.183226837
3	0.15	0.18	3.96	0.1025		1565.68	0.159600408	0.18	0.339600408	0.163738019
4	0.15	0.18	3.95	0.0924	0.0004356	1567.44	0.159779817	0.18	0.340215417	0.147603834
5	0.15	0.18	3.94	0.0782	0.000312002	1575.95	0.160647299	0.18	0.340959301	0.124920128
6	0.15	0.18	3.93	0	0	1562.93	0.159320082	0.18	0.339320082	0
7	0.15	0.18	3.92	0	0	1569.67	0.160007136	0.18	0.340007136	0
8	0.15	0.18	3.91	0	0	1584.98	0.161567788	0.18	0.341567788	0
9	0.15	0.18	3.9	0.0901	0.000414184	1552.22	0.158228338	0.18	0.338642523	0.143929712
10	0.15	0.18	3.89	0.1121	0.000641143	1576.53	0.160706422	0.18	0.341347565	0.179073482
11	0.15	0.18	3.88	0.117	0.000698418	1589.35	0.162013252	0.18	0.34271167	0.186900958
12	0.15	0.18	3.87	0.1208	0.000744522	1589.03	0.161980632	0.18	0.342725154	0.192971246
13	0.15	0.18	3.86	0.1232	0.00077444	1588.95	0.161972477	0.18	0.342746877	0.196805112
14	0.15	0.18	3.85	0.1255	0.000803584	1595.8	0.162670744	0.18	0.343474328	0.200479233

TABLE-8 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=3cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION VERTICAL (v=.266 m/s)(h=3 cm)											
S.NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0299	0.00152551	3260.39	0.332353721	0.03	0.363879231	0.047763578
2	0.15	0.03	3.49	0.042	0.002142857	3261.05	0.332420999	0.03	0.364563856	0.067092652
3	0.15	0.03	3.48	0.0541	0.002760204	3261.4	0.332456677	0.03	0.365216881	0.086421725
4	0.15	0.03	3.47	0.0638	0.003255102	3255.52	0.331857288	0.03	0.365112391	0.101916933
5	0.15	0.03	3.46	0.0751	0.003831633	3256.03	0.331909276	0.03	0.365740909	0.119968051
6	0.15	0.03	3.45	0.0757	0.003862245	3260.43	0.332357798	0.03	0.366220043	0.120926518
7	0.15	0.03	3.44	0.0804	0.004102041	3266.97	0.333024465	0.03	0.367126506	0.128434505
8	0.15	0.03	3.43	0.0822	0.004193878	3279.74	0.334326198	0.03	0.368520075	0.131309904
9	0.15	0.03	3.42	0.085	0.004336735	3294.17	0.335797146	0.03	0.37013388	0.135782748
10	0.15	0.03	3.41	0.0863	0.004403061	3308.69	0.337277268	0.03	0.371680329	0.137859425
11	0.15	0.03	3.4	0.0901	0.004596939	3310.46	0.337457696	0.03	0.372054635	0.143929712
12	0.15	0.03	3.39	0.0933	0.004760204	3311.13	0.337525994	0.03	0.372286198	0.149041534
13	0.15	0.03	3.38	0.0943	0.004811224	3313.1	0.337726809	0.03	0.372538034	0.150638978
14	0.15	0.03	3.37	0.0953	0.004862245	3315.07	0.337927625	0.03	0.37278987	0.152236422

TABLE-9 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.2327	0.002762719	1671.76	0.170413863	0.18	0.353176582	0.429019174
2	0.15	0.18	3.97	0.2079	0.002205225	1680.02	0.171255861	0.18	0.353461086	0.38329646
3	0.15	0.18	3.96	0.1802	0.001656737	1686.68	0.17193476	0.18	0.353591497	0.332227139
4	0.15	0.18	3.95	0.1534	0.00120059	1693.34	0.17261366	0.18	0.353814249	0.282817109
5	0.15	0.18	3.94	0.138	0.000971633	1696.67	0.172953109	0.18	0.353924742	0.254424779
6	0.15	0.18	3.93	0.1288	0.0008464	1698.23	0.17311213	0.18	0.35395853	0.237463127
7	0.15	0.18	3.92	0.1205	0.000740829	1699.85	0.173277268	0.18	0.354018097	0.222160767
8	0.15	0.18	3.91	0.1177	0.000706801	1702.71	0.173568807	0.18	0.354275608	0.216998525
9	0.15	0.18	3.9	0.1156	0.000681804	1705.58	0.173861366	0.18	0.35454317	0.213126844
10	0.15	0.18	3.89	0.1152	0.000677094	1709.11	0.174221203	0.18	0.354898297	0.212389381
11	0.15	0.18	3.88	0.1168	0.000696033	1713.65	0.174683996	0.18	0.355380029	0.215339233
12	0.15	0.18	3.87	0.1187	0.000718862	1718.18	0.17514577	0.18	0.355864631	0.218842183
13	0.15	0.18	3.86	0.1223	0.000763127	1724.19	0.17575841	0.18	0.356521537	0.225479351
14	0.15	0.18	3.85	0.126	0.00081	1730.24	0.176375127	0.18	0.357185127	0.232300885
15	0.15	0.18	3.84	0.1296	0.000856947	1740.41	0.177411825	0.18	0.358268772	0.238938053

TABLE-10 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=..3461 m/s)(h=5 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0811	0.000335572	3352.29	0.341721713	0.03	0.372057284	0.149520649
2	0.15	0.03	3.49	0.1003	0.00051327	3362.2	0.342731906	0.03	0.373245176	0.184918879
3	0.15	0.03	3.48	0.1198	0.000732247	3372.1	0.343741081	0.03	0.374473327	0.220870206
4	0.15	0.03	3.47	0.1334	0.000907937	3380.14	0.344560652	0.03	0.375468589	0.245943953
5	0.15	0.03	3.46	0.1446	0.001066794	3387.46	0.34530683	0.03	0.376373624	0.26659292
6	0.15	0.03	3.45	0.1559	0.001240041	3394.8	0.346055046	0.03	0.377295087	0.287426254
7	0.15	0.03	3.44	0.1641	0.001373919	3401.31	0.346718654	0.03	0.378092573	0.302544248
8	0.15	0.03	3.43	0.1722	0.00151129	3407.76	0.347376147	0.03	0.378889047	0.317477876
9	0.15	0.03	3.42	0.1804	0.001660416	3414.24	0.348036697	0.03	0.379697114	0.33259587
10	0.15	0.03	3.41	0.1876	0.00179556	3420.19	0.348643221	0.03	0.380438821	0.345870206
11	0.15	0.03	3.4	0.1939	0.001918225	3425.66	0.349200815	0.03	0.38111904	0.357485251
12	0.15	0.03	3.39	0.1003	0.00051327	3431.14	0.349759429	0.03	0.380272699	0.184918879
13	0.15	0.03	3.38	0.1068	0.000581951	3436.63	0.350319062	0.03	0.380901013	0.196902655
14	0.15	0.03	3.37	0.1123	0.000643433	3441.26	0.35079103	0.03	0.381434463	0.207042773
15	0.15	0.03	3.36	0.1171	0.000699613	3445.38	0.351211009	0.03	0.381910622	0.21589233

TABLE-11 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.25	0.003188776	1363.35	0.138975535	0.18	0.322164311	0.460914454
2	0.15	0.18	3.97	0.2315	0.002734298	1355.05	0.13812946	0.18	0.320863758	0.426806785
3	0.15	0.18	3.96	0.215	0.002358418	1357.23	0.138351682	0.18	0.3207101	0.396386431
4	0.15	0.18	3.95	0.1998	0.002036737	1365.18	0.13916208	0.18	0.321198816	0.368362832
5	0.15	0.18	3.94	0.1789	0.001632919	1388.39	0.141528033	0.18	0.323160951	0.329830383
6	0.15	0.18	3.93	0.1347	0.000925719	1468.15	0.149658512	0.18	0.330584231	0.248340708
7	0.15	0.18	3.92	0	0	1295	0.132008155	0.18	0.312008155	0
8	0.15	0.18	3.91	0.1348	0.000927094	1285.76	0.131066259	0.18	0.311993353	0.248525074
9	0.15	0.18	3.9	0.1918	0.0018769	1380.36	0.14070948	0.18	0.32258638	0.353613569
10	0.15	0.18	3.89	0.2148	0.002354033	1410.21	0.143752294	0.18	0.326106326	0.396017699
11	0.15	0.18	3.88	0.2277	0.00264527	1419.27	0.144675841	0.18	0.327321111	0.419800885
12	0.15	0.18	3.87	0.2315	0.002734298	1435.15	0.146294597	0.18	0.329028896	0.426806785
13	0.15	0.18	3.86	0.2365	0.002853686	1444.09	0.147205912	0.18	0.330059599	0.436025074
14	0.15	0.18	3.85	0.2419	0.00298549	1440.36	0.146825688	0.18	0.329811178	0.445980826
15	0.15	0.18	3.84	0.2478	0.0031329	1442.64	0.147058104	0.18	0.330191004	0.456858407

TABLE-12 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)										
S. N O.	POSITION			VELO CITY	VELO CITY HEAD	PRESS URE	PRESS URE HEAD	DAT UM HEA D	TOTA L HEAD	FROU DE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0445	0.000101033	3204.73	0.326679918	0.03	0.356780952	0.082042773
2	0.15	0.03	3.49	0.0606	0.000187365	3214.8	0.327706422	0.03	0.357893787	0.111725664
3	0.15	0.03	3.48	0.0788	0.000316808	3216.03	0.327831804	0.03	0.358148612	0.145280236
4	0.15	0.03	3.47	0.0927	0.000438433	3220.95	0.328333333	0.03	0.358771766	0.17090708
5	0.15	0.03	3.46	0.0968	0.000478073	3222.82	0.328523955	0.03	0.359002029	0.178466077
6	0.15	0.03	3.45	0.1044	0.00055609	3227.79	0.329030581	0.03	0.359586671	0.192477876
7	0.15	0.03	3.44	0.1148	0.0006724	3233.81	0.329644241	0.03	0.360316641	0.211651917
8	0.15	0.03	3.43	0.12	0.000734694	3240.73	0.330349643	0.03	0.361084337	0.221238938
9	0.15	0.03	3.42	0.1252	0.000799747	3247.65	0.331055046	0.03	0.361854793	0.230825959
10	0.15	0.03	3.41	0.1258	0.000807431	3256.56	0.331963303	0.03	0.362770733	0.231932153
11	0.15	0.03	3.4	0.127	0.000822908	3259.76	0.332289501	0.03	0.363112409	0.234144543
12	0.15	0.03	3.39	0.1282	0.000838533	3262.96	0.332615698	0.03	0.363454231	0.236356932
13	0.15	0.03	3.38	0.1295	0.000855625	3266.16	0.332941896	0.03	0.363797521	0.238753687
14	0.15	0.03	3.37	0.1299	0.000860919	3269.47	0.333279307	0.03	0.364140226	0.23949115
15	0.15	0.03	3.36	0.1292	0.000851665	3274.41	0.333782875	0.03	0.36463454	0.23820059

TABLE-13 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)											
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.248	0.003137959	1408.38	0.143565749	0.18	0.326703708	0.457227139
2	0.15	0.18	3.97	0.2232	0.002541747	1403.29	0.143046891	0.18	0.325588638	0.411504425
3	0.15	0.18	3.96	0.1956	0.001952008	1413.9	0.14412844	0.18	0.326080449	0.360619469
4	0.15	0.18	3.95	0.1634	0.001362222	1423.79	0.145136595	0.18	0.326498818	0.301253687
5	0.15	0.18	3.94	0.1228	0.00076938	1443.61	0.147156983	0.18	0.327926362	0.22640118
6	0.15	0.18	3.93	0.0031	4.90306E-07	1534.8	0.156452599	0.18	0.33645309	0.005715339
7	0.15	0.18	3.92	0	0		0	0.18	0.18	0
8	0.15	0.18	3.91	0.0023	2.69898E-07	1283.89	0.130875637	0.18	0.310875907	0.004240413
9	0.15	0.18	3.9	0.1204	0.0007396	1380	0.140672783	0.18	0.321412383	0.221976401
10	0.15	0.18	3.89	0.1615	0.001330727	1411.31	0.143864424	0.18	0.325195151	0.297750737
11	0.15	0.18	3.88	0.1835	0.001717972	1426.41	0.14540367	0.18	0.327121642	0.338311209
12	0.15	0.18	3.87	0.194	0.001920204	1437.8	0.14656473	0.18	0.328484934	0.357669617
13	0.15	0.18	3.86	0.2016	0.00207336	1442.75	0.147069317	0.18	0.329142917	0.371681416
14	0.15	0.18	3.85	0.2085	0.002217972	1448.53	0.147658512	0.18	0.329876484	0.384402655
15	0.15	0.18	3.84	0.2177	0.002418025	1450.77	0.14788685	0.18	0.330304875	0.401364307

