SYNOPSIS

India being mainly a country of village, the socio economic development depends on connection through various means of transportation and communication. One of the most prominent and traditional modes of transportation is road transportation. Water tanks are life of people even in these days, to meet the water demands in many parts of India. Water supply is also a very important criterion in human community.

In new tank project the survey was carried out along the bund line. The height of the bund, sluice level, MWL&FTL was fixed. The capacity of the tank was found by the capacity contour. The longitudinal section and cross section were plotted. The proposed tank will help on irrigation, water supply and improving water table of nearby wells.

In canal project, surveying is carried out along the field. Levels were taken at regular intervals and nearby permanent structures. This project is expected to serve nearby area for well as for drinking purpose.

In restoration of old tank project the survey was carried out along the existing bund line. The height of the bund, sluice level, MWL&FTL was determined. The capacity of the tank was found by the proposed tank will help on irrigation, water supply and improving water table of nearby wells.

In highway project a village road was surveyed along the road length. A detailed survey was carried out. Levels were taken at regular intervals of longitudinal section and cross section. The curves were designed at points of change in alignment, at lowest point on the road alignment. A culvert was proposed for cross drainage. The cross section and longitudinal section were plotted and the quantity of earth work was calculated in both filling and cutting.

In water supply and sewage project, surveying was carried out along the road length. Levels were taken at regular intervals and at nearby permanent structures. The population which will be consuming water from this project was found and future population was calculated. the dimension of the water tank was determined. Key map was plotted. This project will help in increasing the living standard of the people. In triangulation it is possible to find horizontal position of point accurately. This method is based on trigonometric proposition that if one side and two angles are known the remaining side can be computed. It is widely used in topography mapping ,charting of lakes, rivers, ocean ,coastlines for the survey required for the design and construction of public works.

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CHAPTER 1

NEW TANK PROJECT WITH CANAL

1.1 INTRODUCTION

Rivers and lakes are the preliminary sources of water for mankind floor his needs.

However these constitute very much less than 1% of the available water on earth. The management of such scare resource is very essential in light of vagaries of rainfall flood and droughts etc. one of the ways of elevating or mitigating this problem is by conserving in the storages. Such storage can be underground water storages like ponds, tanks or large reservoirs.

1.1.1 Tanks

Tank is the general term used for surface water storage of moderate size. Closing the openings of natural saucer shaped land formed by constructing bunds is called tank. Technically tank bund is a minute form of a dam.

1.1.2 Proposal

The proposal of the present survey work is the construction of a new tank. The work consist of.

1) The surveying of longitudinal and cross sectioning of bund.
2) Finding the capacity of the tank by capacity contour method.

1.2 SURVEY DETAILS

In order to obtain the bund level it is necessary to locate the two points of equal elevation at each side of the valley. The survey work has done along a bund line using dumpy level, dead storage level of the bund.

The following survey work is carried out

(a) Longitudinal and cross section levelling of bund.

(b) Contouring of the tank.

(c) Block levelling at waste weir

1.2.1 Longitudinal and cross section levelling of the bund

After temporary bench mark (TBM) are fixed near the project in longitudinal levelling, the levels are taken at regular intervals at every setup of the instruments. The bearings of the line are also taken. The chainage points are noted in the level book. The operation is taken in order to determine the undulation of the ground surface along the profile line. The reduced levels are calculated. In the present survey work the longitudinal sections are taken at each 10m interval.

The cross sections are taken at 10m intervals based on the side slope of the bund. The cross sectional levelling is done in order to know the nature of the ground across the centre line alignment at 5m interval on the either side of centreline.

1.2.2 Contouring

A contour is imaginary line on the ground joining the points of equal elevation. To find the capacity of tank at various levels, the method of direct contouring is adopted .To begin the work, the height of instrument (H.I) is determined by taking the back sight (B.S) on the bench mark (B.M) and adding it to the reduced level of the B.M from the known elevation of the contours and H.I, the required staff reading to fix the points on the various contour from the H.I, thus obtain the points on contour line are located by means of plane table and then all points are joined smoothly to get contour at various required levels and contours are located for minimum water level, normal water level and maximum water level.

