Republic Of Iraq
Ministry of Higher Education and scientific research
University of Technology
Building and Construction Eng. Dept
Water and Dams Engineering Branch

WATER SUPPLY NETWORK

Annual project submitted to the department of building and construction engineering of the University of Technology as partial fulfillment of requirements for the degree of B.Sc

In building and construction engineering

Submitted by

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بسم الله الرحمن الرحيم

و جعلنا من الماء

كل شئ حي افلا

يؤمنون

صدق الله العظيم

سورة الأنبياء الأية ٣٠

I certify that the project titled (Water Supply Network) which is being submitted by (Bassam Manhal Muwaffaq) in partial fulfillment of the requirement of B.SC of science in water and dams ,is a bona fide record of work carried out by him under my supervision.

Signature: Dr. Iblesam R. Karem

Name:

Date: 22-5-2017

I certify that the project titled (Water Supply Network) which is being submitted by (Bassam Manhal Muwaffaq) in partial fulfillment of the requirement of B.SC in water and dams, is a benefit record of work carried out by him under my supervision.

Signature :

Name:

Date:

الإهداء

إلى من بلغ الرسالة وأدى الأمانة .. ونصح الأمة .. إلى نبي الرحمة ونور العالمين..

سيدنا محمد صلى الله عليه وسلم

الى من عشت في كنف حبها و حنانها

الى من اودعتني بين كنوز جناتها

إلى بسمة الحياة وسر الوجود

الى من وضعت املها في

والدتي الحبيبة

إلى من حصد الأشواك عن دربي ليمهد لي طريق العلم

إلى من جرع الكأس فارغاً ليسقيني قطرة حب

إلى من كلّت أنامله ليقدم لنا لحظة سعادة

إلى القلب الكبير

والدي العزيز

إلى القلوب الطاهرة الرقيقة والنفوس البريئة إلى رياحين حياتي

إخوتي

الآن تفتح الأشرعة وترفع المرساة لتنطلق السفينة في عرض بحر واسع مظلم هو بحر الحياة وفي هذه الظلمة لا يضيء إلا قنديل الذكريات ذكريات الأخوة البعيدة إلى الذين أحببتهم وأحبوني

أصدقائي

بطاقة الشكر

في مثل هذه اللحظات يتوقف اليراع ليفكر قبل أن يخط الحروف ليجمعها في كلمات ... تتبعثر الأحرف وعبثاً أن يحاول تجميعها في سطور

سطوراً كثيرة تمر في الخيال ولا يبقى لنا في نهاية المطاف إلا قليلاً من الذكريات وصور تجمعنا برفاق كانوا إلى جانبنا.............

فواجب علينا شكرهم ووداعهم ونحن نخطو خطوتنا الأولى في غمار الحياة

ونخص بالجزيل الشكر والعرفان إلى كل من أشعل شمعة في دروب عملنا و

وإلى من وقف على المنابر وأعطى من حصيلة فكره لينير دربنا

إلى الأستاذة الدكتورة ابتسام

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Summary

This study is deals with design of distribution network for drinking water system consist of (250) buildings, each with three floors and each floor contains (12) apartment, with design period of (50)years by the gravitational system and considering a factor of safety (1.5) the design made by computer software (pipe^{++}) with Hardy-Cross method and Hazen-williams formula.

The design required the delivery of water to a height of (13) m as a minimum, which includes the head losses in pipes and nodes.The software needs several data as: water distribution network , length of pipes and diameter in and the demand of water and then but the main reservoir and the application of several heights of the tank and take the optimal height which was (20) m assumed to be for satisfying the standard speed limit and the pressure for the last point served by the network . The height of water in the last point is found to be (15.66) m ,the deferens is mentioned as head losses.

Chapter One

INTRODECTION

Chapter One

Introduction

1-1 General:

Water distribution networks are the most important part in the distribution of water and is considered the most expensive part in the process and purpose of these networks is the distribution of water in the city for normal consumption and distribution of water under certain pressure.

The purpose of distribution system is to deliver water to consumer with appropriate quality, quantity and pressure. Distribution system is used to describe collectively the facilities used to supply water from its source to the point of usage.

1-2 The Objectives:

The research aims to design a water distribution network for a certain city and conform the design with scientific requirements and specifications approved to facility the calculation and save time , a software provided by modern computers will use.
The research aims to clarify the relationship between the speed of flow inside the pipes and the losses within those pipes. And then analyze the network by using equations (Hardy Cross) to find a discharge and loss in each tube.

Chapter Two

WATER DISTRIBUTION SYSTEM

Chapter Two

Water Distribution System

2-1 Literature Review:

1.Harry Watson(water supply network) , 2ooo was used a software and manual for design a water network ,The result of distribution system from manual and software show that there is a difference between them . computer software sophistically package which consider so many factor regarding the distribution system . hence it gives economical design as compare to manual design Hardy-Cross method is most widely used method but it is too much time consuming and so many iteration are required .

2.Antonio Gameiro (network analyse), 2003 used implementation of the Hardy-Cross method for the solution of piping network , By using a friendly implementation of the Hardy-Cross method for solving piping network he was gated an easy and accurate result for his project. the software is particularly suited for academic application , allowing the user to solve both flow-rate problems and dimensioning problems with different types of boundary condition . the program automatically finds opened and closed paths for energy conservation rendering the utilization of the software guide easy post-processing tools allow the computation of flow characteristics in any point in the network . test conducted so far showed very good convergence rate.

2-2Requirement of Distribution System:

After complete treatment of water, it becomes necessary to distribute it to a number of houses , industries and public places by means of a network of distribution system .The distribution system consists of pipes of various sizes ,valves , pumps etc. The following are the requirements of a good distribution system (7).

1.It should convey the treated water up to the consumers with the same degree of purity .
2.The water should reach to every consumer with the repaired pressure head.
3.Sufficient quantity of treated water should reach for the domestic and industrial use.
4.It should be economical and easy to maintain and use.
5.It should be able to transport sufficient quantity of water during emergency.
6.During repair work ,it should not cause obstruction to the traffic.
7.It should be safe against any future pollution.
8.The quantity of pipes laid should be good and it should not trust.
9.It should be water tight and the water losses due to leakage should be minimum as for as possible.

2-3 Water Consumption:

In the design of networks and water projects is necessary to calculate the amount of water required and this requires the expense of the number of people who use the network and the amount of consumption per person.

Before designing any water network must be determine the life of the project that must be expanded so that the census is to predict who will use the project and how will the population number at the end of the period.

2 -3-1 Types of Consumption:

Water requirements can be divided into four categories

1. Domestic consumption (domestic use): The rate ranging between 40% and 60% of the total consumption.
2. Government consumption: The total rate of about 10% of the total consumption.
3. Industrial consumption and trade: the rate ranging between 20% to 30% of the total consumption.
4. losses: Vary relatively different depending many factors.