TABLE-14 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0388	7.68082E-05	3196.62	0.325853211	0.03	0.355930019	0.071533923
2	0.15	0.03	3.49	0.0542	0.00014988	3210.67	0.327285423	0.03	0.357435303	0.099926254
3	0.15	0.03	3.48	0.0727	0.000269658	3213.94	0.327618756	0.03	0.357888414	0.134033923
4	0.15	0.03	3.47	0.0827	0.000348943	3219.67	0.328202854	0.03	0.358551798	0.152470501
5	0.15	0.03	3.46	0.0889	0.000403225	3221.8	0.32841998	0.03	0.358823205	0.16390118
6	0.15	0.03	3.45	0.1	0.000510204	3224.98	0.328744139	0.03	0.359254343	0.184365782
7	0.15	0.03	3.44	0.1058	0.000571104	3228.66	0.329119266	0.03	0.35969037	0.195058997
8	0.15	0.03	3.43	0.1107	0.000625229	3233.82	0.32964526	0.03	0.360270489	0.20409292
9	0.15	0.03	3.42	0.1178	0.000708002	3236.59	0.329927625	0.03	0.360635627	0.217182891
10	0.15	0.03	3.41	0.125	0.000797194	3239.36	0.33020999	0.03	0.361007184	0.230457227
11	0.15	0.03	3.4	0.1332	0.000905216	3242.13	0.330492355	0.03	0.361397571	0.245575221
12	0.15	0.03	3.39	0.1331	0.000903858	3244.24	0.330707441	0.03	0.361611299	0.245390855
13	0.15	0.03	3.38	0.1312	0.000878237	3249.15	0.331207951	0.03	0.362086188	0.241887906
14	0.15	0.03	3.37	0.1294	0.000854304	3254.05	0.331707441	0.03	0.362561745	0.238569322
15	0.15	0.03	3.36	0.1281	0.000837225	3259.3	0.33224261	0.03	0.363079835	0.236172566

TABLE-15 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)											
S. N O.	**POSITION**			**VELO CITY**	**VELO CITY HEAD**	**PRESS URE**	**PRESS URE HEAD**	**DAT UM HEA D**	**TOTA L HEAD**	**FROU DE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.2453	0.003070005	1432.69	0.146043833	0.18	0.329113837	0.452249263
2	0.15	0.18	3.97	0.214	0.002336531	1437.58	0.146542304	0.18	0.328878834	0.394542773
3	0.15	0.18	3.96	0.1828	0.00170489	1436.2	0.146401631	0.18	0.328106521	0.337020649
4	0.15	0.18	3.95	0.139	0.000985765	1444.9	0.147288481	0.18	0.328274246	0.256268437
5	0.15	0.18	3.94	0.0772	0.000304073	1481.28	0.150996942	0.18	0.331301015	0.142330383
6	0.15	0.18	3.93	0	0	1509.66	0.153889908	0.18	0.333889908	0
7	0.15	0.18	3.92	0	0	0	0	0.18	0.18	0
8	0.15	0.18	3.91	0	0	1313.53	0.133897044	0.18	0.313897044	0
9	0.15	0.18	3.9	0.079	0.000318418	1367.32	0.139380224	0.18	0.319698643	0.145648968
10	0.15	0.18	3.89	0.1173	0.000702005	1409.23	0.143652396	0.18	0.3243544	0.216261062
11	0.15	0.18	3.88	0.1485	0.001125115	1426.19	0.145381244	0.18	0.326506358	0.273783186
12	0.15	0.18	3.87	0.1656	0.001399151	1438.43	0.14662895	0.18	0.328028101	0.305309735
13	0.15	0.18	3.86	0.1802	0.001656737	1438.82	0.146668705	0.18	0.328325442	0.332227139
14	0.15	0.18	3.85	0.189	0.0018225	1446.11	0.147411825	0.18	0.329234325	0.348451327
15	0.15	0.18	3.84	0.1975	0.001990115	1456.15	0.148435270	0.18	0.330425385	0.364122419

TABLE-16 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=5cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION VERTICAL (v=.3461 m/s)(h=5 cm)										
S.NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0476	0.0001156	3192.35	0.325417941	0.03	0.355533541	0.087758112
2	0.15	0.03	3.49	0.0625	0.000199298	3205.22	0.326729867	0.03	0.356929166	0.115228614
3	0.15	0.03	3.48	0.071	0.000257194	3215.32	0.327759429	0.03	0.358016623	0.130899705
4	0.15	0.03	3.47	0.087	0.000386173	3211.04	0.32732314	0.03	0.357709313	0.16039823
5	0.15	0.03	3.46	0.097	0.000480051	3210.77	0.327295617	0.03	0.357775668	0.178834808
6	0.15	0.03	3.45	0.1022	0.0005329	3210.57	0.327275229	0.03	0.357808129	0.188421829
7	0.15	0.03	3.44	0.0987	0.000497025	3227.85	0.329036697	0.03	0.359533722	0.181969027
8	0.15	0.03	3.43	0.1012	0.000522522	3235.08	0.3297737	0.03	0.360296223	0.186578171
9	0.15	0.03	3.42	0.1095	0.000611747	3240.33	0.330308869	0.03	0.360920616	0.201880531
10	0.15	0.03	3.41	0.1156	0.000681804	3245.25	0.330810398	0.03	0.361492202	0.213126844
11	0.15	0.03	3.4	0.1152	0.000677094	3258.53	0.332164118	0.03	0.362841212	0.212389381
12	0.15	0.03	3.39	0.1147	0.000671229	3272.38	0.333575943	0.03	0.364247172	0.211467552
13	0.15	0.03	3.38	0.1131	0.000652633	3287.65	0.335132518	0.03	0.365785151	0.208517699
14	0.15	0.03	3.37	0.1146	0.000670059	3291.45	0.335519878	0.03	0.366189937	0.211283186
15	0.15	0.03	3.36	0.121	0.00074699	3290.66	0.335439348	0.03	0.366186337	0.223082596

TABLE-17 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.3412	0.005939665	1498.91	0.152794088	0.18	0.338733753	0.629056047
2	0.15	0.18	3.97	0.3212	0.005263747	1507.74	0.15369419	0.18	0.338957937	0.592182891
3	0.15	0.18	3.96	0.2973	0.004509556	1515.55	0.154490316	0.18	0.338999872	0.548119469
4	0.15	0.18	3.95	0.2744	0.0038416	1523.44	0.155294597	0.18	0.339136197	0.505899705
5	0.15	0.18	3.94	0.2562	0.00334489	1526.67	0.155623853	0.18	0.338972753	0.472345133
6	0.15	0.18	3.93	0.2407	0.002955943	1527.37	0.155695209	0.18	0.338651152	0.443768437
7	0.15	0.18	3.92	0.2258	0.002601308	1528.09	0.155768603	0.18	0.338369912	0.416297935
8	0.15	0.18	3.91	0.2127	0.002308229	1527.5	0.155708461	0.18	0.33801669	0.392146018
9	0.15	0.18	3.9	0.2001	0.002042858	1526.92	0.155649337	0.18	0.337692195	0.368915929
10	0.15	0.18	3.89	0.1883	0.001809025	1526.61	0.155617737	0.18	0.337426762	0.347160767
11	0.15	0.18	3.88	0.1776	0.001609273	1526.67	0.155623853	0.18	0.337233127	0.327433628
12	0.15	0.18	3.87	0.1672	0.001426318	1526.75	0.155632008	0.18	0.337058327	0.308259587
13	0.15	0.18	3.86	0.1591	0.00129147	1527.35	0.15569317	0.18	0.33698464	0.293325959
14	0.15	0.18	3.85	0.1513	0.001167943	1527.96	0.155755352	0.18	0.336923295	0.278945428
15	0.15	0.18	3.84	0.1446	0.001066794	1531.8	0.156146789	0.18	0.337213583	0.26659292

TABLE-18 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0409	8.53474E-05	3115.39	0.317572885	0.03	0.347658232	0.005386115
2	0.15	0.03	3.49	0.0519	0.000137429	3119.05	0.317945973	0.03	0.348083403	0.095685841
3	0.15	0.03	3.48	0.0672	0.0002304	3122.79	0.318327217	0.03	0.348557617	0.123893805
4	0.15	0.03	3.47	0.0783	0.000312801	3127.18	0.31877472	0.03	0.34908752	0.144358407
5	0.15	0.03	3.46	0.0872	0.000387951	3132	0.319266055	0.03	0.349654006	0.160766962
6	0.15	0.03	3.45	0.0963	0.000473147	3136.83	0.31975841	0.03	0.350231557	0.177544248
7	0.15	0.03	3.44	0.1033	0.000544433	3142.29	0.320314985	0.03	0.350859418	0.190449853
8	0.15	0.03	3.43	0.1103	0.000620719	3147.81	0.320877676	0.03	0.351498395	0.203355457
9	0.15	0.03	3.42	0.1173	0.000702005	3153.35	0.321442406	0.03	0.35214441	0.216261062
10	0.15	0.03	3.41	0.1236	0.000779437	3158.93	0.322011213	0.03	0.35279065	0.227876106
11	0.15	0.03	3.4	0.1294	0.000854304	3164.65	0.322594292	0.03	0.353448596	0.238569322
12	0.15	0.03	3.39	0.1353	0.000933984	3170.34	0.323174312	0.03	0.354108296	0.249446903
13	0.15	0.03	3.38	0.1412	0.001017216	3176.04	0.323755352	0.03	0.354772568	0.260324484
14	0.15	0.03	3.37	0.1466	0.001096508	3181.51	0.324312946	0.03	0.355409454	0.270280236
15	0.15	0.03	3.36	0.1518	0.001175676	3186.84	0.324856269	0.03	0.356031945	0.279867257

TABLE-19 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S.NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.3457	0.006097372	1607.29	0.163841998	0.18	0.34993937	0.637352507
2	0.15	0.18	3.97	0.3328	0.005650808	1608.22	0.163936799	0.18	0.349587607	0.613569322
3	0.15	0.18	3.96	0.3175	0.005143176	1618.66	0.165001019	0.18	0.350144195	0.585361357
4	0.15	0.18	3.95	0.3056	0.004764865	1629.19	0.166074414	0.18	0.350839279	0.563421829
5	0.15	0.18	3.94	0.2863	0.004182025	1661.74	0.169392457	0.18	0.353574482	0.527839233
6	0.15	0.18	3.93	0.2121	0.002295225	1792.44	0.182715596	0.18	0.365010821	0.391039823
7	0.15	0.18	3.92	0	0	1624.3	0.165575943	0.18	0.345575943	0
8	0.15	0.18	3.91	0.1938	0.001916247	1499.75	0.152879715	0.18	0.334795962	0.357300885
9	0.15	0.18	3.9	0.2722	0.003780247	1596.21	0.162712538	0.18	0.346492785	0.501843658
10	0.15	0.18	3.89	0.3067	0.004799229	1644.32	0.167616718	0.18	0.352415947	0.565449853
11	0.15	0.18	3.88	0.3289	0.005519143	1660.36	0.169251784	0.18	0.354770927	0.606379056
12	0.15	0.18	3.87	0.3456	0.006093845	1669.03	0.170135576	0.18	0.356229421	0.637168142
13	0.15	0.18	3.86	0.358	0.00653898	1671.4	0.170377166	0.18	0.356916146	0.660029499
14	0.15	0.18	3.85	0.3727	0.007087005	1667.35	0.169964322	0.18	0.357051327	0.687131268
15	0.15	0.18	3.84	0.3835	0.007503686	1657.96	0.169007136	0.18	0.356510822	0.707042773

