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Pipe Size Calculation for Water Supply

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Abstract: A pipe designer or engineer has to solve complex math equation for calculating the diameter of pipe to determine how much water discharge it can be handled at a particular flow velocity. This article is an effort to make the calculation of water pipe size easier. The formula and factor derived in this document can be used for pipe diameter calculation for all types of normal water supply. Like – chilled water, raw water, soft water, cooling water, hot water and hydrant water at a particular flow velocity.
Keywords: Handy formula for water pipe size calculation, volumetric flow rate, Pipe dia calculation, Flow velocity.

I. INTRODUCTION

Here we figure out or generate a handy formula as an easy tool for calculating the pipe size which can be used for determining the pipe diameter for a given discharge at a particular flow velocity for steady water flow.

1) *Derivation of handy (simple) formula for water pipe size calculation*: We begun with some result that we shall use while making "Handy formula for water pipe size calculation".

$$\text{Volumetric flow rate } Q = \frac{\pi}{4} D^2 V$$

Where D is pipe diameter and V is the average velocity

$$\text{Pipe diameter } D = \sqrt{\frac{4Q}{\pi V}}$$

$$D = \sqrt{Q} \times \left(2\sqrt{\frac{1}{\pi V}}\right)$$

Generally, in industrial application the flow rate measures in cubic meter per hour (CMH) and velocity of water supply in pipeline in meter per second (mps).

$$D = \sqrt{\frac{4 \times Q \times 10^9}{3600 \times \pi \times V \times 10^3}} \;.\;.\;.\;.\;.\;.\;.\;.\; (i)$$

$$D = \sqrt{Q} \times \sqrt{\frac{4 \times 10^9}{3600 \times \pi \times V \times 10^3}}$$

Where,

D - Diameter of pipe in mm
Q - Volumetric flow in CMH
V - Velocity of water in pipe in mps

If the velocity is fixed then the value of $\left(\sqrt{\frac{4 \times 10^9}{3600 \times \pi \times V \times 10^3}}\right)$ will be a constant "C".

$$\boxed{\boldsymbol{D = \sqrt{Q} \times C} \;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\; \textbf{.(ii) A very handy formula.}}$$

Where, C is the constant value at a fixed velocity of water in pipe. Let's call it **DC factor for "water pipe size calculation".**
Formula (i) is a very simple form for calculating pipe sizes for a given volumetric flow and flow velocity.

2) *DC factor for water pipe size calculation:* The values of DC factor at different velocity are given in Table 1 for water pipe size calculation.

TABLE I
DC FACTOR AT DIFFERENT VELOCITY OF WATER IN PIPE

S. No.	Velocity of water in Pipe 'V' in mps	DC factor for water pipe size calculation 'C'	S. No.	Velocity of water in Pipe 'V' in mps	DC factor for water pipe size calculation 'C'
1	1	18.81	11	3.0	10.86
2	1.2	17.17	12	3.2	10.51
3	1.4	15.89	13	3.4	10.20
4	1.6	14.87	14	3.6	9.91
5	1.8	14.02	15	3.8	9.65
6	2.0	13.30	16	4.0	9.40
7	2.2	12.68	17	4.5	8.87
8	2.4	12.14	18	5.0	8.41
9	2.6	11.66	19	5.5	8.02
10	2.8	11.24	20	6.0	7.68

3) *How to use "Handy Formula" (ii):*

- To calculate the pipe diameter in mm, just multiply the square root of volumetric flow Q (value in CMH) with the DC factor at a given or selected velocity from above Table 1.
- Please note that the calculated pipe size is the inner diameter of pipe.

A. *Examples - 1*

Calculate the required pipe size for the 300 CMH (cubic meter per hour) volumetric flow rate at a velocity of 2 mps.by using the volumetric flow formula.

Solution

Flow Q - 300 CMH
Velocity V - 2 mps

Volumetric flow rate $Q = \frac{\pi}{4} D^2 V$

$$D = \sqrt{\frac{4 \times Q \times 10^9}{3600 \times \pi \times V \times 10^3}}$$

$$D = \sqrt{\frac{4 \times 300 \times 10^9}{3600 \times \pi \times 2 \times 10^3}}$$

$$D = 230.33\ mm\ (inner\ diameter\ of\ pipe)$$

B. *Examples - 2*

Calculate the required pipe size for the 300 CMH (cubic meter per hour) volumetric flow rate at a velocity of 2 mps.by using DC factor for water pipe size calculation.

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Solution

Flow Q -	300 CMH
Velocity V -	2 mps
DC factor at velocity 2mps -	13.30

$$D = \sqrt{Q} \times C \,..........\, .(ii)$$

$$D = \sqrt{300} \times 13.30$$

$$D = 230.36\, mm\, (inner\ diameter\ of\ pipe)$$

Here, we can see that the calculation of water pipe size is very simple by using the DC factor.