2-3-2 Factors that Affect Consumption:

1 . The social level of the population
2. Weather conditions
3. The existence of industry
4. The presence or absence of measures of water
5. The cost and quality of water processed.

2-3-3: Changes in Consumption:

That consumption does not remain constant throughout the year, month, or day or hour, but the change during these periods shall be consumption more in drought years, for example in the hot months, as well as in the days of weekends the consumption of water high. As well as in one-day changes occur in water consumption example use large quantities during the morning and afternoon and also less than the depreciation in the early hours of the night. As we have stated previously that the consumption varies from month to month. In Iraq, the maximum consumption of water in the months of July and August.

2-4 Components of Water Distribution Networks:

The most important components of the networks are:

1. Pipeline distribution
2. Valves
3. Fireplugs
4. Pumping stations
5. Reservoirs

2-4-1 Distribution Pipes:

The pipes used for water distribution must be available in a few conditions: durability and length of use and cost savings, the process of selection of the pipeline depends on the following ..

1. Transport capacity of the tube
2. The survival and transport
3. The quality of water-borne
4. Costs of primary and maintenance cost
5. External and internal stresses as a result of soil layers

There are many types of pipes, mainly ...

-a. Cast- iron pipes.

It may be is several features as...

1. The medium price.
2. A strong, durable and resistant to erosion.
3. Long-lived (up to a hundred years or more)
4. In the distribution network will allow branches to take them to the house.

The pipes have also several disadvantages as:-

1. Speed of water flow in the tubes decreases with time due to the increased coefficient of friction.
2. Do not use these tubes for pressure exceeding 7 kg / cm ^{2}
3. Are being broken during transportation or when making connections

-b. Steel pipes.

The Advantages: -

-Facilitate the transfer and installation of pipes for its light weight and does not occur a break because of transport.

Also they have Disadvantage

-Less durable than cast iron pipe, and the difficulty of taking the branches to feed the domestic water.

-c. Wrought iron pipes.

Have the advantages…

1. Provided a significant scale.
2. Resistance to corrosion.
3. Its ability to withstand the shocks and high flexibility.
4. The long length of use.
5. Does not have a negative impact on water quality.

-d. Plastic pipes.

Have the advantages….

1. Cheap price.
2. Somewhat strong
3. Flexible, and low friction coefficients
4. Good electrical insulation
5. Light weight and easy to transport

And following disadvantages….

1. Do not use in soil that contains organic material
2. Have high expansion coefficients are not used at high temperatures and is not used to transfer hot water
3. Some types of these tubes give odor to water and which are not desired by consumers.

The following tables provide dimensional common operational loads for plastic pipes

Table (2.1) Normal gauge PVC pipes

Diameter (cm)	15	20	25	40	50	56	80	100	150
Maximum working Pressure(kg/cm^2)	42	33.6	31.4	23.1	19.6	21.9	8.2	15.4	12.5

Table (2.2) heavy gauge PVC pipe

Diameter (cm)	*15*	*20*	*25*	*40*	*50*	*56*	*80*	*100*
Maximum working Pressure(kg/cm^2)	*59.9*	*48.3*	*44.3*	*32.9*	*28*	*29.4*	*25.9*	*22.4*

2-4-2 Valves:

-a. Gate valves:

Use this valve on the pipe major and semi-major order to be able to isolate any part of the network for rest easily when it is required (repair or maintenance). Use these valves also for pipes in spaces not more than (250) meters and they should set up (a manholes) for each valve to be easily reached if a large valve and in addition to a small valve is opened by the valve, to prevent osteoporosis in pressure as a result of the large pressure difference.

-b. Air relief valves:

This valve is used in the high points pipes so as to prevent leakage of air free from water at those points out of the tube because the lack of infiltration leads to reduced output and affect the performance of the hydraulic network.

2-4-2-c. Non return valves:

This allows the valve over the water in a certain direction does not allow his passage in the opposite direction and riding on the main lines of water pipes at the way out of the station pumps and the dimensions of about (4) km at the low points of the pipeline, it prevents reflux of water from the length of the tube high when you break the tube in front of the valve and applied to ride directly behind the valve to the valve facilitate the detection of reservations on the valve apostate if necessary

2-4-3 Fireplugs:

Is an extension connected to the network of pipelines linking the fire to secure the scene of places easily accessible so that it covers most of the areas served by the network.

2-5 Requirements of Good Distribution System

1. Water quality should not get deteriorated in the distribution pipes.
2. It should be capable of supplying water at all the intended places with sufficient pressure head.
3. It should be capable of supplying the requisite amount of water during fire fighting.
4. The layout should be such that no consumer would be without water supply, during the repair of any section of the system.
5. All the distribution pipes should be preferably laid one metre away or above the sewer lines.
6. It should be fairly water-tight as to keep losses due to leakage to the minimum.

When selecting distribution networks it must take into account the following points ....

1. Pipes to be of durable material.
2. Pipes to be of sufficient capacity to transport the required discharge all the time.
4. The protection of water in the pipes of bacterial contamination .
5. The need to work on the existence of piped water constantly.

2-6 Layouts of Distribution Network:

The distribution pipes are generally laid below the road pavements, and as such their layouts generally follow the layouts of roads. There are, in general, four different types of pipe networks; any one of which either singly or in combinations, can be used for a particular place. They are:

1.*Dead End System*
2. *Ring System*
3. *Grid Iron System*
4.*Radial System*

2-6-1 Dead End System:

Lines include a major branch of sub-pipes based on shape, Fig (2-1) and this way the roads were less cost, but the large number of endings of many areas of the city was deprived of water in the case of closing the water pipes for repairs,