TABLE-20 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S.NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0637	0.000207025	3323	0.338735984	0.03	0.368943009	0.117441003
2	0.15	0.03	3.49	0.0985	0.000495013	3342.65	0.340739042	0.03	0.371234055	0.181600295
3	0.15	0.03	3.48	0.1195	0.000728584	3358.32	0.342336391	0.03	0.373064976	0.220317109
4	0.15	0.03	3.47	0.1432	0.001046237	3374.86	0.344022426	0.03	0.375068663	0.264011799
5	0.15	0.03	3.46	0.1569	0.001256001	3389.08	0.345471967	0.03	0.376727968	0.289269912
6	0.15	0.03	3.45	0.1652	0.0013924	3400.18	0.346603466	0.03	0.377995866	0.304572271
7	0.15	0.03	3.44	0.1841	0.001729225	3409.68	0.347571865	0.03	0.37930109	0.339417404
8	0.15	0.03	3.43	0.2	0.002040816	3420.05	0.34862895	0.03	0.380669766	0.368731563
9	0.15	0.03	3.42	0.209	0.002228622	3425.75	0.34920999	0.03	0.381438612	0.385324484
10	0.15	0.03	3.41	0.2218	0.002509961	3429.73	0.349615698	0.03	0.382125659	0.408923304
11	0.15	0.03	3.4	0.2337	0.002786515	3434.08	0.350059123	0.03	0.382845638	0.430862832
12	0.15	0.03	3.39	0.2386	0.00290459	3446.42	0.351317023	0.03	0.384221613	0.439896755
13	0.15	0.03	3.38	0.2344	0.002803233	3450.85	0.351768603	0.03	0.384571836	0.432153392
14	0.15	0.03	3.37	0.2272	0.002633665	3452.9	0.351977574	0.03	0.384611239	0.418879056
15	0.15	0.03	3.36	0.2201	0.002471633	3455.22	0.352214067	0.03	0.3846857	0.405789086

TABLE-21 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. N O.	**POSITION**			**VELO CITY**	**VELO CITY HEAD**	**PRESS URE**	**PRESS URE HEAD**	**DAT UM HEA D**	**TOTA L HEAD**	**FROU DE NO.**
	X	**Y**	**Z**							
1	0. 15	0. 18	3. 98	0.3383	0.00583 9127	1399.85	0.14269 6228	0.18	0.32853 5355	0.62370 944
2	0. 15	0. 18	3. 97	0.3123	0.00497 6086	1405.14	0.14323 5474	0.18	0.32821 156	0.57577 4336
3	0. 15	0. 18	3. 96	0.2862	0.00417 9104	1412.94	0.14403 0581	0.18	0.32820 9685	0.52765 4867
4	0. 15	0. 18	3. 95	0.2588	0.00341 7216	1419.85	0.14473 4964	0.18	0.32815 2181	0.47713 8643
5	0. 15	0. 18	3. 94	0.2011	0.00206 3327	1458.03	0.14862 6911	0.18	0.33069 0238	0.37075 9587
6	0. 15	0. 18	3. 93	0.0129	8.49031 E-06	1551.93	0.15819 8777	0.18	0.33820 7267	0.02378 3186
7	0. 15	0. 18	3. 92	0	0	0	0	0.18	0.18	0
8	0. 15	0. 18	3. 91	0.0065	2.15561 E-06	1258.31	0.12826 8094	0.18	0.30827 0249	0.01198 3776
9	0. 15	0. 18	3. 9	0.1544	0.00121 6294	1338.45	0.13643 7309	0.18	0.31765 3603	0.28466 0767
10	0. 15	0. 18	3. 89	0.1903	0.00184 7658	1370.82	0.13973 7003	0.18	0.32158 4661	0.35084 8083
11	0. 15	0. 18	3. 88	0.2132	0.00231 9094	1383.27	0.14100 6116	0.18	0.32332 521	0.39306 7847
12	0. 15	0. 18	3. 87	0.2301	0.00270 1327	1388	0.14148 8277	0.18	0.32418 9604	0.42422 5664
13	0. 15	0. 18	3. 86	0.2452	0.00306 7502	1391.91	0.14188 685	0.18	0.32495 4352	0.45206 4897
14	0. 15	0. 18	3. 85	0.2581	0.00339 8756	1399.47	0.14265 7492	0.18	0.32605 6248	0.47584 8083
15	0. 15	0. 18	3. 84	0.2702	0.00372 49	1403.74	0.14309 2762	0.18	0.32681 7662	0.49815 6342

TABLE-22 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. N O.	**POSITION**			**VELO CITY**	**VELO CITY HEAD**	**PRESS URE**	**PRESS URE HEAD**	**DAT UM HEA D**	**TOTA L HEAD**	**FROU DE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0459	0.00010749	3152.96	0.32140265	0.03	0.351510141	0.084623894
2	0.15	0.03	3.49	0.0651	0.000216225	3159.79	0.322098879	0.03	0.352315104	0.120022124
3	0.15	0.03	3.48	0.0828	0.000349788	3161.36	0.322258919	0.03	0.352608707	0.152654867
4	0.15	0.03	3.47	0.0961	0.000471184	3165.79	0.322710499	0.03	0.353181684	0.177175516
5	0.15	0.03	3.46	0.1098	0.000615104	3169.44	0.323082569	0.03	0.353697673	0.202433628
6	0.15	0.03	3.45	0.1192	0.000724931	3173.78	0.323524975	0.03	0.354249905	0.219764012
7	0.15	0.03	3.44	0.1287	0.000845086	3182.54	0.324417941	0.03	0.355263027	0.237278761
8	0.15	0.03	3.43	0.1353	0.000933984	3191.8	0.325361876	0.03	0.35629586	0.249446903
9	0.15	0.03	3.42	0.1423	0.001033127	3203.97	0.326602446	0.03	0.357635574	0.262352507
10	0.15	0.03	3.41	0.1473	0.001107005	3206.47	0.326857288	0.03	0.357964293	0.271570796
11	0.15	0.03	3.4	0.1526	0.00118881	3206.14	0.326823649	0.03	0.358011749	0.281342183
12	0.15	0.03	3.39	0.1613	0.001327433	3205.58	0.326766565	0.03	0.358093998	0.297382006
13	0.15	0.03	3.38	0.1701	0.001476225	3205.01	0.326708461	0.03	0.358184686	0.313606195
14	0.15	0.03	3.37	0.1789	0.001632919	3207.24	0.32693578	0.03	0.358568699	0.329830383
15	0.15	0.03	3.36	0.174	0.001544694	3219.13	0.328147808	0.03	0.359692502	0.32079646

TABLE-23 UPSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.3321	0.005627062	1617.6	0.164892966	0.18	0.350520028	0.612278761
2	0.15	0.18	3.97	0.3082	0.004846288	1623.05	0.165448522	0.18	0.35029481	0.568215339
3	0.15	0.18	3.96	0.2642	0.003561308	1641.37	0.167316004	0.18	0.350877312	0.487094395
4	0.15	0.18	3.95	0.224	0.00256	1663.47	0.169568807	0.18	0.352128807	0.412979351
5	0.15	0.18	3.94	0.1303	0.000866229	1738.45	0.177212029	0.18	0.358078258	0.240228614
6	0.15	0.18	3.93	0	0	1798.35	0.183318043	0.18	0.363318043	0
7	0.15	0.18	3.92	0	0	0	0	0.18	0.18	0
8	0.15	0.18	3.91	0	0	1249.53	0.127373089	0.18	0.307373089	0
9	0.15	0.18	3.9	0.1033	0.000544433	1487.13	0.151593272	0.18	0.332137705	0.190449853
10	0.15	0.18	3.89	0.1737	0.001539372	1554.33	0.158443425	0.18	0.339982797	0.320243363
11	0.15	0.18	3.88	0.2035	0.00211287	1578.96	0.160954128	0.18	0.343066998	0.375184366
12	0.15	0.18	3.87	0.2363	0.002848862	1586.69	0.1617421	0.18	0.344590962	0.435656342
13	0.15	0.18	3.86	0.2587	0.003414576	1595.95	0.162686035	0.18	0.346100611	0.476954277
14	0.15	0.18	3.85	0.2761	0.003889347	1610.91	0.164211009	0.18	0.348100357	0.509033923
15	0.15	0.18	3.84	0.2927	0.004371086	1617.22	0.16485423	0.18	0.349225317	0.539638643

TABLE-24 DOWNSTREAM READING FOR VERTICAL OBSTRUCTION AT HEAD=8cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0594	0.000180018	3290.51	0.335424057	0.03	0.365604075	0.109513274
2	0.15	0.03	3.49	0.0846	0.000365161	3309.79	0.337389399	0.03	0.36775456	0.155973451
3	0.15	0.03	3.48	0.0969	0.000479062	3330.57	0.339507645	0.03	0.369986707	0.178650442
4	0.15	0.03	3.47	0.1158	0.000684165	3339.29	0.340396534	0.03	0.371080699	0.213495575
5	0.15	0.03	3.46	0.1347	0.000925719	3345.86	0.341066259	0.03	0.371991978	0.248340708
6	0.15	0.03	3.45	0.144	0.001057959	3345.45	0.341024465	0.03	0.372082424	0.265486726
7	0.15	0.03	3.44	0.1579	0.001272062	3355.97	0.34209684	0.03	0.373368902	0.291113569
8	0.15	0.03	3.43	0.1721	0.001511143	3366.49	0.343169215	0.03	0.374680358	0.31729351
9	0.15	0.03	3.42	0.1801	0.001654898	3374.89	0.344025484	0.03	0.375680383	0.332042773
10	0.15	0.03	3.41	0.1909	0.001859327	3382.29	0.344779817	0.03	0.376639144	0.351954277
11	0.15	0.03	3.4	0.2023	0.002088025	3389.13	0.345477064	0.03	0.377565089	0.372971976
12	0.15	0.03	3.39	0.2142	0.0023409	3395.06	0.346081549	0.03	0.378422449	0.394911504
13	0.15	0.03	3.38	0.2254	0.0025921	3401.22	0.34670948	0.03	0.37930158	0.415560472
14	0.15	0.03	3.37	0.2183	0.002431372	3401.32	0.346719674	0.03	0.379151046	0.402470501
15	0.15	0.03	3.36	0.2085	0.002217972	3416.84	0.348301733	0.03	0.380519705	0.384402655

TABLE-25 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)											
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1419	0.001027327	1632.63	0.166425076	0.18	0.347452403	0.261615044
2	0.15	0.18	3.97	0.1216	0.000754416	1637.29	0.166900102	0.18	0.347654518	0.224188791
3	0.15	0.18	3.96	0.099	0.000500051	1640.21	0.167197757	0.18	0.347697808	0.182522124
4	0.15	0.18	3.95	0.0786	0.000315202	1643.11	0.167493374	0.18	0.347808576	0.144911504
5	0.15	0.18	3.94	0.0651	0.000216225	1643.98	0.167582059	0.18	0.347798284	0.120022124
6	0.15	0.18	3.93	0.0545	0.000151543	1643.7	0.167553517	0.18	0.34770506	0.100479351
7	0.15	0.18	3.92	0.0444	0.00010058	1643.43	0.167525994	0.18	0.347626573	0.081858407
8	0.15	0.18	3.91	0.0362	6.68592E-05	1642.9	0.167471967	0.18	0.347538827	0.066740413
9	0.15	0.18	3.9	0.0285	4.14413E-05	1642.35	0.167415902	0.18	0.347457343	0.052544248
10	0.15	0.18	3.89	0.0225	2.58291E-05	1642.23	0.16740367	0.18	0.347429499	0.041482301
11	0.15	0.18	3.88	0.0188	1.80327E-05	1642.75	0.167456677	0.18	0.34747471	0.034660767
12	0.15	0.18	3.87	0.0156	1.24163E-05	1643.26	0.167508665	0.18	0.347521081	0.028761062
13	0.15	0.18	3.86	0.0157	1.2576E-05	1645.08	0.16769419	0.18	0.347706766	0.028945428
14	0.15	0.18	3.85	0.0174	1.54469E-05	1646.93	0.167882773	0.18	0.34789822	0.032079646