RL OF TOP BUND LEVEL =115.450m
RL OF MAXIMUM WATER LEVEL =114.450m
RL OF FULL TANK LEVEL =113.450m
RL OF DEAD STORAG ELEVEL =107.450m

TABLE 1.1 Earth work calculations of new tank project

CHAINAGE	AREA (m^2)		MEAN AREA (m^2)		DISTANCE (m)	VOLUME(m^3)	
	FILLING	CUTTING	FILLING	CUTTING		FILLING	CUTTING
0	0.12	0	0	0		0	0
10	44.04	0	22.08	0	10	220.80	0
20	133.38	0	177.42	0	10	889.20	0
30	240.11	0	186.74	0	10	1867.45	0
35	65.14	0	152.62	0	5	763.12	0
45	10.72	0	37.93	0	10	379.30	0
55	0.15	0	5.43	0	10	54.35	0

TOTAL QUANTITY OF FILLING=4174.22 m^3

TOTAL QUANTITY OF CUTTING=0m^3

1.2.3 Computation of the capacity of the tank

The gross capacity of the tank is impounded up to N.W.L. the total capacity of the tank is sum of the vertical interval between the contours the more accurate is the computation of the capacity. The capacity is computed using the Trapezoidal formula, and is given by

V=L[(A1+A2)/2]

Where A1, A2.....An, are the intervals of the successive contours.

USEFUL STORAGE =595.50m^3

SURCHARGE STORAGE =77.25m^3

DEAD STORAGE =15.90m^3

1.3 CONSTRUCTION OF CANAL

Canal project is a part of irrigation science which deals with artificial carrying of water from the reservoir or any other water storage system to required field. A canal is defined as an artificial channel constructed on the ground to carry water from a river or another canal or a reservoir to the fields. Usually, canals have a trapezoidal cross-section. The canals are usually designated as purpose, also carries water to the power generation, and also sometimes provides navigation facilities. The types of canal adopted in this work are.

1) Contour canal

2) Alignment canal

1.3.1 Survey Details

Contour canal

Starting chainage –0m

Ending chainage-100m

Alignment canal

Starting chainage –100m

Ending chainage-230m

Side slope

In cutting-1.5: 1

In filling -1.5: 1

Bed slope=1in1000

Depth=(including free board)

Bottom width =1m

Top width of canal=3m

2.2.1 Earth work calculations

CHAINAGE	AREA (m^2)		MEAN AREA (m^2)		DISTANCE (m)	VOLUME(m^3)	
	FILLING	CUTTING	FILLING	CUTTING		FILLING	CUTTING
0	3.06	12.65					
15	3.69	13.05	3.37	12.85	15	50.10	192.75
30	3.32	11.61	3.50	12.33	15	52.05	184.95
45	4.05	9.82	3.68	10.71	15	55.27	160.72
60	6.17	7.09	5.11	8.45	15	76.65	126.82
75	9.61	9.47	7.89	8.28	15	118.35	124.20
90	6.30	12.70	7.95	11.08	15	119.32	166.27
100	1.36	11.75	3.83	12.22	10	57.45	183.37
100	1.43	3.40	1.39	7.57	15	20.92	113.62
115	0	101.39	0.71	52.39	15	10.72	785.92
130	0	40.08	0	70.73	15	0	1061.02
145	11.78	16.51	5.89	28.29	15	88.35	424.42
160	0	42.55	5.89	29.53	15	88.35	442.95
175	0.50	15.20	0.25	28.87	15	3.75	433.12
190	11.95	0	6.22	7.60	15	93.37	106.40
205	26.74	0	19.34	0	15	290.17	0
220	2.73	5.10	14.73	2.55	15	221.02	38.25
230	0	13.02	1.36	9.06	10	20.47	135.90

1.4 CONCLUSIONS

The following conclusions are drawn based on tank project survey conducted at ALETTY near SULLIA.