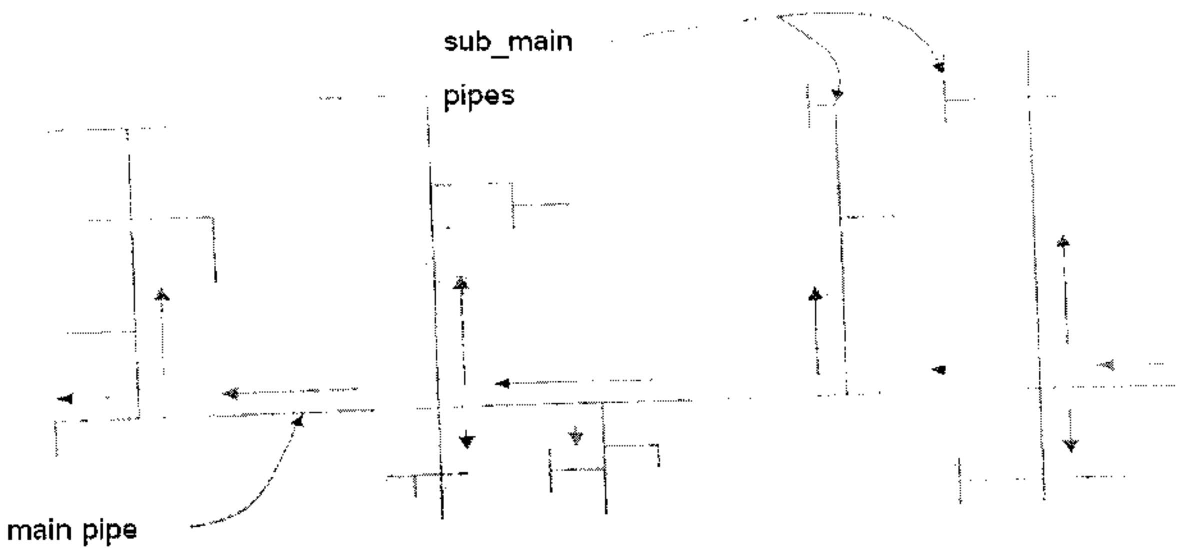


Figure (2-1)Dead end system

2-6-2 Circle or Ring System:

It is a water main pipe around the city or the region and subdivided it pipeline subsidiary by planning paths pipeline distribution and this method is better than the first because it does not include the ends closed as in Figure (2-2) and therefore it is

characterized that any line with a fit can be locked without affecting the rest of the network .

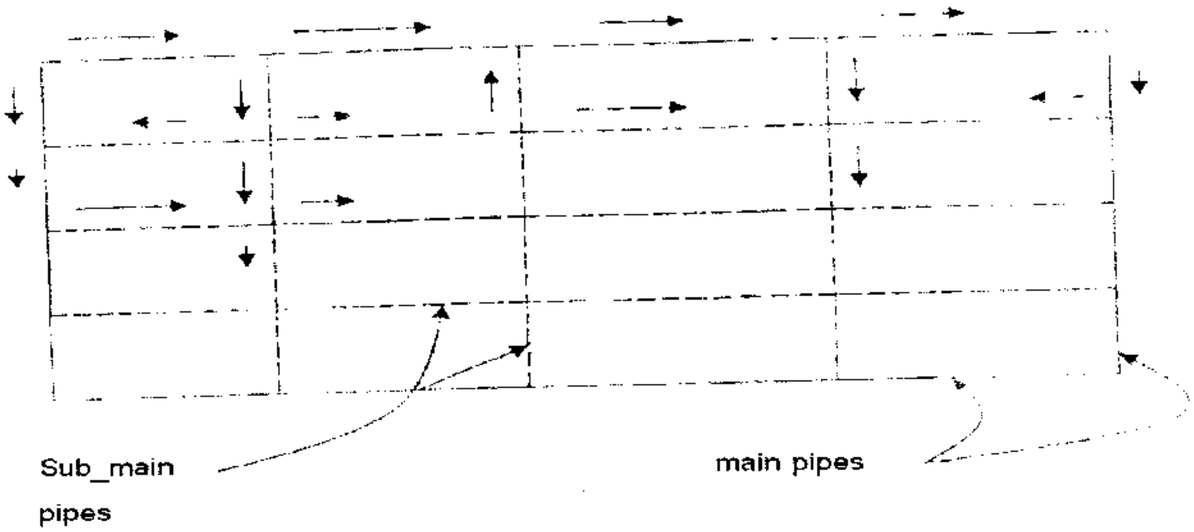


Figure (2-2) Circle system network

2-6-3 Grid Iron System

Includes a major tube surrounds the city as well as other major pipeline distribution network shown in Fig(2-3) so as not to increase the distance between the main pipeline for one kilometer. This method, though expensive, but it's better than the previous methods for the water pressure in distribution pipes.

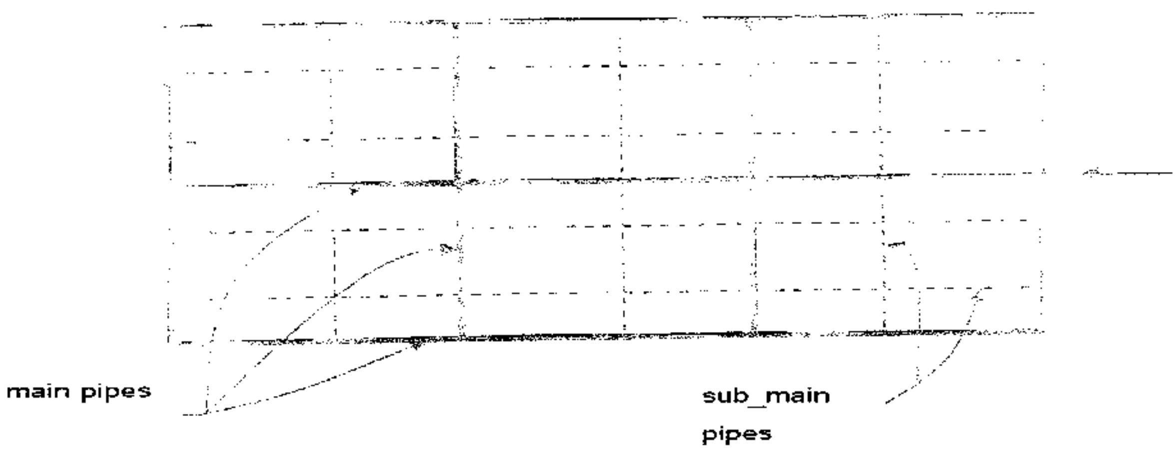


Figure (2-3) Grid iron system

2-6-4 Radial System Water Distribution in The Country:

Can be considered as a circular because it does not depend on dividing the city into areas as in Figure (2-4) and then placed in the center of all city water tank for water distribution in the direction around the city and sometimes out pipe major carrier of water without being related to the pipes for another and then subdivided them into tubes distribution required. the benefit of this method is that water reserves at a rate of discharge and high pressure until the beginning of distribution in the central areas in the city.