TABLE-26 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)											
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0258	3.39612E-05	3256.98	0.332006116	0.03	0.362040077	0.047566372
2	0.15	0.03	3.49	0.0284	4.1151E-05	3259.2	0.332232416	0.03	0.362273567	0.052359882
3	0.15	0.03	3.48	0.0353	6.3576E-05	3261.42	0.332458716	0.03	0.362522292	0.065081121
4	0.15	0.03	3.47	0.0411	8.61842E-05	3263.91	0.332712538	0.03	0.362798722	0.075774336
5	0.15	0.03	3.46	0.046	0.000107959	3266.52	0.332978593	0.03	0.363086552	0.08480826
6	0.15	0.03	3.45	0.0512	0.000133747	3269.14	0.333245668	0.03	0.363379415	0.09439528
7	0.15	0.03	3.44	0.0554	0.00015659	3272.44	0.333582059	0.03	0.363738649	0.102138643
8	0.15	0.03	3.43	0.0595	0.000180625	3275.8	0.333924567	0.03	0.364105192	0.10969764
9	0.15	0.03	3.42	0.0636	0.000206376	3279.18	0.334269113	0.03	0.364475489	0.117256637
10	0.15	0.03	3.41	0.0674	0.000231773	3282.84	0.334642202	0.03	0.364873975	0.124262537
11	0.15	0.03	3.4	0.0708	0.000255747	3286.84	0.335049949	0.03	0.365305696	0.130530973
12	0.15	0.03	3.39	0.0742	0.0002809	3290.81	0.335454638	0.03	0.365735538	0.13679941
13	0.15	0.03	3.38	0.0777	0.000308025	3294.78	0.335859327	0.03	0.366167352	0.143252212
14	0.15	0.03	3.37	0.0809	0.000333919	3298.79	0.336268094	0.03	0.366602013	0.149151917

TABLE-27 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1151	0.000675919	1532.63	0.156231397	0.04	0.196907315	0.183865815
2	0.15	0.18	3.97	0.0809	0.000333919	1537.29	0.156706422	0.04	0.197040341	0.129233227
3	0.15	0.18	3.96	0.0835	0.000355727	1540.21	0.157004077	0.04	0.197359805	0.133386581
4	0.15	0.18	3.95	0.084	0.00036	1543.11	0.157299694	0.04	0.197659694	0.134185304
5	0.15	0.18	3.94	0.0865	0.000381747	1543.98	0.157388379	0.04	0.197770127	0.138178914
6	0.15	0.18	3.93	0.2147	0.002351841	1543.7	0.157359837	0.04	0.199711678	0.342971246
7	0.15	0.18	3.92	0.0592	0.000178808	1543.43	0.157332314	0.04	0.197511122	0.09456869
8	0.15	0.18	3.91	0.1997	0.002034698	1542.9	0.157278287	0.04	0.199312986	0.319009585
9	0.15	0.18	3.9	0.0304	4.7151E-05	1542.35	0.157222222	0.04	0.197269373	0.0485623
10	0.15	0.18	3.89	0.0149	1.1327E-05	1542.23	0.15720999	0.04	0.197221317	0.023801917
11	0.15	0.18	3.88	0.0192	1.88082E-05	1542.75	0.157262997	0.04	0.197281805	0.030670927
12	0.15	0.18	3.87	0.0634	0.00020508	1543.26	0.157314985	0.04	0.197520064	0.101277955
13	0.15	0.18	3.86	0.0851	0.00036949	1545.08	0.15750051	0.04	0.19787	0.135942492
14	0.15	0.18	3.85	0.1074	0.000588508	1546.93	0.157689093	0.04	0.198277601	0.171565495

TABLE-28 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0302	0.001540816	3215.5	0.327777778	0.04	0.369318594	0.048242812
2	0.15	0.03	3.49	0.0356	0.001816327	3216.4	0.327869521	0.04	0.369685847	0.05686901
3	0.15	0.03	3.48	0.0421	0.002147959	3218.16	0.32804893	0.04	0.370196889	0.067252396
4	0.15	0.03	3.47	0.0451	0.00230102	3219.96	0.328232416	0.04	0.370533436	0.072044728
5	0.15	0.03	3.46	0.0481	0.002454082	3222.4	0.328481142	0.04	0.370935223	0.076837061
6	0.15	0.03	3.45	0.0511	0.002607143	3224.85	0.328730887	0.04	0.37133803	0.081629393
7	0.15	0.03	3.44	0.0545	0.002780612	3227.91	0.329042813	0.04	0.371823426	0.087060703
8	0.15	0.03	3.43	0.058	0.002959184	3231.59	0.329417941	0.04	0.372377125	0.092651757
9	0.15	0.03	3.42	0.0616	0.003142857	3235.24	0.32979001	0.04	0.372932867	0.098402556
10	0.15	0.03	3.41	0.0652	0.003326531	3238.91	0.330164118	0.04	0.373490649	0.104153355
11	0.15	0.03	3.4	0.0696	0.00355102	3242.6	0.330540265	0.04	0.374091285	0.111182109
12	0.15	0.03	3.39	0.0742	0.003785714	3246.33	0.330920489	0.04	0.374706204	0.118530351
13	0.15	0.03	3.38	0.0788	0.004020408	3249.97	0.331291539	0.04	0.375311947	0.125878594
14	0.15	0.03	3.37	0.0834	0.004255102	3253.84	0.331686035	0.04	0.375941137	0.133226837

TABLE-29 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.1133	0.000654943	1386.58	0.141343527	0.18	0.32199847	0.208886431
2	0.15	0.18	3.97	0.0808	0.000333094	1405.36	0.1432579	0.18	0.323590994	0.148967552
3	0.15	0.18	3.96	0.0834	0.000354876	1423.27	0.145083588	0.18	0.325438464	0.153761062
4	0.15	0.18	3.95	0.0819	0.000342225	1437.53	0.146537207	0.18	0.326879432	0.150995575
5	0.15	0.18	3.94	0.0756	0.0002916	1460.63	0.148891947	0.18	0.329183547	0.139380531
6	0.15	0.18	3.93	0.0696	0.000247151	1469.56	0.149802243	0.18	0.330049394	0.128318584
7	0.15	0.18	3.92	0.0592	0.000178808	1479.23	0.150787971	0.18	0.33096678	0.109144543
8	0.15	0.18	3.91	0.038	7.36735E-05	1477.13	0.150573904	0.18	0.330647578	0.070058997
9	0.15	0.18	3.9	0.0301	0.000046225	1458.65	0.148690112	0.18	0.328736337	0.0554941
10	0.15	0.18	3.89	0.0313	4.99842E-05	1461.23	0.148953109	0.18	0.329003093	0.05770649
11	0.15	0.18	3.88	0.044	9.87755E-05	1708.28	0.174136595	0.18	0.354235371	0.081120944
12	0.15	0.18	3.87	0.0962	0.000472165	1862.1	0.189816514	0.18	0.370288679	0.177359882
13	0.15	0.18	3.86	0.1199	0.00073347	1858.19	0.189417941	0.18	0.370151411	0.221054572
14	0.15	0.18	3.85	0.1494	0.001138794	1847.04	0.188281346	0.18	0.369420139	0.275442478

TABLE-30 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0302	4.65327E-05	3288.83	0.335252803	0.03	0.365299336	0.055678466
2	0.15	0.03	3.49	0.0356	6.46612E-05	3288.83	0.335252803	0.03	0.365317464	0.065634218
3	0.15	0.03	3.48	0.0421	9.04291E-05	3287.78	0.33514577	0.03	0.365236199	0.077617994
4	0.15	0.03	3.47	0.0451	0.000103776	3286.42	0.335007136	0.03	0.365110912	0.083148968
5	0.15	0.03	3.46	0.0481	0.000118041	3285.04	0.334866463	0.03	0.364984504	0.088679941
6	0.15	0.03	3.45	0.0511	0.000133225	3283.64	0.334723751	0.03	0.364856976	0.094210914
7	0.15	0.03	3.44	0.0545	0.000151543	3284.43	0.334804281	0.03	0.364955825	0.100479351
8	0.15	0.03	3.43	0.058	0.000171633	3285.43	0.334906218	0.03	0.365077851	0.106932153
9	0.15	0.03	3.42	0.0616	0.0001936	3286.41	0.335006116	0.03	0.365199716	0.113569322
10	0.15	0.03	3.41	0.0652	0.00021689	3287.36	0.335102956	0.03	0.365319846	0.12020649
11	0.15	0.03	3.4	0.0696	0.000247151	3289.43	0.335313965	0.03	0.365561116	0.128318584
12	0.15	0.03	3.39	0.0742	0.0002809	3291.85	0.335560652	0.03	0.365841552	0.13679941
13	0.15	0.03	3.38	0.0788	0.000316808	3294.27	0.335807339	0.03	0.366124148	0.145280236
14	0.15	0.03	3.37	0.0834	0.000354876	3296.71	0.336056065	0.03	0.366410941	0.153761062

TABLE-31 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.1247	0.000793372	1378.81	0.140551478	0.18	0.32134485	0.22990413
2	0.15	0.18	3.97	0.0789	0.000317613	1369.69	0.139621814	0.18	0.319939427	0.145464602
3	0.15	0.18	3.96	0.0615	0.000192972	1390.6	0.141753313	0.18	0.321946285	0.113384956
4	0.15	0.18	3.95	0.0513	0.00013427	1404.18	0.143137615	0.18	0.323271885	0.094579646
5	0.15	0.18	3.94	0.0462	0.0001089	1408.7	0.143598369	0.18	0.323707269	0.085176991
6	0.15	0.18	3.93	0.0538	0.000147676	1409.58	0.143688073	0.18	0.323835749	0.099188791
7	0.15	0.18	3.92	0.006	1.83673E-06	1296.72	0.132183486	0.18	0.312185323	0.011061947
8	0.15	0.18	3.91	0.0075	2.8699E-06	1135.96	0.115796126	0.18	0.295798996	0.013827434
9	0.15	0.18	3.9	0.0239	2.91434E-05	1488.81	0.151764526	0.18	0.331793669	0.044063422
10	0.15	0.18	3.89	0.1126	0.000646876	1619.41	0.165077472	0.18	0.345724347	0.20759587
11	0.15	0.18	3.88	0.1409	0.001012898	1644.94	0.167679918	0.18	0.348692817	0.259771386
12	0.15	0.18	3.87	0.142	0.001028776	1640.13	0.167189602	0.18	0.348218378	0.26179941
13	0.15	0.18	3.86	0.155	0.001225765	1634.81	0.166647299	0.18	0.347873064	0.285766962
14	0.15	0.18	3.85	0.1399	0.000998572	1628.15	0.16596684	0.18	0.346966972	0.257927729

TABLE-32 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=3cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION horizontal (v=.266 m/s)(h=3 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0137	9.57602E-06	3215.5	0.327777778	0.03	0.357787354	0.025258112
2	0.15	0.03	3.49	0.0042	0.0000009	3216.4	0.327869521	0.03	0.357870421	0.007743363
3	0.15	0.03	3.48	0.0052	1.37959E-06	3218.16	0.32804893	0.03	0.358050309	0.009587021
4	0.15	0.03	3.47	0.0096	4.70204E-06	3219.96	0.328232416	0.03	0.358237118	0.017699115
5	0.15	0.03	3.46	0.0117	6.98418E-06	3222.4	0.328481142	0.03	0.358488126	0.021570796
6	0.15	0.03	3.45	0.0148	1.11755E-05	3224.85	0.328730887	0.03	0.358742062	0.027286136
	0.15	0.03	3.44	0.018	1.65306E-05	3227.91	0.329042813	0.03	0.359059344	0.033185841
8	0.15	0.03	3.43	0.0212	2.29306E-05	3231.59	0.329417941	0.03	0.359440871	0.039085546
9	0.15	0.03	3.42	0.02476	3.12784E-05	3235.24	0.329790001	0.03	0.359821289	0.045648968
10	0.15	0.03	3.41	0.028	0.00004	3238.91	0.330164118	0.03	0.360204118	0.051622419
11	0.15	0.03	3.4	0.0305	4.74617E-05	3242.6	0.330540265	0.03	0.360587727	0.056231563
12	0.15	0.03	3.39	0.0332	5.62367E-05	3246.33	0.330920489	0.03	0.360976726	0.06120944
13	0.15	0.03	3.38	0.036	6.61224E-05	3249.97	0.331291539	0.03	0.361357662	0.066371681
14	0.15	0.03	3.37	0.0387	7.64128E-05	3253.84	0.331686035	0.03	0.361762447	0.071349558