C. Examples - 3

What will be the pipe size for the water flow rate of 150 CMH at a velocity of 1.8 mps?

Solution

Flow Q -	150 CMH
Velocity V -	1.8 mps
DC factor at velocity 2mps -	14.02

$$D = \sqrt{Q} \times C \,..........\, .(ii)$$

$$D = \sqrt{150} \times 14.02$$

$$D = 171.70\, mm\, (inner\ diameter\ of\ pipe)$$

II. GLOSSORY

1) CMH : Cubic meter per hour
2) mps : Meter per sec
3) DC : Dinesh Chauhan's factor for water pipe size calculation

III.CONCLUSIONS

The DC factor is a multiplying factor at a particular velocity of water to calculate the pipe diameter by multiplying it with the square root of volumetric flow. By using the DC factor, the calculation becomes very easy to calculate the water pipe size.

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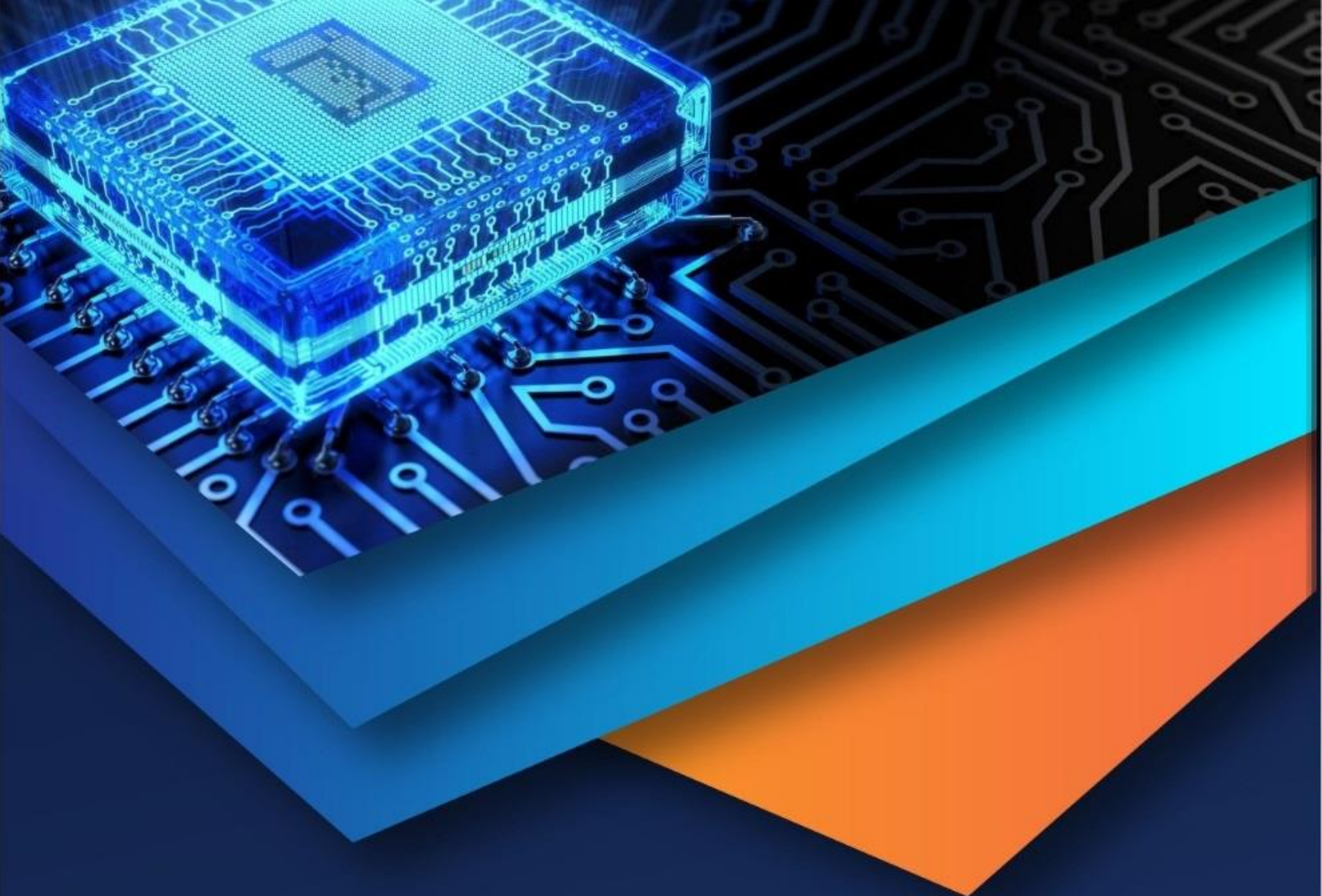

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