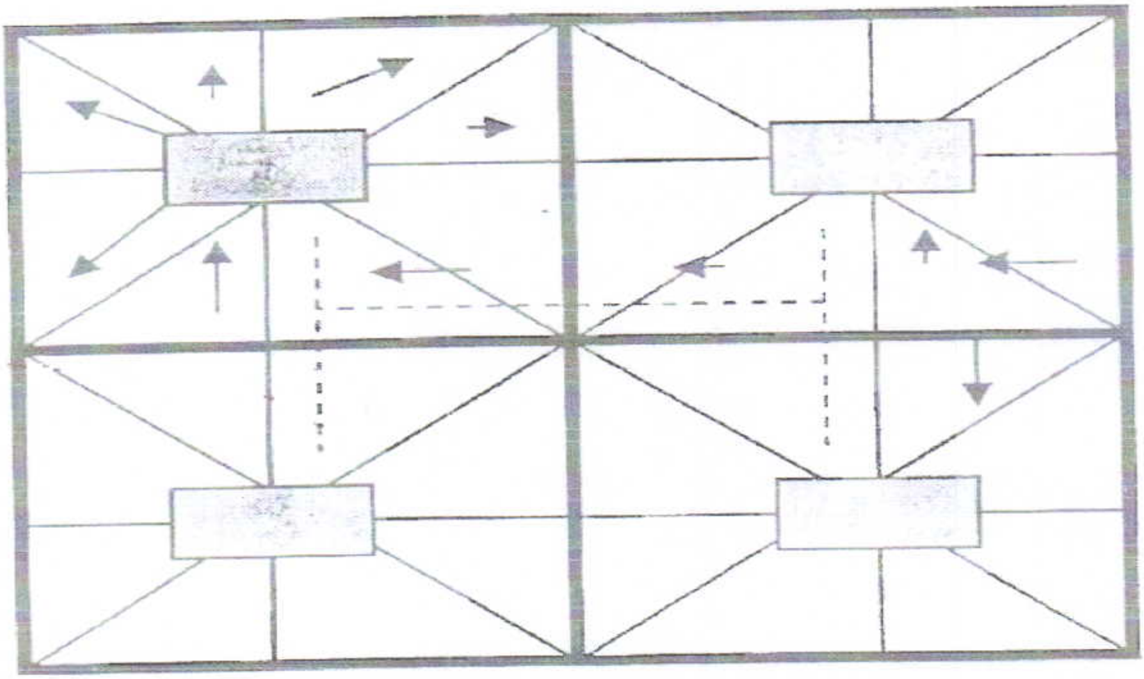


Figure (2-4) Radial system

2.7 The Features of Good Distribution:

Good distribution system that must meet the following requirements ....

1.Through the delivery of potable water for use to consumers through the distribution network and the outside of the treatment plants must be fixed within the degree of purity required level.

2.Pressure of the water reaching the consumer must have the required level, or adequate to meet the need and be within the permissible limits.

3.The amount of water available must meet various purposes, including civilian and industrial and other

4.The maintenance of distribution networks should be easy and economical

5.In case of emergency such as a fire must be equipped with adequate quantities of water

2.8 Distribution Systems:

2.8.1 The Pumping System With Storage:

This system is considered one of the most flexibility systems where the amount of excess water consumption during the minimum is stored in tanks for use by the high consumption during the maximum. This method usually works in most cases, have advantages, among them the following ..

1. Pumps working at a regular pace
2. In the case of a fire pump that can meet the quantity of water required to extinguish the fire

2.8.2 The Gravitational System:

When the source of water is a lake or reservoir height of a particular arbitrator, the desired pressure can be supplied to consumers using the gravitational flow of water distribution.

2.8.3 Direct Pumping System:

In this way water is pumped directly into the pipe and it should be noted that the disadvantages of this method is different.

1. In the case of a power off stops water supply
2. Change in water consumption affects the pressure inside the pipe

To avoid the evening focused above the number of pumps with different capacities and operate the pumps according to water needs, this method requires care in the operation and maintenance of good

2.9 Methods of Supply of Water :

Can be equipped water and delivery it to costumers by one of the following systems:

2.9.1 Continuous System:

In this system are water supply to consumers through the continuous (24 hours). This system has disadvantages, including loss of large quantities of water as a result of the use of others required for their intended purpose and you lack of awareness of consumers to the value of water available to them continuously.
Benefits of the system continued ....

1. No need to store water to consumers because water continues processing
2. The water is always available for emergencies such as fire
3. No need of valves because the water cycle continues in the tube so air pool has no place inside the tube.

2-9-2 The AC System (Intermittent System):

In this system are equipped the water during certain hours per day and that would normally be in the morning and evening, the time of processing can be changed through the seasons of the year, use the equipment when the AC quantities of water available from the source is not sufficient to meet the requirements for continued processing.

Benefits of the AC:

1. This system is considered appropriate when the water from the source are available in limited quantities.
2. Reservoirs used in homes for the provision of water for a day or two in case of an interruption processing.

Disadvantages of the AC system ....
1. Consumers are forced to store water for hours of uninterrupted processing
2. Consumers are forced to set up tanks in their homes, which increases the economic cost.
3. The existence of a large number of valves and other structures because the processing is given through a tube in the case of another closure tube
4. May not have adequate amounts of water in case of fire.

Chapter Three

THEORETICAL CONSIDRATION

Chapter Three

Theoretical considerations

3.1 Forecasting Population Methods:

3.1.1 Arthematic Method:

Based upon the consideration that the rate of graoth is constant.

$K=\frac{\Delta p}{\Delta t}$

$K=(\frac{Pn-Pm}{Tn-Tm})$

By integration …

Pt = po + kt…….(3-1)

Where:

K:the straight line slope ($k=\frac{\Delta P}{\Delta T}$)(from recorded data)

Pt:the population at future time

Po:the present population

t :design period

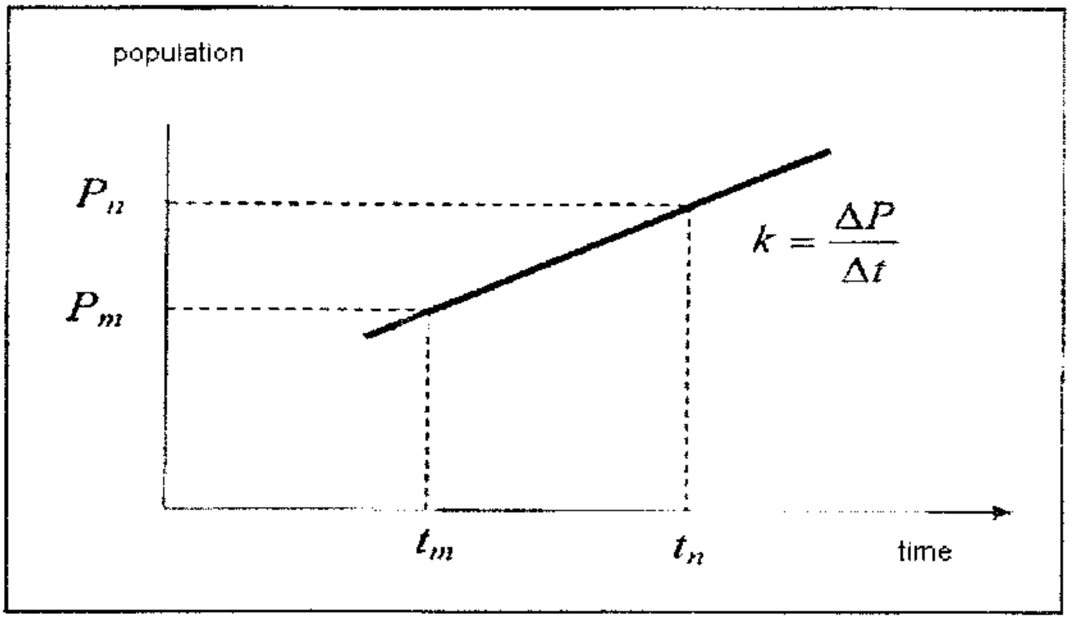


Figure (3-1) Relation between population and time

3-1-2.Uniform Method:

Based upon the consideration that the rate of grouth is proportional to population.

$$\mathbf{Ln(pt) = ln(po) + K\,\Delta\, t} \ldots\ldots(3\text{-}2)$$

K:the straight line slope (k = $\frac{\Delta\, \ln P}{\Delta T}$)

Pt:the population at future time

Po:the present population

t:design period

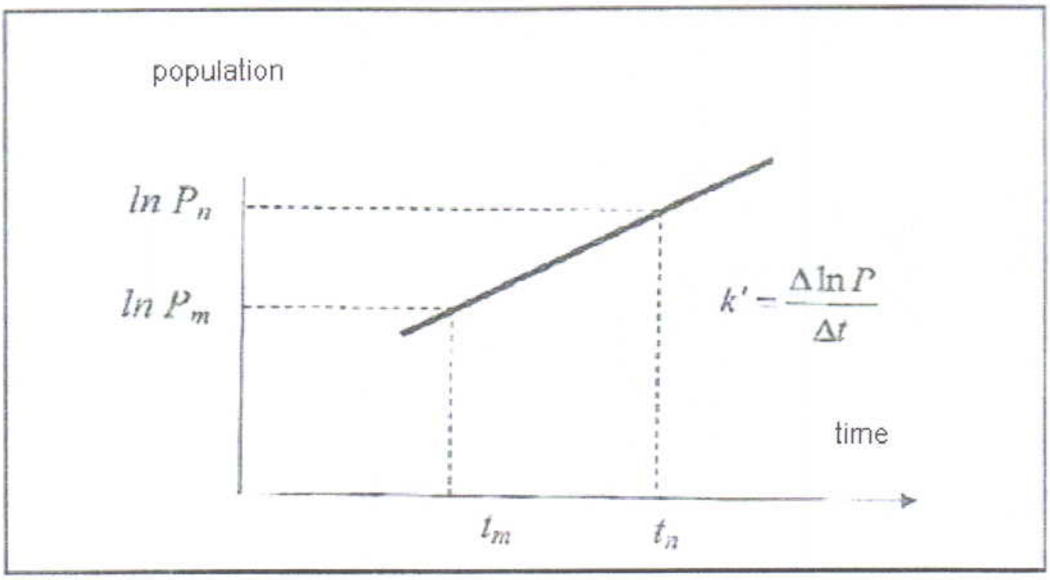


Figure (3-2)The uniform method

3-1-3.Logistic Method:

$$\mathbf{P} = \frac{P\ sat}{1+e^{(a+b\Delta t)}} \ldots \ldots (3-3)$$

P sat= $\frac{2PoP1P2-P1^2\,(Po+P2)}{PoP2-P1^2}$

a=ln $\left(\frac{Psat-PO}{Po}\right)$

b= $\frac{1}{n}$ ln $\left(\frac{Po\,(Psat-P1)}{P1\,(Psat-P0)}\right)$

Where:

P sat : the saturation population of community

A and b =constant

N=the time internal between suclssive a record

Δ t:time period beyand the base year coresponding to Po

3-2 The Hydraulics Analyze of Water Supply Network

3-2-1 Network Analysis:

Analysis of water distribution system includes determining quantities of flow and head losses in the various pipe lines, and resulting residual pressures. In any pipe network, the following two conditions must be satisfied:

1. The algebraic sum of pressure drops around a closed loop must be zero, i.e. there can be no discontinuity in pressure.
2. The flow entering a junction must be equal to the flow leaving that junction; i.e. the law of continuity must be satisfied.

Based on these two basic principles, the pipe networks are generally solved by the methods of successive approximation. The widely used method of pipe network analysis is the Hardy-Cross method.

3-2-2 Hardy Cross Method In The Hydraulic Analysis:

The method is based on the following principles ..

1.for Any continuous flow in the pipe, the algebraic sum of flow in pipes in each node is equal to zero

$$\Sigma Q = 0$$

2. For The constant pressure, the algebraic sum of the loss of energy in any closed loop in the system is equal to zero

$$\Sigma hf = 0$$

3-2-3 Head Balance Method:

This method consists of assuming a distribution of flow in the network in such a way that the principle of continuity is satisfied at each junction. A correction to these assumed flows is then computed successively for each pipe loop in the network, until the correction is reduced to an acceptable magnitude.

If Q_a is the assumed flow and Q is the actual flow in the pipe, then the correction δ is given by,(5)

$\boldsymbol{\delta = Q - Q_a}$; **or** $\boldsymbol{Q = Q_a + \delta}$..........(4-1)

Now, expressing the head loss (H_L) as

$\boldsymbol{H_L = K.Q^x}$ ....(4-2)

we have, the head loss in a pipe

$\boldsymbol{= K.(Q_a + \delta)^x}$................(4-3)

$= K.[Q_a^x + x.Q_a^{x-1}\delta + \text{.........negligible terms}]$

$\boldsymbol{= K.[Q_a^x + x.Q_a^{x-1}\delta]}$...............(4-4)

Now, around a closed loop, the summation of head losses must be zero.

$\boldsymbol{\Sigma K.[Q_a^x + x.Q_a^{x-1}\delta] = 0}$ ....(4-5)

or $\boldsymbol{\Sigma K.Q_a^x = -\Sigma Kx\, Q_a^{x-1}\delta}$........................(4-6)

Since, δ is the same for all the pipes of the considered loop, it can be taken out of the summation.

Or $\Sigma K.Q_a^x = -\Sigma Kx\, Q_a^{x-1}$

or $\boldsymbol{\delta = -\Sigma K.Q_a^x / \Sigma x.KQ_a^{x-1}}$................(4-7)

Since δ is given the same sign (direction) in all pipes of the loop, the denominator of the above equation is taken as the absolute sum of the individual items in the summation. Hence,

Or $\delta = -\Sigma K.Q_a^x / \Sigma\, |\, x.KQ_a^{x-1}\, |$

or $\boldsymbol{\delta = -\Sigma H_L / x.\, \Sigma\, |H_L/Q_a|}$ ....(4-8)

where H_L is the head loss for assumed flow Q_a.