TABLE-33 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.2327	0.002762719	1671.76	0.170413863	0.18	0.353176582	0.429019174
2	0.15	0.18	3.97	0.2079	0.002205225	1680.02	0.171255861	0.18	0.353461086	0.38329646
3	0.15	0.18	3.96	0.1802	0.001656737	1686.68	0.17193476	0.18	0.353591497	0.332227139
4	0.15	0.18	3.95	0.1534	0.00120059	1693.34	0.17261366	0.18	0.353814249	0.282817109
5	0.15	0.18	3.94	0.138	0.000971633	1696.67	0.172953109	0.18	0.353924742	0.254424779
6	0.15	0.18	3.93	0.1288	0.0008464	1698.23	0.17311213	0.18	0.35395853	0.237463127
7	0.15	0.18	3.92	0.1205	0.000740829	1699.85	0.173277268	0.18	0.354018097	0.222160767
8	0.15	0.18	3.91	0.1177	0.000706801	1702.71	0.173568807	0.18	0.354275608	0.216998525
9	0.15	0.18	3.9	0.1156	0.000681804	1705.58	0.173861366	0.18	0.35454317	0.213126844
10	0.15	0.18	3.89	0.1152	0.000677094	1709.11	0.174221203	0.18	0.354898297	0.212389381
11	0.15	0.18	3.88	0.1168	0.000696033	1713.65	0.174683996	0.18	0.355380029	0.215339233
12	0.15	0.18	3.87	0.1187	0.000718862	1718.18	0.17514577	0.18	0.355864631	0.218842183
13	0.15	0.18	3.86	0.1223	0.000763127	1724.19	0.17575841	0.18	0.356521537	0.225479351
14	0.15	0.18	3.85	0.126	0.00081	1730.24	0.176375127	0.18	0.357185127	0.232300885
15	0.15	0.18	3.84	0.1296	0.000856947	1740.41	0.177411825	0.18	0.358268772	0.238938053

TABLE-34 DOWNSTREAM READING FOR HORIZONTAL L OBSTRUCTION AT HEAD=5cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=..3461 m/s)(h=5 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0811	0.000335572	3352.29	0.341721713	0.03	0.372057284	0.149520649
2	0.15	0.03	3.49	0.1003	0.00051327	3362.2	0.342731906	0.03	0.373245176	0.184918879
3	0.15	0.03	3.48	0.1198	0.000732247	3372.1	0.343741081	0.03	0.374473327	0.220870206
4	0.15	0.03	3.47	0.1334	0.000907937	3380.14	0.344560652	0.03	0.375468589	0.245943953
5	0.15	0.03	3.46	0.1446	0.001066794	3387.46	0.34530683	0.03	0.376373624	0.26659292
6	0.15	0.03	3.45	0.1559	0.001240041	3394.8	0.346055046	0.03	0.377295087	0.287426254
7	0.15	0.03	3.44	0.1641	0.001373919	3401.31	0.346718654	0.03	0.378092573	0.302544248
8	0.15	0.03	3.43	0.1722	0.00151129	3407.76	0.347376147	0.03	0.378889047	0.317477876
9	0.15	0.03	3.42	0.1804	0.001660416	3414.24	0.348036697	0.03	0.379697114	0.33259587
10	0.15	0.03	3.41	0.1876	0.0017956	3420.19	0.348643221	0.03	0.380438821	0.345870206
11	0.15	0.03	3.4	0.1939	0.001918225	3425.66	0.349200815	0.03	0.38111904	0.357485251
12	0.15	0.03	3.39	0.1003	0.00051327	3431.14	0.349759429	0.03	0.380272699	0.184918879
13	0.15	0.03	3.38	0.1068	0.000581951	3436.63	0.350319062	0.03	0.380901013	0.196902655
14	0.15	0.03	3.37	0.1123	0.000643433	3441.26	0.35079103	0.03	0.381434463	0.207042773
15	0.15	0.03	3.36	0.1171	0.000699613	3445.38	0.351211009	0.03	0.381910622	0.21589233

TABLE-35 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.1724	0.001516416	1007.08	0.102658512	0.18	0.284174928	0.317846608
2	0.15	0.18	3.97	0.1277	0.000832005	1013.71	0.103334353	0.18	0.284166357	0.235435103
3	0.15	0.18	3.96	0.1018	0.000528737	1027.97	0.104787971	0.18	0.285316708	0.187684366
4	0.15	0.18	3.95	0.08	0.000326531	1084.54	0.110554536	0.18	0.290881067	0.147492625
5	0.15	0.18	3.94	0.0656	0.000219559	1113.59	0.11351558	0.18	0.293735359	0.120943953
6	0.15	0.18	3.93	0.055	0.000154337	1123.92	0.114568807	0.18	0.294723144	0.10140118
7	0.15	0.18	3.92	0.0485	0.000120013	1132.58	0.11545158	0.18	0.295571593	0.089417404
8	0.15	0.18	3.91	0.0521	0.00013849	1136.96	0.115898063	0.18	0.296036554	0.096054572
9	0.15	0.18	3.9	0.0501	0.000128062	956.856	0.097538838	0.18	0.27766669	0.092367257
10	0.15	0.18	3.89	0.0501	0.000128062	858.856	0.087549032	0.18	0.267677093	0.092367257
11	0.15	0.18	3.88	0.0568	0.000164604	1177.8	0.120061162	0.18	0.300225766	0.104719764
12	0.15	0.18	3.87	0.1456	0.00108016	1297.2	0.132232416	0.18	0.313314016	0.268436578
13	0.15	0.18	3.86	0.1567	0.001252801	1291.53	0.131654434	0.18	0.312907235	0.28890118
14	0.15	0.18	3.85	0.1697	0.00146929	1265.34	0.128984709	0.18	0.3104544	0.312868732
15	0.15	0.18	3.84	0.1771	0.001600225	1248.29	0.127246687	0.18	0.308846912	0.326511799

TABLE-36 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)										
S. N O.	**POSITION**			**VELO CITY**	**VELO CITY HEAD**	**PRESS URE**	**PRESS URE HEAD**	**DAT UM HEA D**	**TOTA L HEAD**	**FROU DE NO.**
	X	**Y**	**Z**							
1	0. 15	0. 03	3. 5	0.043	0.00219 3878	2764.5	0.28180 4281	0.03	0.31399 8159	0.07927 7286
2	0. 15	0. 03	3. 49	0.0369	0.00188 2653	2771.08	0.28247 5025	0.03	0.31435 7679	0.06803 0973
3	0. 15	0. 03	3. 48	0.0561	0.00286 2245	2777.72	0.28315 1886	0.03	0.31601 4131	0.10342 9204
4	0. 15	0. 03	3. 47	0.0604	0.00308 1633	2788.21	0.28422 1203	0.03	0.31730 2836	0.11135 6932
5	0. 15	0. 03	3. 46	0.0694	0.00354 0816	2798.57	0.28527 7268	0.03	0.31881 8084	0.12794 9853
6	0. 15	0. 03	3. 45	0.0787	0.00401 5306	2808.84	0.28632 4159	0.03	0.32033 9465	0.14509 587
7	0. 15	0. 03	3. 44	0.0845	0.00431 1224	2819.54	0.28741 4883	0.03	0.32172 6107	0.15578 9086
8	0. 15	0. 03	3. 43	0.091	0.00464 2857	2830.13	0.28849 4393	0.03	0.32313 7251	0.16777 2861
9	0. 15	0. 03	3. 42	0.0984	0.00502 0408	2840.53	0.28955 4536	0.03	0.32457 4944	0.18141 5929
10	0. 15	0. 03	3. 41	0.1065	0.00543 3673	2850.73	0.29059 4292	0.03	0.32602 7965	0.19634 9558
11	0. 15	0. 03	3. 4	0.1115	0.00568 8776	2849.9	0.29050 9684	0.03	0.32619 846	0.20556 7847
12	0. 15	0. 03	3. 39	0.1155	0.00589 2857	2845.28	0.29003 8736	0.03	0.32593 1593	0.21294 2478
13	0. 15	0. 03	3. 38	0.1195	0.00609 6939	2840.5	0.28955 1478	0.03	0.32564 8417	0.22031 7109
14	0. 15	0. 03	3. 37	0.1235	0.00630 102	2835.57	0.28904 893	0.03	0.32534 995	0.22769 174
15	0. 15	0. 03	3. 36	0.1276	0.00651 0204	2837.47	0.28924 261	0.03	0.32575 2814	0.23525 0737

TABLE-37 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)											
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.2164	0.002389233	1174.34	0.119708461	0.18	0.302097693	0.398967552
2	0.15	0.18	3.97	0.1832	0.001712359	1184.53	0.120747197	0.18	0.302459556	0.337758112
3	0.15	0.18	3.96	0.1538	0.001206859	1189.89	0.121293578	0.18	0.302500437	0.283554572
4	0.15	0.18	3.95	0.1295	0.000855625	1204.05	0.122737003	0.18	0.303592628	0.238753687
5	0.15	0.18	3.94	0.1066	0.000579773	1234.69	0.125860347	0.18	0.30644012	0.196533923
6	0.15	0.18	3.93	0.0961	0.000471184	1272.13	0.12967686	0.18	0.310148045	0.177175516
7	0.15	0.18	3.92	0.0474	0.000114631	1198.42	0.122163099	0.18	0.302277729	0.087389381
8	0.15	0.18	3.91	0.0178	1.61653E-05	1084.82	0.110583078	0.18	0.290599244	0.032817109
9	0.15	0.18	3.9	0.0182	0.0000169	976.038	0.09949419	0.18	0.27951109	0.033554572
10	0.15	0.18	3.89	0.0325	5.38903E-05	1296.35	0.13214577	0.18	0.31219966	0.059918879
11	0.15	0.18	3.88	0.1338	0.00091339	1411.6	0.143893986	0.18	0.324807376	0.246681416
12	0.15	0.18	3.87	0.194	0.001920204	1458.75	0.148700306	0.18	0.33062051	0.357669617
13	0.15	0.18	3.86	0.2052	0.002148318	1452.17	0.148029562	0.18	0.33017788	0.378318584
14	0.15	0.18	3.85	0.218	0.002424694	1428.45	0.145611621	0.18	0.328036315	0.401917404
15	0.15	0.18	3.84	0.2251	0.002585205	1423.93	0.145150866	0.18	0.327736071	0.415007375

