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Design of Water Supply Pipe Networks in NIT Srinagar using EPANET Software

Sandeep Thakur [1], Abhinav Verma [1], VK Angral [1], Dr. M.A. Ahanger[2],
[1] B. tech Scholar, Civil Engineering, National Institute of Technology, Srinagar, J&K, India
[2] Professor, Civil Engineering, National Institute of Technology, Srinagar, J&K, India

***Abstract*: - Water is one of the most vital natural resources for all life on Earth. The availability and quality of water always have played an important part in determining not only where people can live, but also their quality of life. Even though there always has been plenty of fresh water on Earth, water has not always been available when and where it is needed, nor is it always of suitable quality for all uses. Water must be considered as a finite resource that has limits and boundaries to its availability and suitability for use. Water is used for various purposes like commercial (hotels, restaurants, office buildings, other commercial facilities), domestic (drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens), industrial(cleaning, transportation, dilution, and cooling in manufacturing facilities) , irrigation (freeze protection, chemical application, crop cooling, harvesting, and for the leaching of salt from crop zone). For all this purposes we need to supply water which is done by water distribution system.**

In this study pipe network system has been designed for NIT SRINAGAR using EPANET software for 30 years population projection (design period). The design consists of hydraulic design. Population of the campus (including residential and non-residential) with a margin for increase in population has been considered while determining the water demand. `

INTRODUCTION: -

Water distribution systems connect consumers to sources of water, using hydraulic components, such as pipes, valves, and reservoirs. The engineer faced with the design of such a system, or of additions to an existing system, has to select the sizes of its components. Also, he has to consider the way in which the operational components, pumps and valves, will be used to supply the required demands with adequate pressures. The network has to perform adequately under varying demand loads, and in the design process, one considers several significant loads: maximum hourly, average daily, low-demand periods during which reservoirs are to be filled, etc. Operational decisions for these loads are essentially part of the design process, since one cannot separate the so-called design decisions, the sizing of components, from the operational decisions; they are two inseparable parts of one problem. This paper presents a method for optimizing the design of a water distribution system: sizing its components and setting the operational decisions for pumps and valves under a number of loading conditions, those which are considered 'typical' or ' critical. ' EPANET can be used in the planning of pipe network systems to meet forecasted demands of the next 20 years or 30 years. For example, the program can be used to develop long term capital-improvement plans for the existing pipe network system. These plans can include staging, sizing, and locating future pipe network and water chlorination facilities. The software can also be used in the development of a main rehabilitation plan or a system-improvement plan. And, a network analysis can provide suggestions and recommendations to prepare for the occurrence of any unusual events.

EXISTING WORK: -

Pipe network analysis of water distribution systems has evolved from a time-consuming process done infrequently to a quick and easy process done regularly on systems of all sizes. Pipe network analysis initially started early in 1940. Years later, two network analysis programs were introduced by Shamir and Howard (1968) and Epp and Fowler (1970). Both programs used the Newton-Raphson method to linearize the nonlinear mass and energy equations. The major differences between these two programs are:

1. The Shamir-Howard program is based on node-oriented equations, while the Epp-Fowler program is based on loop-oriented equations.
2. The Shamir-Howard program solves for pressure, demand, and the parameters of pipes and nodes, while the Epp-Fowler program solves only for pressures and flow rates.

IMPLEMENTATION: -

Estimation of Water Demand

Assuming consumption of water as per specified by IS Code 1172:1993 as follow:

1. 135 lpcd for hostel
2. 50 lpcd for floating population
3. 150 lpcd for residential buildings
4. 50 lpcd for offices
5. 450 lpcd for medical unit
6. 350 lpcd for medical quater
7. 2 as peak factor

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Table 1: Estimated Future Demand