The numerator in the above equation is the algebraic sum of the head losses in the various pipes of the closed loop computed with assumed flow. Since the direction and magnitude of flow in these pipes is already assumed, their respective head losses with due regard to sign can be easily calculated after assuming their diameters. The absolute sum of respective KQ_a^{x-1} or H_L/Q_a is then calculated. Finally the value of δ is found out for each loop, and the assumed flows are corrected. Repeated adjustments are made until the desired accuracy is obtained.

The value of x in Hardy- Cross method is assumed to be constant (i.e. 1.85 for Hazen-William's formula, and 2 for Darcy-Weisbach formula)(8).

Chapter Four

CALCULATION^s AND RESULTS

Chapter Four

Calculations and Results

4-1: Description of The Project

Design a distribution network of drinking water consists of 250 buildings, each with a height of three floors and contains 12 apartments, for period design of 50 years and an average consumption of 450 L/day/ person

The calculations were obtained using assumed information as:

Number of population in 1990 = 14500
Number of Population in 2000 = 15000

Calculation the demand flow by arithmetic method as shown…

$k = \frac{\Delta P}{\Delta T}$

$k = \frac{15000-14500}{2000-1990}$

K=50

Pt = Po + Kt

P(20)=15000+50*20=16000 capita

Q= q*n (n=No .of capita)

Q=450*16000

Q=7200000 L/day

7200000/3600*24 =

83.33 L/S is the demand flow

4-2: Overview of (Pipe^{++}) Software:

4-2 Overview of ($pipe^{++}$) Software:

Is a program which models flow and quality in a town water supply pipe system. Components which can be modelled include:

*Reservoirs
*Pipes
*Pumping Stations
*Minor Head Losses
*Check Valves
*Reservoir Inlet Control
valves
*Various specialised control
valves
*Pressure Reducing Valves
*Pressure Sustaining Valves
*Flow Control Valves
*Sprinklers
*Hydrants

Pipe flows may be calculated using either the Colebrook White equation or the Hazen Williams equation. If the Colebrook White equation was selected, it is need to specify the pipe wall roughness (mm or millifeet). Darcy's factor (f) will then be calculated using either the Laminar flow equation (when Reynolds Number ≤ 2000) or the Colebrook White Equation (when Reynolds Number > 2000).

Then the network mesh must be drowning using lines to represent pipes and pre defined symbols to represent pumps, valves, reservoirs. The pipes drawn in a CAD system (eg Autocad) you can create a DXF file of the pipes and nodes. PIPES++ can then read this .DXF file

Data is entered via dialog boxes which are accessed by double clicking on the pipe or symbol

Extended Period simulations (typically for 24 hours) can be carried out and during the simulation pumps can be started and stopped and valves opened and closed based on control rules which you specify (eg when a reservoir fills, stop a pump; when it falls 2 metres start the pump).

Water quality analyses can also be carried out to simulate how the concentration of Chlorine, Fluoride or some other chemical varies with time. Chemical injection points can also be specified with the chemical concentration specifed as data for the duration of .the analysis. Trace graphs are available for these results also

The various graphs can be sent to a printer or plotter or copied via the Clipboard directly to a word processor (eg Word for Windows) for inclusion in a report

4-3 The Input Data:

By using software (pipe++) and after drown the pipes network the bottom information was inserted ....

1.the length and diameter of the networks pipe.

2.the demand of water supply.

3. The trail head of the reservoir .

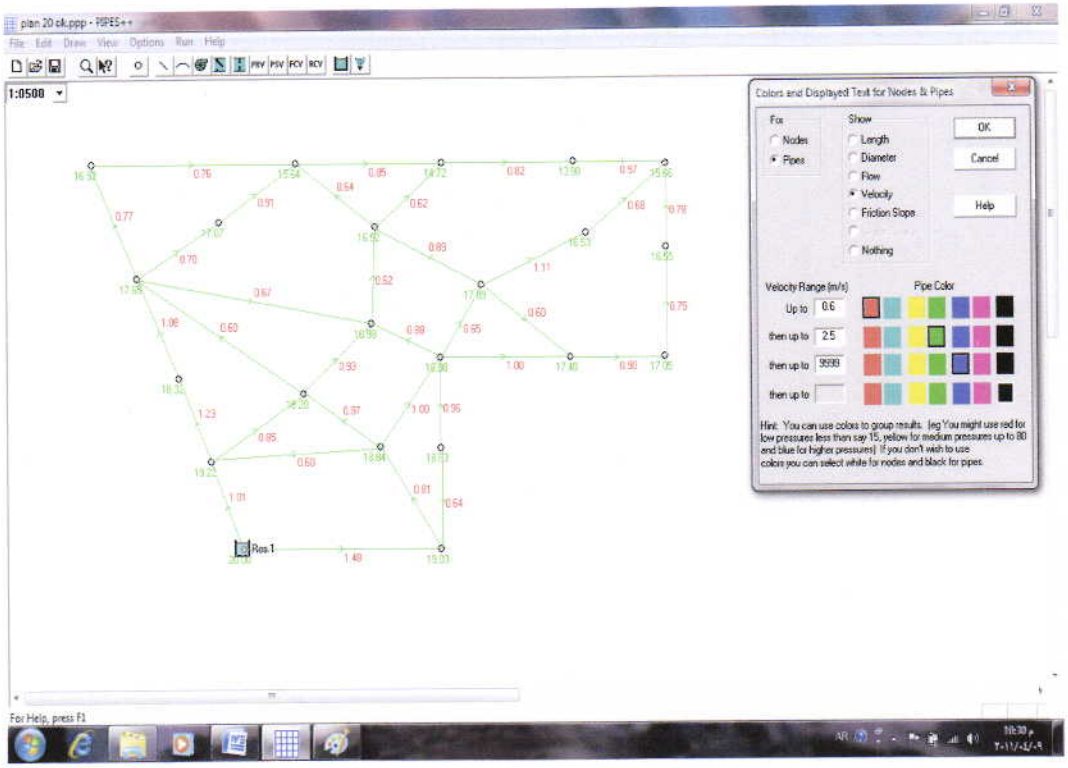
4. Type of equation for analysis use.