TABLE-38 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)											
S. N O.	POSITION			VELO CITY	VELO CITY HEAD	PRESS URE	PRESS URE HEAD	DAT UM HEA D	TOTA L HEAD	FROU DE NO.
	X	Y	Z							
1	0. 15	0. 03	3. 5	0.0203	0.00103 5714	3009.79	0.30680 8359	0.03	0.33784 4073	0.03742 6254
2	0. 15	0. 03	3. 49	0.033	0.00168 3673	3010.93	0.30692 4567	0.03	0.33860 824	0.06084 0708
3	0. 15	0. 03	3. 48	0.0404	0.00206 1224	3013.15	0.30715 0866	0.03	0.33921 2091	0.07448 3776
4	0. 15	0. 03	3. 47	0.0479	0.00244 3878	3015.37	0.30737 7166	0.03	0.33982 1044	0.08831 1209
5	0. 15	0. 03	3. 46	0.0534	0.00272 449	3019.14	0.30776 1468	0.03	0.34048 5958	0.09845 1327
6	0. 15	0. 03	3. 45	0.0591	0.00301 5306	3022.92	0.30814 6789	0.03	0.34116 2095	0.10896 0177
7	0. 15	0. 03	3. 44	0.0642	0.00327 551	3027.41	0.30860 4485	0.03	0.34187 9995	0.11836 2832
8	0. 15	0. 03	3. 43	0.0688	0.00351 0204	3032.82	0.30915 5963	0.03	0.34266 6167	0.12684 3658
9	0. 15	0. 03	3. 42	0.0735	0.00375	3038.21	0.30970 5403	0.03	0.34345 5403	0.13550 885
10	0. 15	0. 03	3. 41	0.0781	0.00398 4694	3043.67	0.31026 1978	0.03	0.34424 6671	0.14398 9676
11	0. 15	0. 03	3. 4	0.0823	0.00419 898	3049.43	0.31084 9134	0.03	0.34504 8113	0.15173 3038
12	0. 15	0. 03	3. 39	0.0866	0.00441 8367	3055.18	0.31143 527	0.03	0.34585 3637	0.15966 0767
13	0. 15	0. 03	3. 38	0.0909	0.00463 7755	3060.9	0.31201 8349	0.03	0.34665 6104	0.16758 8496
14	0. 15	0. 03	3. 37	0.0952	0.00485 7143	3066.62	0.31260 1427	0.03	0.34745 857	0.17551 6224
15	0. 15	0. 03	3. 36	0.0997	0.00508 6735	3072.43	0.31319 368	0.03	0.34828 0415	0.18381 2684

TABLE-39 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.1944	0.001928131	1207.08	0.123045872	0.18	0.304974002	0.35840708
2	0.15	0.18	3.97	0.15545	0.001232893	1213.71	0.123721713	0.18	0.304954606	0.286596608
3	0.15	0.18	3.96	0.1278	0.000833308	1227.97	0.125175331	0.18	0.306008639	0.235619469
4	0.15	0.18	3.95	0.10475	0.000559825	1284.54	0.130941896	0.18	0.311501721	0.193123156
5	0.15	0.18	3.94	0.0861	0.000378225	1313.59	0.13390316	0.18	0.314281385	0.158738938
6	0.15	0.18	3.93	0.07555	0.000291214	1323.92	0.134956167	0.18	0.315247382	0.139288348
7	0.15	0.18	3.92	0.04795	0.000117306	1332.58	0.13583894	0.18	0.315956246	0.088403392
8	0.15	0.18	3.91	0.03495	6.23216E-05	1336.96	0.136285423	0.18	0.316347745	0.064435841
9	0.15	0.18	3.9	0.03415	5.95011E-05	1356.856	0.138313558	0.18	0.318373059	0.062960914
10	0.15	0.18	3.89	0.0413	0.000087025	1258.856	0.128323751	0.18	0.308410776	0.076143068
11	0.15	0.18	3.88	0.0953	0.000463372	1377.8	0.140448522	0.18	0.320911894	0.17570059
12	0.15	0.18	3.87	0.1698	0.001471022	1597.2	0.162813456	0.18	0.344284478	0.313053097
13	0.15	0.18	3.86	0.18095	0.001670556	1591.53	0.162235474	0.18	0.34390603	0.333609882
14	0.15	0.18	3.85	0.19385	0.001917236	1565.34	0.159565749	0.18	0.341482985	0.357393068
15	0.15	0.18	3.84	0.2011	0.002063327	1548.29	0.157827727	0.18	0.339891054	0.370759587

TABLE-40 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=5cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION horizontal (v=.3461 m/s)(h=5 cm)										
S. N O.	**POSITION**			**VELO CITY**	**VELO CITY HEAD**	**PRESS URE**	**PRESS URE HEAD**	**DAT UM HEA D**	**TOTA L HEAD**	**FROU DE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0103	0.00052551	3264.5	0.332772681	0.03	0.363298191	0.018989676
2	0.15	0.03	3.49	0.013	0.000663265	3271.08	0.333443425	0.03	0.36410669	0.023967552
3	0.15	0.03	3.48	0.0104	0.000530612	3277.72	0.334120285	0.03	0.364650898	0.019174041
4	0.15	0.03	3.47	0.0189	0.000964286	3288.21	0.335189602	0.03	0.366153888	0.034845133
5	0.15	0.03	3.46	0.0234	0.001193878	3298.57	0.336245668	0.03	0.367439545	0.043141593
6	0.15	0.03	3.45	0.0391	0.001994898	3208.84	0.327098879	0.03	0.359093777	0.072087021
7	0.15	0.03	3.44	0.0442	0.002255102	3219.54	0.328189602	0.03	0.360444704	0.081489676
8	0.15	0.03	3.43	0.0488	0.002489796	3230.13	0.329269113	0.03	0.361758909	0.089970501
9	0.15	0.03	3.42	0.0485	0.00247449	3240.53	0.330329256	0.03	0.362803746	0.089417404
10	0.15	0.03	3.41	0.0511	0.002607143	3250.73	0.331369011	0.03	0.363976154	0.094210914
11	0.15	0.03	3.4	0.0723	0.003688776	3249.9	0.331284404	0.03	0.364973179	0.13329646
12	0.15	0.03	3.39	0.0766	0.003908163	3245.28	0.330813456	0.03	0.364721619	0.141224189
13	0.15	0.03	3.38	0.0809	0.004127551	3240.5	0.330326198	0.03	0.364453749	0.149151917
14	0.15	0.03	3.37	0.0852	0.004346939	3235.57	0.329823649	0.03	0.364170588	0.157079646
15	0.15	0.03	3.36	0.0897	0.004576531	3237.47	0.330017329	0.03	0.36459386	0.165376106

TABLE-41 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.3412	0.005939665	1498.91	0.152794088	0.18	0.338733753	0.629056047
2	0.15	0.18	3.97	0.3212	0.005263747	1507.74	0.15369419	0.18	0.338957937	0.592182891
3	0.15	0.18	3.96	0.2973	0.004509556	1515.55	0.154490316	0.18	0.338999872	0.548119469
4	0.15	0.18	3.95	0.2744	0.00384016	1523.44	0.155294597	0.18	0.339136197	0.505899705
5	0.15	0.18	3.94	0.2562	0.00334589	1526.67	0.155623853	0.18	0.338972753	0.472345133
6	0.15	0.18	3.93	0.2407	0.002955943	1527.37	0.155695209	0.18	0.338651152	0.443768437
7	0.15	0.18	3.92	0.2258	0.002601308	1528.09	0.155768603	0.18	0.338369912	0.416297935
8	0.15	0.18	3.91	0.2127	0.002308229	1527.5	0.155708461	0.18	0.33801669	0.392146018
9	0.15	0.18	3.9	0.2001	0.002042858	1526.92	0.155649337	0.18	0.337692195	0.368915929
10	0.15	0.18	3.89	0.1883	0.001809025	1526.61	0.155617737	0.18	0.337426762	0.347160767
11	0.15	0.18	3.88	0.1776	0.001609273	1526.67	0.155623853	0.18	0.337233127	0.327433628
12	0.15	0.18	3.87	0.1672	0.001426318	1526.75	0.155632008	0.18	0.337058327	0.308259587
13	0.15	0.18	3.86	0.1591	0.00129147	1527.35	0.15569317	0.18	0.33698464	0.293325959
14	0.15	0.18	3.85	0.1513	0.001167943	1527.96	0.155755352	0.18	0.336923295	0.278945428
15	0.15	0.18	3.84	0.1446	0.001066794	1531.8	0.156146789	0.18	0.337213583	0.26659292

TABLE-42 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN NO OBSTRUCTION

WITHOUT OBSTRUCTION VERTICAL (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0409	8.53474E-05	3115.39	0.317572885	0.03	0.347658232	0.075405605
2	0.15	0.03	3.49	0.0519	0.000137429	3119.05	0.317945973	0.03	0.348083403	0.095685841
3	0.15	0.03	3.48	0.0672	0.0002304	3122.79	0.318327217	0.03	0.348557617	0.123893805
4	0.15	0.03	3.47	0.0783	0.000312801	3127.18	0.31877472	0.03	0.34908752	0.144358407
5	0.15	0.03	3.46	0.0872	0.000387951	3132	0.319266055	0.03	0.349654006	0.160766962
6	0.15	0.03	3.45	0.0963	0.000473147	3136.83	0.31975841	0.03	0.350231557	0.177544248
7	0.15	0.03	3.44	0.1033	0.000544433	3142.29	0.320314985	0.03	0.350859418	0.190449853
8	0.15	0.03	3.43	0.1103	0.000620719	3147.81	0.320877676	0.03	0.351498395	0.203355457
9	0.15	0.03	3.42	0.1173	0.000702005	3153.35	0.321442406	0.03	0.35214441	0.216261062
10	0.15	0.03	3.41	0.1236	0.000779437	3158.93	0.322011213	0.03	0.35279065	0.227876106
11	0.15	0.03	3.4	0.1294	0.000854304	3164.65	0.322594292	0.03	0.353448596	0.238569322
12	0.15	0.03	3.39	0.1353	0.000933984	3170.34	0.323174312	0.03	0.354108296	0.249446903
13	0.15	0.03	3.38	0.1412	0.001017216	3176.04	0.323755352	0.03	0.354772568	0.260324484
14	0.15	0.03	3.37	0.1466	0.001096508	3181.51	0.324312946	0.03	0.355409454	0.270280236
15	0.15	0.03	3.36	0.1518	0.001175676	3186.84	0.324856269	0.03	0.356031945	0.279867257

TABLE-43 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION horizontal (v=.4263 m/s)(h=8 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.18	3.98	0.3193	0.005201658	1486.22	0.15150051	0.18	0.336702167	0.588679941
2	0.15	0.18	3.97	0.3062	0.004783594	1485.61	0.151438328	0.18	0.336221922	0.564528024
3	0.15	0.18	3.96	0.2881	0.004234776	1501.94	0.153102956	0.18	0.337337732	0.531157817
4	0.15	0.18	3.95	0.2778	0.00393739	1531.66	0.156132518	0.18	0.340069908	0.512168142
5	0.15	0.18	3.94	0.252	0.00324	1544.77	0.157468909	0.18	0.340708909	0.46460177
6	0.15	0.18	3.93	0.2137	0.002329984	1546.7	0.157665647	0.18	0.339995631	0.393989676
7	0.15	0.18	3.92	0.1462	0.001090533	1583.84	0.16145158	0.18	0.342542113	0.269542773
8	0.15	0.18	3.91	0.0866	0.000382631	1477.27	0.150588175	0.18	0.330970806	0.159660767
9	0.15	0.18	3.9	0.0661	0.000222919	1238.4	0.126238532	0.18	0.306461451	0.121865782
10	0.15	0.18	3.89	0.0682	0.000237308	1388.61	0.141550459	0.18	0.321787767	0.125737463
11	0.15	0.18	3.88	0.1592	0.001293094	1477.17	0.150577982	0.18	0.331871076	0.293510324
12	0.15	0.18	3.87	0.2324	0.00275556	1507.52	0.153671764	0.18	0.336427364	0.428466077
13	0.15	0.18	3.86	0.2442	0.003042533	1517.23	0.15466157	0.18	0.337704102	0.450221239
14	0.15	0.18	3.85	0.2626	0.003518304	1498.09	0.152710499	0.18	0.336228804	0.484144543
15	0.15	0.18	3.84	0.2727	0.003794147	1499.08	0.152811417	0.18	0.336605564	0.502765487