USEFUL STORAGE =595.50m^3
SURCHARGE STORAGE=77.25m^3
DAED STORAGE=15.90m^3

The water can be used for various purposes. The overall prosperity of the people will increase due to the project.

While aligning canal the slope plays an important role. The water in canal is likely to flow in gravity. Canal lining plays an important role in the efficiency of canal. It controls the seepage of water and also the silt and fee flow of water.

CHAPTER 2

RESTORATION OF BUND

2.1 INTRODUCTON

The proposal of the present survey work is the restoration of old tank . Here surveys were carried at old bund site for the purpose of increase the capacity of old bunk so that the quantity of water stored during rainy season can be increased. The work consist of

1. The surveying of longitudinal and cross section of existing bund .
2. The surveying of longitudinal and cross section of proposed bund
3. Finding the capacity of the tank by capacity contour method

2.2 SURVAY DETAILS

In order to obtain the bund level , to locate the two points of equal elevation at each side of the existing bund .The survey work is done along the bund line which includes the levels of sluices , maximum water level , waste weir full tank of the existing bund . the following survey work is completed using dumpy level.

(a) Longitudinal and cross section levelling of existing bund and proposed bund.
(b) Contouring at MWL , NWL of existing bund and MWL of proposed bund .

2.2.1 Longitudinal and cross section levelling of the bund.

In longitudinal levelling the levels are taken at regular intervals at every setup of the instruments .the bearings of the line are also taken and temporary benchmark are fixed . The change points are noted in the level book . this operation is taken in order to determine the undulation of the ground surface along the profile line . The reduced levels are calculated .In the present survey work the longitudinal sections are taken at each 5m intervals.

The cross section s are taken on either side of the top of the bund line, at the base of the existing bund slope on both sides at 5m intervals . the cross section levelling is done in order to known the nature of existing bund across the centre line alignment.

2.2.2 Contouring

A contour is line important to know the capacity of reservoir . To find the capacity of tank at various levels , the method of direct contouring is adopted . The points are located by means of plane table and all the points are joined to plot the contour for both new tank level and old tank level.

Starting point of contour =110.195m

RL of contour selected = 116.500m

MWL of old bund =111.545m

NWL of old bund = 110.545m

NWL of new bund=112.545m

Table 2.1 Earth work calculations of restored bund

CHAINAGE	AREA (m^2)		MEAN AREA (m^2)		DISTANCE (m)	VOLUME(m^3)	
	FILLING	CUTTING	FILLING	CUTTING		FILLING	CUTTING
0	0.40	0	0	0	0	0	0
6	21.33	0	10.86	0	6	65.19	0
10	22.86	0	22.09	0	4	88.38	0
20.3	49.38	0	36.12	0	10.3	372.03	0
30	30.67	0	40.02	0	9.7	388.24	0
40	13.90	0	22.28	0	10	222.85	0
44.75	0.34	0	7.12	0	4.75	33.82	0

TOTAL QUANTITY OF FILLING=1170.51m^3
TOTAL QUANTITY OF CUTTING=0m^3

3.2.4 Computation of the capacity of the tank

The gross capacity of the tank is cubic content of water impounded up to F.T.L. The total capacity of the tank is sum of the capacities between the successive contours. The smaller the vertical interval between the contours the more accurate is the computation of the capacity.

The capacity is computed using the trapezoidal formula and is given by

V= H[((A1+A2)/2)+A2+A3+.....An-1]

Where A1,A2,A3,...An are the intervals of successive contour

EXISTING BUND CAPACITY = 34.40m^3
RESTORED BUND CAPACITY =55.10m^3
DEAD STORAGE = 27.36m^3

3.3 CONCLUSION

The following conclusion are drawn based on restoration of old tank project survey conducted at **ALETTY** near **SULLIA**.