BRANCH	BTech Student	B	MTECH STUDENTS	MTECH STUDENTS	Demand (lpd) @50lpcd	Demand (lps)
	Present (2014)	Future estimated	Present (2014)	Future (2014)		
CIVIL ENGINEERING	123	185	GE 12	27	970	97000 lpd =1.123 lps
			SE 20	35		
			TE 13	28		
			WRE 10	25		
ELECTRICAL ENGINEERING	78	117	EPE 21	36	540	54000 lpd =0.625 lps
MECHANICAL ENGINEERING	77	116	MSD 20 ITMM 21	35 36	606	60600 lpd =0.701 lps
ELECTRONICS AND COMMUNICATION	77	116	ME 11 C&IT 20	26 35	586	58600 lpd =0.678 lps
INFORMATION TECHNOLOGY	62	92	NA	20	408	40800 lpd =0.472 lps
CHEMICAL ENGINEERING	78	117	CHE 15	30	528	52800 lpd =0.61 lps
COMPUTER SCIENCE	62	`	NA	20	408	40800 lpd =0.472 lps
METALLURGY ENGINEERING	78	117	NA	20	508	50800 lpd =0.587 lps

NA stands for not available *lpd stands for liters per day *lps stands for liters per second *Seat matrix is taken from CCMT and counselling websites.

For hostels:

As hostels are nearly full up to their capacity so future increment is given to them and assume 135 lpcd as water demand with peak factor of 2 as recommended by code IS: 1172:1993.

Table 2: Water demand for Hostels

Name of Hostel	No of rooms	Capacity	Water Demand @135lpcd @ 2 peak factor	Residual Head Required (in m)
Jhelum	300 in 6 blocks	1 person per room = 300	81000 lpd =0.94 lps	17
Chenab	99	4 persons per room = 396	106920 lpd =1.24 lps	17
Indus	123	4 persons per room = 492	132840 lpd = 1.54 lps	17
Tawi	48	4 persons per room = 192	51840 lpd = 0.6 lps	7
Dal	48 sets	5 persons per set = 240	64800 lpd = 0.75 lps	17
S-Hostel	72 sets	5 persons per set = 360	97200 lpd = 1.125 lps	17
M TECH Hostel	**Block 1** 26	3 persons per room = 78	21060 lpd = 0.244 lps	12
	Block 2 4	4 persons per room =16	4320 lpd = 0.05 lps	7
Mega Hostel	5 storey building with capacity of 1000 persons		270000 lpd = 3.13 lps	27
Girls Hostel	12 sets	180	48600 lpd = 0.562 lps	17

Total water demand for Hostels = 878580 lpd =10.169 lps

Also, there are two blocks for Pre-fabricated hostel which is built near jhelum hostel. Assuming 135 lpcd with capacity of 400 persons, then water demand will be equal to 1.25 lps.

Table 3: Water Demand for new blocks

BLOCK NO	Specifications of blocks	Water demand (50 lpcd for Floating population and 150 lpcd for residential with peak factor 2)	HEAD REQUIRED
1	6nos. 100 Capacity Drawing Hall With A2 Size Drawing Board 25 Nos. 100 Capacity Lecture Theatre With Stepped Seats 20 Nos. 40 Capacity Classrooms On Level Floor, Computer Centre = 3 floor Electrical Engineering (Ext.)….. 1 Floor Academic Section/Examination Halls ------- 1 Floor Deans Offices/ Cafeteria ---- 1 Floor	Floor 1 = 0.69 lps Floor 2 = 2.89 lps Floor 3 = 0.93 lps Floor 4 = 0.24 lps Floor 5 = 0.02 lps Floor 6 = 0.02 lps Total =4.79 lps	32 m
2	IT ------ 1 Floor Computer Science And Engineering ------- 1 Floor Physics ------ 1 Floor Chemistry ------ 1 Floor Maths ------ 1/2 Floor Humanities ------ 1/2 Floor Electronics Comm.Enggdept., CRF Centre ------ 1 Floor	Floor 1 = 0.17 lps Floor 2 = 0.175 lps Floor 3 = 0.21 lps Floor 4 = 0.21 lps Floor 5 = 0.21 lps Floor 6 = 0.24 lps Total = 1.215 lps	32m
3	Workshops ------ 1 Floor Mechanical Engineering ------ 2floor Chemical Engineering ------ 1 Floor Metallurgical Engineering ------ 1 Floor Civil Lab /WRMC ------ 1 Floor	Floor 1 = 0.20 lps Floor 2-3 = 0.25 lps Floor 4 = 0.21 lps Floor 5 = 0.21 lps Floor 6 = 0.09 lps Total = 0.97 lps	32m
4	Hospital 2 Nos. Banks ATMs Telephone Exchange Shopping Mall P&D Stores Service Centre	Floor 1 = 0.07 lps Floor 2 = 0.12 lps Floor 3 = 0.12 lps Floor 4 = 0.12 lps Floor 5 = 0.12 lps Floor 6 = 0.06 lps Total = 0.61 lps	32m
5	Girls Hostel With Single Seater / Double Seater Rooms Dining Hall & Kitchen Multipurpose Rooms Activity Rooms	Assuming capacity of new hostel to be of 500 persons consuming water @135 lpcd then demand will be 1.562 lps	27 m
6	Badminton Court Table Tennis – 2 Tables Chess , Carom Reading Lounge Outdoor Courts for Basket Ball, Volley Ball	Assuming Demand = 0.82 lps	12m
7	No. of Flats : 12 to 15 with Floor area of 120 Sq.m Total No. of Flats=70 to85	Assuming 72 flats with 6 family size consuming water @150 lpcd, Demand = 1.5 lps	27m

