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To Calculate the Optimum area of Thrust Block for Blank End with Closable Valves

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Abstract-*The present work is to find the optimum area of thrust block for blank end with closable valve system. In this we considered particularly six types of poorly graded soil whose bearing capacity is known. The value of Pressure Head from Pipauri village which is situated in Bidhnoo Block, Kanpur District. The reason for taking the safety factor is to consider the surge condition in which there is sudden rise of pressure due to some fault in laid pipeline system. The method used for finding out the optimum area of Thrust Block is simple which considers diameter of pipe as a variable and area is calculated for different diameters. . From these values the design is achieved by calculating the optimum Area from the design equation and then breaking the area into corresponding bearing width and height (b and h).*

The width and height can be compared by keeping a fix ratio between them.

Keywords- Thrust block, optimum area, Kanpur district, surge, Width, Height

1-Introduction

Pipauri village is situated in Bidhnoo block, Kanpur Nagar.The Pressure Head is taken from Pipauri Gram Panchayat water supply scheme provided by Kanpur Jal Nigam where the total head, head loss where given and the pressure head was calculated using Bernoulli's equation .In this paper we mainly considered six Types of poorly graded soil whose bearing Capacity is known .The method used is simple that is calculating the thrust block area using different parameter such as pressure, bearing capacity, diameter of pipe, and then breaking the obtained area into width and height which has a constant ratio.

2-Importance of Thrust Block

Considering The present situation of clean water and water crisis the sustainable use of water or wise use of water is important because the loss of water may lead to scarcity, and the failure or movement of any pipeline system carrying treated water or raw water will increase the cost of treatment in short term but scarcity of water in long term.So to prevent this type of failure or movement the Thrust block is necessary.

3-Materials

Concrete is a construction material which is manufactured by the mixture of materials which are called as aggregates, cement and water. By controlling the proportion of these three components the minimum grade is prepared .M20 can be considered as a minimum grade of concrete considering the safety point of view.

4-Steel reinforcement

As the concrete is strong in compression and weak in tension, so concrete was reinforced with the HYSD bars to take up the tension and to prevent concrete from the shrinkage and creep which will occur due to the

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variation of temperature with the time. Minimum steel used was 0.12% surface area. Minimum 10mm Nominal reinforcement bars are provided.

5-Methodology

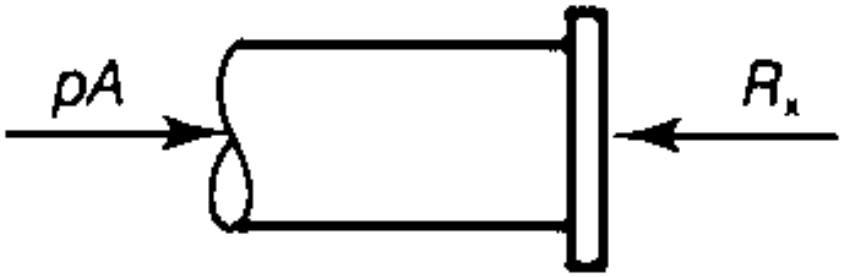

Fig 5.1-Blank end and closable valves

Axial Thrust $Rx = pA$

The main aim of the design is to provide a bearing Area (Ab) of the Block that will distribute the force against the soil such that the lateral bearing strength of the soil was not exceeded. Equilibrium condition is shown in equation (1).

$$2p(\frac{\pi D^2}{4})\sin(\Theta/2)Sf \leq Sb(b*h) \qquad \text{equation 1}$$

The required bearing Area of the thrust block is given in equation (2) below.

$$(2p(\frac{\pi D^2}{4})\sin(\Theta/2)Sf) \,/\, Sb = (b*h) \qquad \text{equation 2}$$

That is equation 2 changes to

$$Ab = T * Sf/Sb \qquad \text{equation 3}$$

Equation 3 is obtained from equation 2 which is used for the design of Thrust Block