The capacity of bund was increased from $34.40m^3$ to $55.10m^3$. The water can be used for various purposes like irrigation, domestic use, etc. The overall prosperity of the people will increase due to this project.

CHAPTER 3

HIGHWAY PROJECT

Introduction

Transportation is a vital infrastructure for the speedy economic growth of a developing country. Road transportation is one of the important modes of transport having many desirable characteristics. Such as flexibility, door to door service and accessibility to remote area's.

Road networks are rightly called the arteries of a country. Road system influences all the aspects of human life. Road systems are very necessary for economic development, spreading of human habitation, meet strategic purposes, etc.

In the present era planning is considered as pre-requisite and basic need for any new project or an expansion program. Thus highway planning is also a basic need for any highway development. Since, we have undertaken **'HIGHWAY PROJECT'** as our project work; we have considered the following objectives.

i. Efficient and safe traffic operation but a minimum cost.
ii. Attainment of maximum utility.
iii. Construction with locally available resources to minimize the cost of project.
iv. Future requirements and improvements in view of anticipated developments.
v. Availability of funds and economic consideration.
vi. Incorporation of technical recommendations framed by Indian Roads Congress (IRC) for various aspects of highway construction.

Proposal

This project deals with the design of road and can be executed in following manners.

i. A road was selected and detailed surveys including cross section and longitudinal sections were carried out.

ii. Plan of road alignment – longitudinal section were drawn to scale and final alignment was fixed, as per IRC specification, confirming to village roads.

iii. Block levelling for the culvert.

Geometric Design of Highway Pavement

The geometric design of a highway deals with the dimensions and layout of visible features of highway such as alignment, sight distance, curves, super elevation and intersections etc. the geometrics of highway should be designed to provide optimum efficiency in traffic operation with maximum safety at reasonable cost. The designed may be exposed to planning of new highway network to meet the requirement of the anticipated traffic. The design is also includes the sizes of drainage, aggregate, cross slopes, super elevation etc.

Requirements of Ideal Alignment

i. The proposed alignment should be as short as possible

ii. Road should be easy for construction and maintenance

iii. Road should be economical in operation

Obligatory Points

These are divided into two types

a. Obligatory points through which the alignment should pass

b. Points through which the alignment should not pass. These will cause the alignment often deviated from the shortest or easiest path.

Traffic

The proposed alignment should suit the traffic requirement. Origin and destination study should be carried out in the area and desire lines be drawn showing the trend of traffic flow. The new road to be aligned should keep in view traffic flow pattern and future trends.

Geometric Design

Geometric design factors such as gradients, Radius of the curve and sight distance also would govern final alignment of highway. If straight alignment is aimed at, often it may be necessary to provide very steep gradients. As for as possible while aligning a new road,

the gradient should be flat and less than the ruling or design gradient. Thus it may be necessary to change the alignment in view of design sped, maximum allowable super elevation and coefficient of lateral friction. It may be necessary to make the adjustment in the horizontal alignment of road keeping view the minimum radius of the curve and the transition curve.

Economy

The alignment should be economical. The initial cost, maintenance cost and vehicle operation cost should be minimum, high embankment or deep cutting are avoided and choose the balance cutting and filling sight. These factors also control the alignment of road.

Engineering Surveys for Highway Location

The engineering surveys have to be carried out before finalizing the highway project. The stages of engineering surveys are:

Map Study

Map study gives a guidance of routes to be surveyed in the field. The main features like river, hills and valleys, etc. are known by map study. B y careful study of maps, the idea of aligning a new highway can be obtained.

Reconnaissance Survey

In this survey, the land along the various proposed highway routes are inspected. All the relevant details not available in the map are collected and noted down

Preliminary Survey

This is carried out to collect all the physical information's, which is necessary in connections with the proposed highway alignment. The quantity of earth work and cost of construction are worked out. The best proposal is selected after preliminary survey.