4-4 The Output Data:

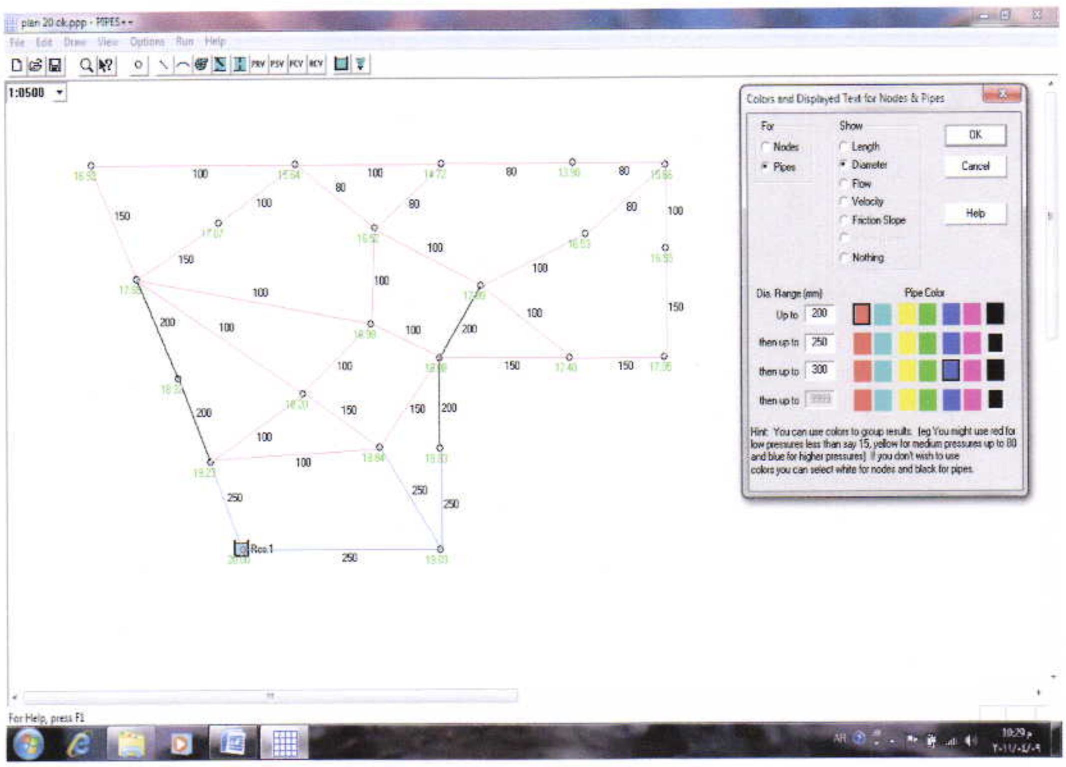
The software was calculated the total head losses and the other results by used hardy-cross and Hazen-William's equations as in table (4-1) , The software application resuls are shown in figures (4-1),(4-2),(4-3)and(4-4).

Table(4-1) The result of project

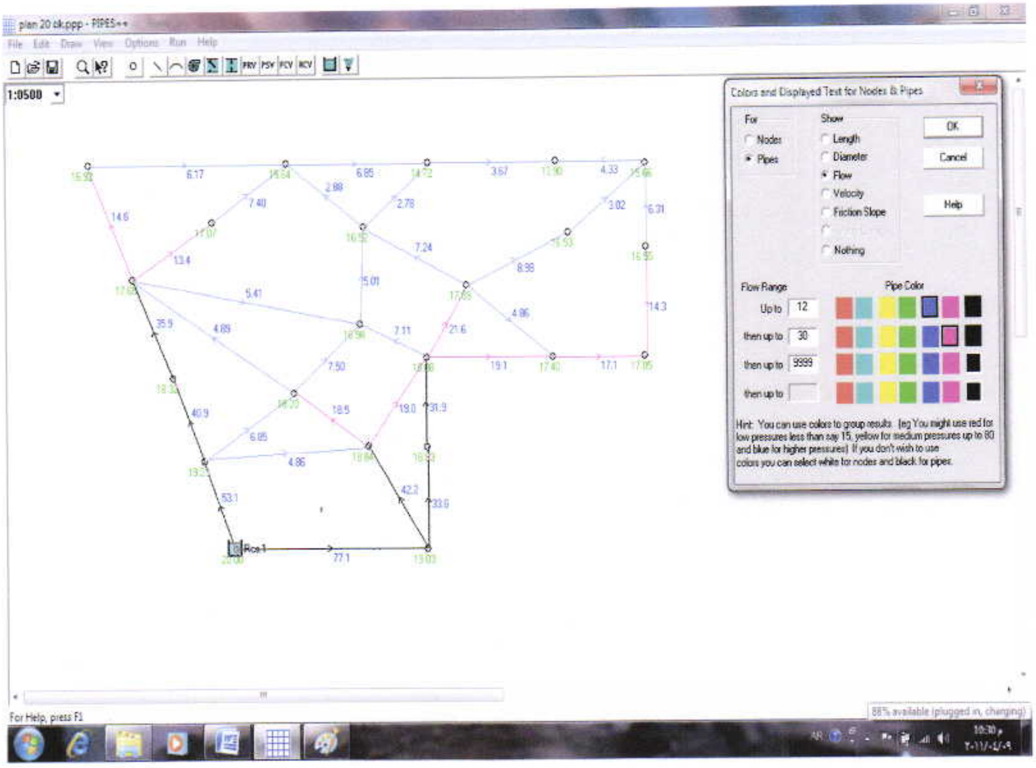
pipe	from node	to node	length (m)	diameter (mm)	velocity (m/s)	flow (l/s)	**total head** (m) **loss**	head loss (m/km)
1	1	2	100	250	1.48	77.2	0.97	9.70
2	2	3	100	250	0.64	33.6	0.21	2.10
3	3	4	130	200	0.96	31.9	0.74	5.69
4	4	5	80	150	1	19.1	0.69	8.62
5	5	6	50	150	0.90	17.1	0.34	6.80
6	6	7	100	150	0.75	14.3	0.50	5.00
7	7	8	100	100	0.78	6.31	0.89	8.90
8	8	9	95	80	0.97	4.33	1.77	18.6
9	10	9	60	80	0.82	3.67	0.82	13.7
10	11	10	90	100	0.85	6.85	0.93	10.3
11	12	11	150	100	0.76	6.17	1.27	8.47
12	13	12	140	150	0.77	14.6	0.73	5.21
13	14	13	95	200	1.08	35.9	0.68	7.16
14	15	14	100	200	1.23	40.9	0.91	9.10
15	1	15	160	250	1.02	53.1	0.77	4.81
16	2	16	60	250	0.81	42.2	0.19	3.17
17	15	16	70	100	0.60	4.86	0.39	5.57
18	16	17	80	150	0.97	18.6	0.65	8.12
19	16	4	90	150	1.00	19	0.76	8.44
20	15	17	100	100	0.85	6.85	1.04	10.4
21	17	18	100	100	0.93	7.52	1.22	12.2
22	4	18	100	100	0.88	7.13	1.11	11.1
23	4	20	70	200	0.65	21.6	0.20	2.86
24	17	13	100	100	0.60	4.89	0.55	5.50
25	13	18	100	100	0.67	5.44	0.76	6.70
26	18	19	80	100	0.62	4.99	0.46	5.75
27	13	22	130	150	0.70	13.4	0.57	4.38
28	22	11	120	100	0.91	7.40	1.43	11.9
29	19	10	220	80	0.62	2.77	1.80	8.18
30	19	11	100	80	0.64	2.87	0.87	8.70
31	20	19	120	100	0.90	7.25	1.37	11.4
32	20	21	80	100	1.11	8.98	1.36	17.00
33	21	8	90	80	0.68	3.02	0.86	9.56
34	20	5	90	100	0.60	4.85	0.49	5.44