Where-

p =Internal pressure in pipe

Θ =angle of bend

Sf=safety factor

Sb=Bearing capacity of soil

T=Thrust calculated

D=diameter of pip

Ab =size of thrust block

b=width

h=height

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5.1 Types of soil considered

Manly six types of soils are considered which are poorly graded with known bearing capacity these are-

S NO	TYPES OF SOIL	BEARING STRENGTH(kN/m²)
1	Soft Clay	47.88
2	Silt	71.82
3	Sandy Silt	191.52
4	Sand	143.64
5	Sandy Clay	287.28
6	Hard Clay	430.92

Table 5.1-Soils with their Bearing Capacity

6-Results and Discussion

Table 6.1- Soft Clay with bearing capacity=47.88 kN/m²

S.NO	Diameter of pipe(m)	Thrust (kN)	Area (m²)	Width(b) (m)	Height(h) (m)
1	.40	125.6	3.93	1.477	2.65
2	.50	196.25	6.148	1.848	3.326
3	.60	282.6	8.85	2.21	3.99
4	.70	384.65	12.65	2.65	4.77
5	.80	502.4	15.73	2.956	5.32
6	1.0	785	24.59	3.69	6.65

Table 6.2- Silt with bearing capacity=71.82 kN/m²

S.NO	Diameter of pipe(m)	Thrust (kN)	Area (m²)	Width(b) (m)	Height(h) (m)
1	.40	125.6	2.623	1.207	2.17
2	.50	196.25	4.098	1.508	2.715
3	.60	282.6	5.90	1.81	3.25
4	.70	384.65	8.033	2.112	3.8
5	.80	502.4	10.49	2.414	4.34
6	1.0	785	16.39	3.01	5.43

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Table 6.3- Sandy silt with bearing capacity=143.64 kN/m²

S.NO	Diameter of pipe(m)	Thrust (kN)	Area (m^2)	Width(b) (m)	Height(h) (m)
1	.40	125.6	1.31	0.85	1.535
2	.50	196.25	2.049	1.066	1.92
3	.60	282.6	2.95	1.28	2.304
4	.70	384.65	4.0168	1.493	2.688
5	.80	502.4	5.246	1.707	3.07
6	1.0	785	8.197	2.133	3.84

Table 6.4- Sand with bearing capacity=191.52 kN/m²

S.NO	Diameter of pipe(m)	Thrust (kN)	Area (m^2)	Width(b) (m)	Height(h) (m)
1	.40	125.6	0.983	0.738	1.33
2	.50	196.25	1.537	0.924	1.663
3	.60	282.6	2.21	1.108	1.99
4	.70	384.65	3.012	1.293	2.328
5	.80	502.4	3.93	1.477	2.659
6	1.0	785	6.148	1.848	3.32

Table 6.5- Sandy Clay with bearing capacity=287.28 kN/m²

S.NO	Diameter of pipe(m)	Thrust (kN)	Area (m^2)	Width(b) (m)	Height(h) (m)
1	.40	125.6	0.655	0.603	1.085
2	.50	196.25	1.0246	0.7544	1.358
3	.60	282.6	1.475	0.9052	1.629
4	.70	384.65	2.008	1.056	1.901
5	.80	502.4	2.62	1.206	2.17
6	1.0	785	4.098	1.5088	2.715

Table 6.6- Hard Clay with bearing capacity=430.92 kN/m²

S.NO	Diameter of pipe(m)	Thrust (kN)	Area (m^2)	Width(b) (m)	Height(h) (m)
1	.40	125.6	0.437	0.492	0.8869
2	.50	196.25	0.683	0.6159	1.108
3	.60	282.6	0.9837	0.7392	1.33
4	.70	384.65	1.338	0.862	1.55
5	.80	502.4	1.748	0.985	1.77
6	1.0	785	2.73	1.23	2.2167

The area obtained from these values of bearing capacity can be compared with standard size that is the value obtained from soil like soft clay, silt the size of thrust block required in this case is large and seems to be uneconomical as the bearing capacity of these soil is very low.

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