Detailed Survey

After Preliminary Survey, A Detailed Survey Is Carried Out. Here Temporary Bench Marks Are Fixed And Levelling Works Are Performed. Here An Elaborate And Complete Data Are Collected For Preparing Detailed Plan And Estimate The Project.

Different Types of Curves Used in Highway

Curves in highway are provided for smooth and comfort driving experience on roads. They are used to connect two different road alignments. They are of two types

1. Horizontal curves
2. Vertical curves
3. Transition curves

Horizontal Curve

A horizontal highway curve is a curve in plan to provide change in direction to the central line of a road. Horizontal curves are further divided into following.

i. Simple curves : Single arc connecting two tangents
ii. Compound curve : Two arcs of different radii bending in same directions
iii. Reverse curve : Two arcs of different radii bending in different directions

Vertical Curve

In Order To Have Smooth Vehicle Movement On The Roads, The Changes In The Grade Should Be Smoothened Out By The Vertical Curves.

Vertical curves may be classified as

i. Summit curve : Curves with convexity upwards
ii. Valley curves : Curves with concavity upwards

Transition Curves

A transition curve has a radius which decreases from infinity at the tangent point to a designed radius of the circular curve. When a transition curve is introduced between a straight and circular curve, the radius of the circular curve decreases, becomes minimum at the beginning of the circular curve.

Different types of transition curves are

i. Spiral
ii. Lemniscates
iii. Cubic parabola

Surveying Details

Introduction

In a road survey the first step is levelling. The levelling work is carried out using instruments such as dumpy level, cross staff and levelling staff. Other instruments such as prismatic compass to find the bearings of alignments, arrows and ranging roads to mark the points on the field are also used.

The road is aligned by two operations

i. Longitudinal sectioning
ii. Cross sectioning

anywhere there is necessity of providing a culvert, block levelling of the area is carried out.

Details of field work

The standing point 'A' is fixed with the help of three permanent objects tacking, their bearing and measuring the distance from 'A'. Once the point 'A' is fixed alignment of highway is set along the point 'A', according and conveniently the total station point is to be set so as to obtain maximum coverage of the alignment points. Once the total station point is set, set up the total station by giving all the inputs.

The levels are carried along the alignments for every 10m and cross sections are taken at every 30m interval on either side for a distance of 9m. In addition to this cross sections also carried out when there is change in alignment.

Longitudinal Levelling or Profile Levelling

Profile levelling is the process of determining the elevation of points at fixed intervals along the chain line. Here the line along which the section is to be taken is marked by ranging rods, and the fore bearing of the line is taken with the help of prismatic compass.

The level is then setup at a point. The telescope is then directed to a staff, held on the temporary benchmark of R.L. 100m. And the reading is taken. This reading is called as back sight. Then the intermediate sight is taken on the straight point of the line by holding the staff. For each setup, intermediate sights should be taken after the foresight on the next turning station has been taken.

Checking the Levels

For checking the levels we use the technique called Fly Levelling. In this method we start from the last point and go to the first point, taking back sight and fore sights only.

Cross Sectioning

Cross sections are run at right angles to the horizontal profile and at either side of it for the purpose of lateral outline of the road surface.

Contouring

On a plan, the relative altitudes of the points can be represented by contour lines as they indicate the elevators directly. The area to be surveyed is divided into a number of squares. The levels on the corner of these squares are determined using direct levelling. The contour interpolation is done by graphical methods.

Highway Geometric Design

The geometric design of a highway deals with the dimensions and layout of visible features of the highway such as alignment, sight distance and intersections.

The geometrics of highway should be designed to provide optimum efficiency in traffic operations with maximum safety at reasonable cost.

Highway geometric design consists of the following

- Cross section elements
- Sight distance considerations
- Horizontal alignment details
- Intersection elements

Highway Cross Section Elements

Pavement Surface Characteristics

i. Friction - This lies between vehicle tyres and pavement surface in longitudinal direction.
ii. Skid - It occurs when the wheel slide without revolving. Skid is of two types, viz. longitudinal and lateral skid.
iii. Longitudinal skid: When the path travelled along the road surface is greater than the circumferential movement of the wheels
iv. Lateral skid: When centrifugal force is the driving force for the skid

Classification of Terrain

The classification of terrain is normally done by means of the cross slope of the country, viz the slope approximately perpendicular to the centre line of the highway location. The following classification is generally followed.