TABLE-44 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN 10% OBSTRUCTION

WITH 10% OBSTRUCTION horizontal (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0309	0.001576531	3330.24	0.339474006	0.03	0.371050537	0.056969027
2	0.15	0.03	3.49	0.041	0.002091837	3332.26	0.339679918	0.03	0.371771755	0.075589971
3	0.15	0.03	3.48	0.051	0.002602041	3334.13	0.33987054	0.03	0.372472581	0.094026549
4	0.15	0.03	3.47	0.0554	0.002826531	3332.87	0.3397421	0.03	0.372568631	0.102138643
5	0.15	0.03	3.46	0.0604	0.003081633	3331.45	0.33959735	0.03	0.372678982	0.111356932
6	0.15	0.03	3.45	0.0656	0.003346939	3329.88	0.339437309	0.03	0.372784248	0.120943953
7	0.15	0.03	3.44	0.0666	0.003397959	3336.38	0.340099898	0.03	0.373497857	0.122787611
8	0.15	0.03	3.43	0.0677	0.003454082	3343.81	0.340857288	0.03	0.37431137	0.124815634
9	0.15	0.03	3.42	0.0692	0.003530612	3350.99	0.341589195	0.03	0.375119807	0.127581121
10	0.15	0.03	3.41	0.0711	0.003627551	3357.99	0.342302752	0.03	0.375930303	0.131084071
11	0.15	0.03	3.4	0.0776	0.003959184	3371.58	0.343688073	0.03	0.377647257	0.143067847
12	0.15	0.03	3.39	0.0859	0.004382653	3387.34	0.345294597	0.03	0.37967725	0.158370206
13	0.15	0.03	3.38	0.0947	0.004831633	3303.06	0.336703364	0.03	0.371534997	0.174594395
14	0.15	0.03	3.37	0.1038	0.005295918	3318.74	0.338301733	0.03	0.373597651	0.191371681
15	0.15	0.03	3.36	0.1131	0.005770408	3334.39	0.339897044	0.03	0.375667452	0.208517699

TABLE-45 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION horizontal (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.3623	0.006697005	1301	0.132619776	0.18	0.31931678	0.667957227
2	0.15	0.18	3.97	0.3406	0.005918794	1294.11	0.131917431	0.18	0.317836225	0.627949853
3	0.15	0.18	3.96	0.321	0.005257194	1285.44	0.131033639	0.18	0.316290833	0.591814159
4	0.15	0.18	3.95	0.2999	0.004588776	1278.18	0.130293578	0.18	0.314882354	0.552912979
5	0.15	0.18	3.94	0.2718	0.003769145	1287.02	0.131194699	0.18	0.314963844	0.501106195
6	0.15	0.18	3.93	0.2037	0.002117025	1328.35	0.135407747	0.18	0.317524772	0.375553097
7	0.15	0.18	3.92	0.092	0.000431837	1315.4	0.134087666	0.18	0.314519502	0.169616519
8	0.15	0.18	3.91	0.0385	0.000075625	1243.46	0.126754332	0.18	0.306829957	0.070980826
9	0.15	0.18	3.9	0.0398	8.08184E-05	1259.33	0.128372069	0.18	0.308452888	0.073377581
10	0.15	0.18	3.89	0.0806	0.000331447	1284.46	0.130933741	0.18	0.311265188	0.14859882
11	0.15	0.18	3.88	0.1207	0.00074329	1298.97	0.132412844	0.18	0.313156134	0.222529499
12	0.15	0.18	3.87	0.1207	0.00074329	1317.17	0.134268094	0.18	0.315011384	0.222529499
13	0.15	0.18	3.86	0.1268	0.000820318	1327.17	0.135287462	0.18	0.31610778	0.233775811
14	0.15	0.18	3.85	0.1391	0.000987184	1333.29	0.135911315	0.18	0.316898499	0.256452802
15	0.15	0.18	3.84	0.1527	0.001189658	1337.08	0.136297655	0.18	0.317487313	0.281526549

TABLE-46 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN 20% OBSTRUCTION

WITH 20% OBSTRUCTION horizontal (v=.4263 m/s)(h=8 cm)										
S. NO.	POSITION			VELOCITY	VELOCITY HEAD	PRESSURE	PRESSURE HEAD	DATUM HEAD	TOTAL HEAD	FROUDE NO.
	X	Y	Z							
1	0.15	0.03	3.5	0.0323	0.001647959	2978.71	0.303640163	0.03	0.335288122	0.059550147
2	0.15	0.03	3.49	0.0438	0.002234694	2980.35	0.303807339	0.03	0.336042033	0.080752212
3	0.15	0.03	3.48	0.0549	0.00280102	2983.01	0.304078491	0.03	0.336879512	0.101216814
4	0.15	0.03	3.47	0.0648	0.003306122	2985.86	0.304369011	0.03	0.337675134	0.119469027
5	0.15	0.03	3.46	0.0724	0.003693878	2989.77	0.304767584	0.03	0.338461462	0.133480826
6	0.15	0.03	3.45	0.0788	0.004020408	2994.24	0.305223242	0.03	0.33924365	0.145280236
7	0.15	0.03	3.44	0.0853	0.004352041	2998.71	0.305678899	0.03	0.34003094	0.157264012
8	0.15	0.03	3.43	0.0913	0.004658163	3004.28	0.306246687	0.03	0.34090485	0.168325959
9	0.15	0.03	3.42	0.0973	0.004964286	3009.99	0.306828746	0.03	0.341793032	0.179387906
10	0.15	0.03	3.41	0.1034	0.00527551	3015.68	0.307408767	0.03	0.342684277	0.190634218
11	0.15	0.03	3.4	0.1097	0.005596939	3021.56	0.308008155	0.03	0.343605094	0.202249263
12	0.15	0.03	3.39	0.1157	0.005903061	3028.05	0.308669725	0.03	0.344572786	0.213311209
13	0.15	0.03	3.38	0.1218	0.006214286	3034.56	0.309333333	0.03	0.345547619	0.224557522
14	0.15	0.03	3.37	0.128	0.006530612	3041.05	0.309994903	0.03	0.346525515	0.235988201
15	0.15	0.03	3.36	0.1343	0.006852041	3047.53	0.310655454	0.03	0.347507494	0.247603245

TABLE-47 UPSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION horizontal (v=.4263 m/s)(h=8 cm)										
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.18	3.98	0.3465	0.006125625	1487.69	0.151650357	0.18	0.337775982	0.638827434
2	0.15	0.18	3.97	0.3231	0.005326205	1487.23	0.151603466	0.18	0.33692967	0.595685841
3	0.15	0.18	3.96	0.3034	0.004696508	1486.79	0.151558614	0.18	0.336255122	0.559365782
4	0.15	0.18	3.95	0.2745	0.003844401	1487.76	0.151657492	0.18	0.335501893	0.506084071
5	0.15	0.18	3.94	0.2368	0.002860931	1514.37	0.154370031	0.18	0.337230961	0.436578171
6	0.15	0.18	3.93	0.1187	0.000718862	1524.21	0.155373089	0.18	0.33609195	0.218842183
7	0.15	0.18	3.92	0.0089	4.04133E-06	1322.59	0.134820591	0.18	0.314824633	0.016408555
8	0.15	0.18	3.91	0.0092	4.31837E-06	1343.59	0.136961264	0.18	0.316965582	0.016961652
9	0.15	0.18	3.9	0.101	0.000520459	1436.41	0.146423038	0.18	0.326943497	0.18620944
10	0.15	0.18	3.89	0.2106	0.002262876	1495.44	0.152440367	0.18	0.334703242	0.388274336
11	0.15	0.18	3.88	0.267	0.003637194	1505.96	0.153512742	0.18	0.337149936	0.492256637
12	0.15	0.18	3.87	0.2709	0.003744225	1507.26	0.15364526	0.18	0.337389485	0.499446903
13	0.15	0.18	3.86	0.2813	0.004037229	1507.33	0.153652396	0.18	0.337689625	0.518620944
14	0.15	0.18	3.85	0.2965	0.004485319	1507.75	0.153695209	0.18	0.338180528	0.546644543
15	0.15	0.18	3.84	0.3084	0.00485258	1514.29	0.154361876	0.18	0.339214455	0.568584071

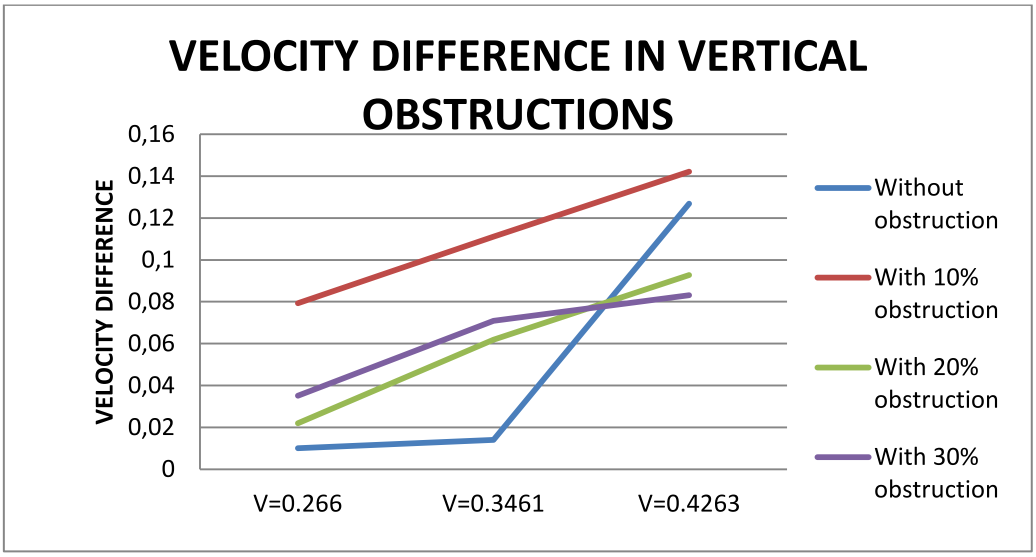
TABLE-48 DOWNSTREAM READING FOR HORIZONTAL OBSTRUCTION AT HEAD=8cm IN 30% OBSTRUCTION

WITH 30% OBSTRUCTION horizontal (v=.4263 m/s)(h=8 cm)											
S. NO.	**POSITION**			**VELOCITY**	**VELOCITY HEAD**	**PRESSURE**	**PRESSURE HEAD**	**DATUM HEAD**	**TOTAL HEAD**	**FROUDE NO.**
	X	**Y**	**Z**							
1	0.15	0.03	3.5	0.0401	0.002045918	3030.67	0.308936799	0.03	0.340982718	0.073930678
2	0.15	0.03	3.49	0.0602	0.003071429	3035.47	0.309426096	0.03	0.342497524	0.110988201
3	0.15	0.03	3.48	0.0724	0.003693878	3040.37	0.309925586	0.03	0.343619464	0.133480826
4	0.15	0.03	3.47	0.0847	0.004321429	3045.28	0.310426096	0.03	0.344747524	0.156157817
5	0.15	0.03	3.46	0.0939	0.004790816	3051.3	0.311039755	0.03	0.345830572	0.173119469
6	0.15	0.03	3.45	0.1032	0.005265306	3057.45	0.311666667	0.03	0.346931973	0.190265487
7	0.15	0.03	3.44	0.1123	0.005729592	3063.86	0.312320082	0.03	0.348049673	0.207042773
8	0.15	0.03	3.43	0.1211	0.006178571	3070.74	0.313021407	0.03	0.349199978	0.223266962
9	0.15	0.03	3.42	0.1299	0.006627551	3077.6	0.313720693	0.03	0.350348244	0.23949115
10	0.15	0.03	3.41	0.1388	0.007081633	3084.5	0.314424057	0.03	0.35150569	0.255899705
11	0.15	0.03	3.4	0.1468	0.007489796	3091.7	0.315158002	0.03	0.352647798	0.270648968
12	0.15	0.03	3.39	0.155	0.007908163	3098.89	0.315890928	0.03	0.353799091	0.285766962
13	0.15	0.03	3.38	0.1632	0.008326531	3106.07	0.316622834	0.03	0.354949364	0.300884956
14	0.15	0.03	3.37	0.1714	0.008744898	3113.25	0.31735474	0.03	0.356099638	0.31600295
15	0.15	0.03	3.36	0.1784	0.009102041	3120.36	0.318079511	0.03	0.357181552	0.328908555