The above table 3 shows the water demand for new block.Net water demand (including auditorium, hostel, residential and floating water demand and new 7 blocks) = 27.68 lps = 2391552 lpd.

RESULT: -

Validation of results by Hardy Cross Method:

For approving outcomes given by EPANET, we should discover the release in pipes exclusively utilizing Hardy Cross Method and look at the two outcomes. On the off chance that EPANET results are near Hardy cross outcomes, at that point our product is

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getting us results which are legitimate as well. For this reason, we take circle close square 1 which comprises of 5 hubs system as appeared in figure 1.

According to EPANET results, pipes AB, BC, CD, DE and EA convey release of 0.65, 0.25, 10.08, 1.96 and 1.29. Presently will compute deviation (dQ) by strong cross strategy which ought to be exceptionally less, at that point just our results will be right.

Deviation is given as $dQ = \frac{\sum R\,|Q|Q}{\sum 2RQ}$.

Taking loop direction in anticlockwise direction

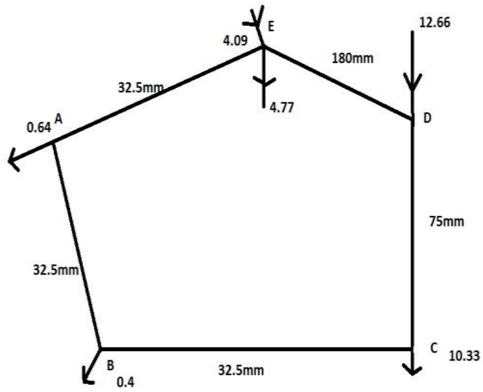

Figure 1: Hardy Cross Method

Table 4: Calculations for first trail

Pipe	**Radius R (in m)**	**Discharge Q (in lps)**	$\sum R\,|Q|Q$ **(m^7 per sec)**
AB	0.0325	0.65	1.37 X 10^-8
BC	0.0325	0.25	2.03 X 10^-9
CD	0.075	-10.08	-7.62 X 10^-6
DE	0.090	1.96	1.76 X 10^-7
EA	0.0325	1.29	5.4 X 10^-8

dQ = -2.67 X 10^-5 m^3 per sec = -2.67 X 10^-2 lps which is very less so discharges flowing in pipes are true. Hence epanet results are valid. The above figure shows the calculation for first trail.

CONCLUSION: -

Subsequently here we are examined plan of water supply pipe networks. The point of the water supply organize framework is to guarantee that water achieves all zones in great quality and amount, with the end goal of investigation and reenactment to acquire least and most extreme power, speed of stream in the pipe arrange framework so as to guarantee the correct working of water pipe organize. Likewise, broke down circles organize as indicated by progression and vitality preservation equations because of the assurance of obscure releases, streams and weight at hubs. Strong Cross technique is utilized due to unravel and break down shut circles organize for stream coherence and head-misfortune so as to adjust the system as the setting of this paper.

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