Table 1

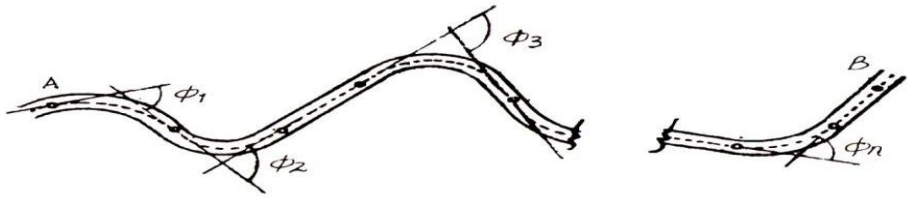
S. No	Terrain classification	Percent cross slope of country
1	Level	0-10
2	Rolling	10-25
3	Mountainous	25-60
4	Steep	Greater than 60

An extensive survey of 42000km of roads India as part of the Road User Cost Study has enabled the development of the following system of terrain classification:

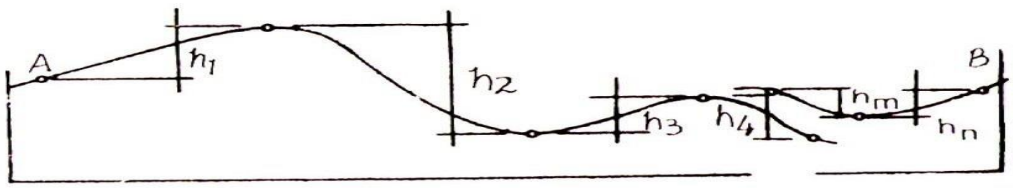
Table 2 **Terrain classification suggested in Road User Cost Study**

Sl .No	Terrain classification	Rise and fall (m/km)	Curvature (deg/km)
1	Plain a)low curvature b)high curvature	 0-15 0-15	 0-50 Above 51
2	Rolling a)low curvature b)high curvature	 16-30 16-30	 0-100 Above 101
3	Hilly a)low curvature b)high curvature	 Over 31 Over 31	 0-200 Above 201

Average Curvature of section AB, CV=$\frac{\emptyset_1+\emptyset_2+\emptyset_3+\cdots+\emptyset_{n+}\emptyset_m}{\text{DISTANCE AB (KM)}}$, Expressed in Degrees/km



Average Rise and fall section AB, RF=$\frac{h_1+h_{2+}h_{3+}\cdots\ldots\ldots+h_{n+}h_m}{\text{DISTANCE AB (KM)}}$, Expressed in meter/km



Therefore, average curvature of section AB, CV=$\frac{616^0}{1.5}$ =**410** Degrees/km

Therefore, average Rise and fall of section AB, RF=$\frac{68.05}{1.5}$ = **45.35**meter/km

Both the value is greater than terrain classification value

Therefore consider as **Hilly Terrain**

IRC Recommendation for Highway Cross Section Elements

i. Co-efficient of longitudinal friction=0.35 to 0.40

ii. Co-efficient of lateral friction=0.15

iii. Payment unevenness of 150cm/km is desirable for good pavement surfaces of high speed highways

iv. Camber or cross slope : It is the slope provided to the road surface in transverse direction to drain off the rain water from the road surface

Table 3 **IRC Recommendation for Camber**

Sl.no.	Type of road surface	Range of camber in areas of rainfall range	
		Heavy	Low
1	Cement concrete and high type bituminous surface	1 in 50	1 in 60
2	Thin bituminous surface	1 in 40	1 in 50
3	Water bound macadam and gravel pavement	1 in 33	1 in 40
4	Earth	1 in 25	1 in 33

Width of pavement or carriageway: It depends on the width of traffic and number of lanes. Width of 3.75m is considered ideal.

i. Width of roadway or formation: Width of formation of roadway is the sum of widths of pavement and the shoulders.