CHAPTER-6

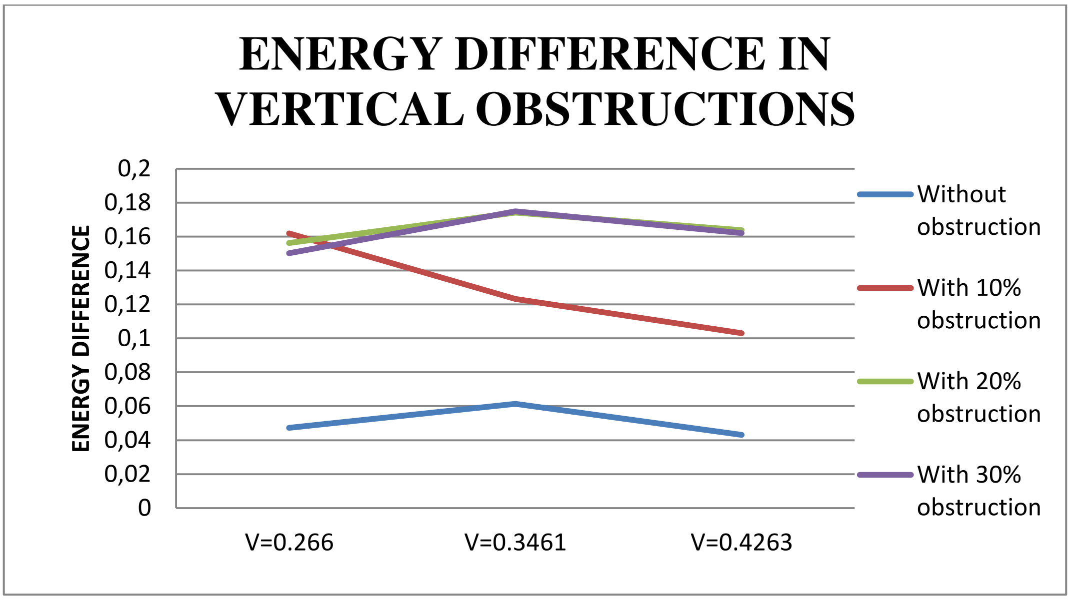
CONCLUSION

In the case of vertical obstructions when we increase the velocity (as head is increased then we observe):



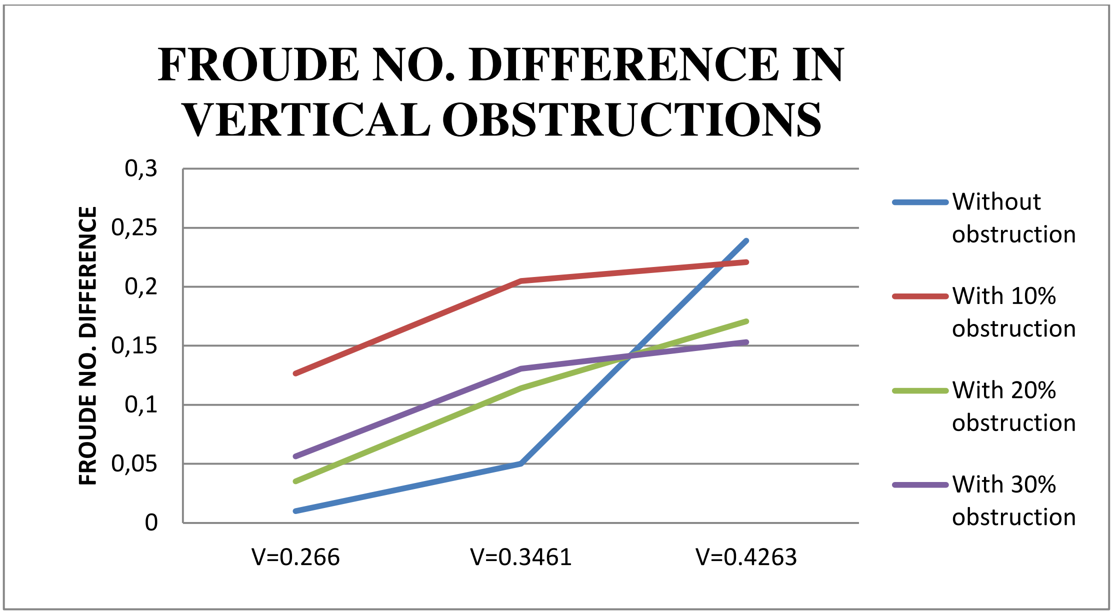
1. In the above case a reduction of 0.1269 in the case of (v=0.4263& without obstruction is observed due to constant decrease in velocity along the flow through the steps.
2. We can see as the velocity increases respective values of decrease in velocity also increases.
3. When we observe the velocity reduction with respect to % obstruction then we observe that there is a max. reduction of velocity in 10% obstruction case then there is not much significant increase in the velocity as the % obstruction increases.

In the case of vertical obstructions when we observe the ENERGY HEAD



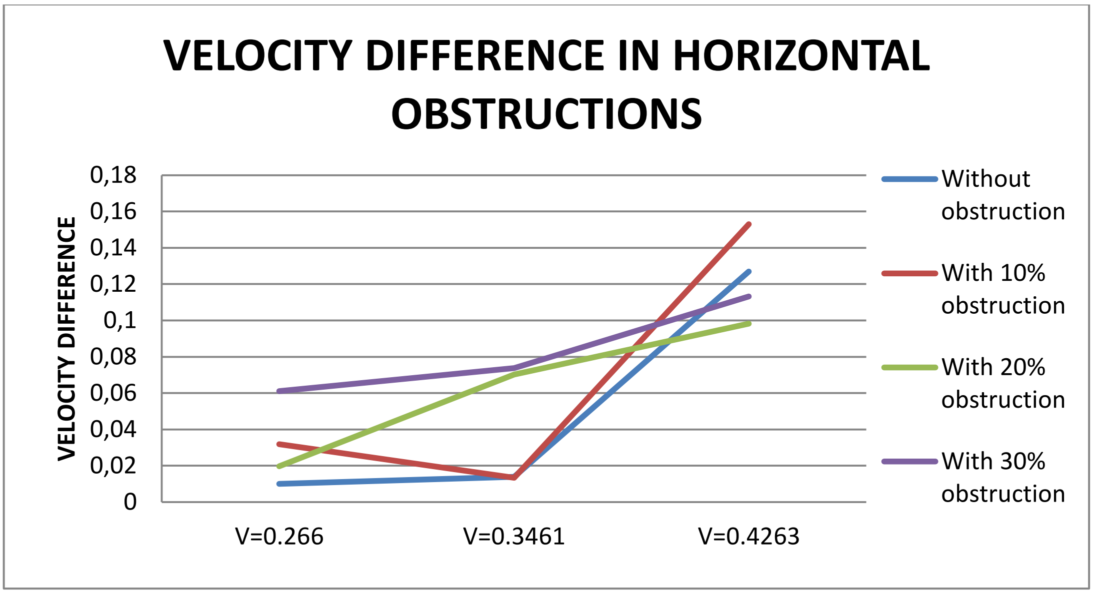
Here also we observe the energy reduction with respect to % obstruction then we observe that there is a max. reduction of energy in 10% obstruction case then there is not much significant increase in the energy as the % obstruction increases.

In the case of vertical obstructions when we observe the FROUDE NO.



Here also we observe the Froude no. reduction with respect to % obstruction then we observe that there is a max. reduction of Froude no. in 10% obstruction case then there is not much significant increase in the Froude no. as the % obstruction increases.

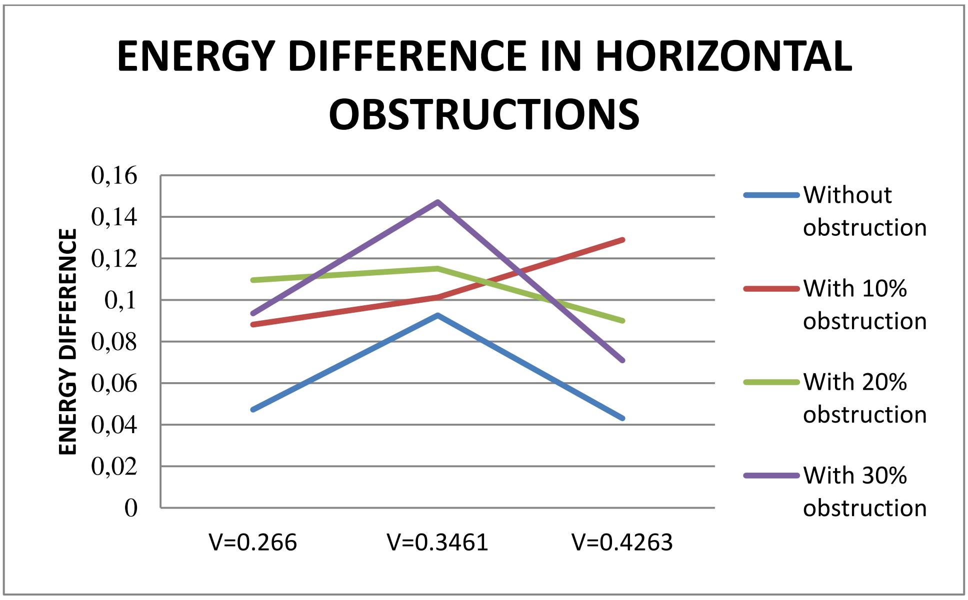
In the case of horizontal obstructions when we increase the velocity(as head is increased then we observe:



1. Here we observe the velocity reduction with respect to % obstruction then we observe that with increase in % obstruction there is respective increase in difference of velocity. So we can say that in case of horizontal obstruction we can also increase obstruction beyond 30% if possible.

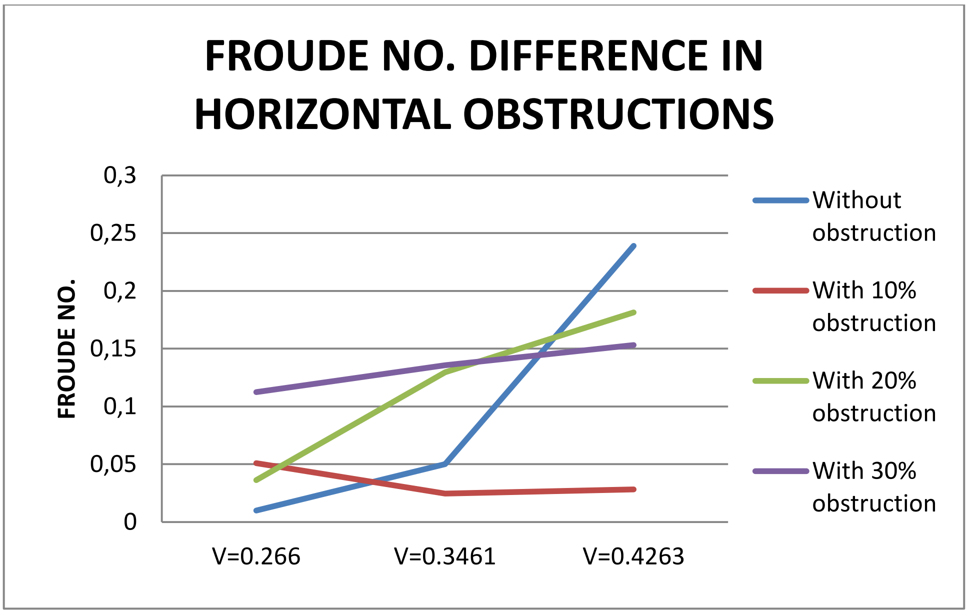
2. Also we obsereve that except for 10% obstruction case velocity reduction is comparatively higher

In the case of horizontal obstructions when we observe the ENERGY HEAD



Here we observe the energy reduction with respect to % obstruction then we observe that with increase in % obstruction there is approximately not much effect on energy reduction since there was corresponding increase in pressure downstream .

In the case of horizontal obstructions when we observe the FROUDE NO.



.Here we observe the Froude no. reduction with respect to % obstruction then we observe that with increase in % obstruction there is respective increase in difference of Froude no. So we can say that in case of horizontal obstruction we can also increase obstruction beyond 30% if possible.

CHAPTER-7

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