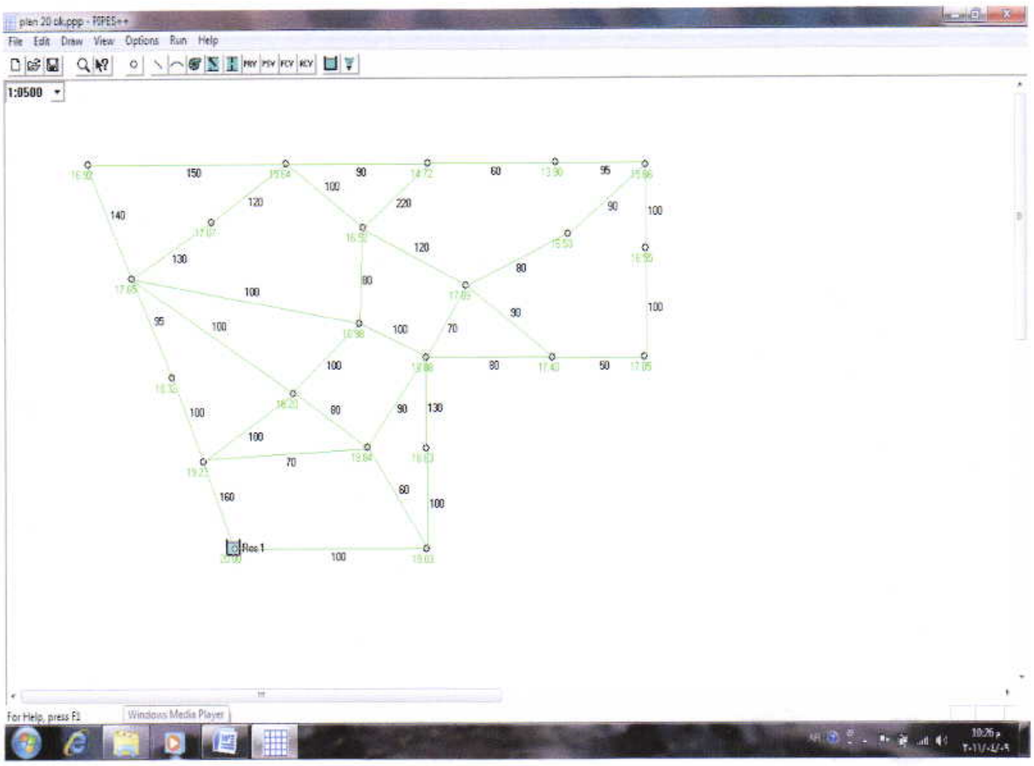
Fig(4-1)Velocity distribution



Fig(4-2) Diameter distribution



Fig(4-3) Flow distribution



Fig(4-4) Length distribution

Chapter Five

CONCLUTION AND RECOMMENDATION

Chapter Five

Conclusion and Recommendations

5-1 Conclusion:

From the calculations and the results that previously shown , by using (pipe^{++}) software and with several trails find that....

1. Satisfy the velocity limit between (0.6-2.5)m/s in the pipe network.

2. Satisfy the gradation in the piping from the largest too the smallest ranging between (250-80) mm.

3. Satisfy a uniform distribution in the pipe network and without any dead zone in the network, and that which be by using (loop Network Method).

4. Satisfy the required height in the farthest point of the network.

5. Satisfy minimum head losses in the network and junctions.

6.design and analysis the network as the future expansion in the city and populations by a factor of safety(1.5).

7. Applicating a several trails of height, shows that the high of(20)m gives the minimum losses.

9. the demand flow is determined from forecasting method (83.33 L/S), while the result sum flow from the computer software is found to be(130 L/S), this difference is refer to factor of safety (1.5) as in table(4-1)

5-2 Recommendations:

1.Using several equations in the software and comparing the results.

2.Using modified software like (E-PANET).

3.Study larger region for available data.

4.Using different reservoir height and comparing the results.

5.Using different graduated diameter and comparing the results.

The references

1.Water Supply & Sewerage E.W. Steel & Terence J. McGhee

2.Water Supply by Humeer.

3. Water supply network by Harry Watson.

4. Network analyse by Antonio Gameiro

5. Lectures of Dr. Sattaa in Networks.

6. Lectures of Dr.Jaafer Sadeq in Hydro Structure.

7. Lectures of Dr.mahmoud Salieh in Networks Design.

8.From Internet Site.http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/wasteWater/Lecture%2015.htm

الخلاصة

تتلخص فكرة هذا المشروع في تصميم شبكة توزيع مياه شرب لمجمع سكني عمودي مكون من (250) بناية وبارتفاع (3) طوابق للبناية الواحدة.ويحوي كل طابق على (4) شقق (اي ما مجموعه (12) شقة في كل بناية) ولفترة تصميمية مقدارها (50) عاماً.وبمعامل أمان قدره(1.5), باستخدام طريقة هاردي-كروس ومعادلات هيزن ويليم.

حيث تقتضي متطلبات التصميم إيصال الماء إلى ارتفاع (13) متر كحد ادنى حيث يتضمن هذا الارتفاع مقدار خسائر الاحتكاك في الانابيب والعقد.

لقد تم العمل على البرنامج برسم شبكة توزيع المياه وإدخال البيانات المتضمنة أطوال الأنابيب والأقطار بالإضافة إلى المتطلبات المائية للسكان ,وبعد ذلك وضع الخزان الرئيسي وتطبيق عدة ارتفاعات للخزان واخذ الارتفاع الأمثل الذي كان مقداره (20) متر.حيث تم اختياره لتحقيقه حدود السرعة والضغوط المثالية لاخر نقطة تخدمها الشبكة.حيث وصل ارتفاع الماء في أخر نقطة ما يعادل (15.66)متر ويتضمن هذا الارتفاع الخسائر المذكورة سابقاً,إي يغطي الارتفاع المطلوب والموضح وهو(13)متر.وبذلك نكون قد حصلنا على التصميم الأمثل لشبكة توزيع المياه.