Table 4 Recommended Width of Roadway by IRC

Sl.no.	Road classification	Roadway width(in m)	
		Plain and rolling terrain	Mountain and steep terrain
1	National and state highway ▪ Single lane ▪ Two lane	 12.0 12.0	 6.25 8.80
2	Village roads-single lane	7.5	4.00

Design Speed

The design speed is the main factor on which geometric design elements depends. The sight distances, radius of horizontal curve, super elevation, extra widening of pavement, length of horizontal transition curve and the length of summit and valley curve are all dependent on design speed. The design speed of roads depends on class of the road and terrain.

Table 5 Design Speed on Highway

Road classification	Design speed in mph for various terrains							
	Plain		Rolling		Mountainous		Steep	
	Ruling	Min.	Ruling	Min.	Ruling	Min.	Ruling	Min.
National and state highway	100	80	80	65	50	40	40	30

Gradient

The slope of the road pavement in the longitudinal direction is called grade or gradient. It may be expressed either as a ratio or rise or fall in a specified horizontal distance, or as percentage of rise or fall.

Depending on the steepness of the road pavement, the gradients are categorized as follows:

i. Ruling gradient
ii. Limiting gradient
iii. Exceptional gradient
iv. Minimum gradient

Table 6 **Recommended Gradients as per IRC**

Terrain	Ruling gradient	Limiting gradient	Exceptional gradient
Plain and rolling	3.3%(1 in 30)	5%(1 in 20)	6.7%(1 in 15)
Mountainous having elevation >3000m above MSL	5%(1 in 20)	6%(1 in 16.7)	7%(1 in 14.3)
Steep terrain up to 3000m above MSL	6%(1 in 16.7)	7%(1 in 14.3)	8%(1 in 25)

Right of Way:

Right of Way is the area of land required for the road, along its alignment.

The land width is governed by following factor Width of formation depending on the category of highway and width of roadway and road margins.

1. Height of embankment, side slopes, drainage system and sight distances.

Table 7 Recommended land width of different roads:

SL.NO.	Road Classification	Plain and rolling terrain				Mountains and Steep terrain	
		Open areas		Built areas		Open areas	Built areas
		Normal	Range	Normal	Range	Normal	Range
1.	National and State highways	45	30-60	30	30-60	24	20
2.	Major district Roads	25	25-30	20	15-25	18	15
3.	Other district Roads	15	15-5	15	15-20	15	12
4.	Village Roads	12	12-18	10	12-15	9	9

Super elevation

In order to counteract the effect of centrifugal force and to reduce the tendency of the vehicle to overturn or skid, the outer edge of pavement is raised with respect to the inner edge, thus providing a transverse slope throughout the length of the horizontal curve. This transverse inclination to the pavement surface is known as super elevation.

Design of Horizontal Alignment

Horizontal Curves

When the centre line of the road changes the direction along the horizontal plane, horizontal curves are provided and the same are designed as follows:

Super Elevation

To counter act the effect of centrifugal force and to reduce the tendency of vehicle to overturn of skid the outer edge of pavement is raised with respect to inner edge. Such

provision of transverse slope is provided on horizontal curves. The design of super elevation is illustrated as below.

Extra Widening

Extra Widening Is Provided To Provide Extra Space Required For Mechanical And Psychological Reasons Along The Horizontal Curves, Which Is Provided As Per The Table Below:

Extra Widening Recommended by IRC

Sl. No	Radius of curve in metre	Extra width for two lane road in metre
1	Up to 20m	1.5
2	20 to 40m	1.5
3	41 to 60m	1.2
4	61 to 100m	0.9
5	101 to 300m	0.6
6	Above 300m	Nil

Vertical Alignment

When two different or contrary gradients meet, they are connected by a curve in the vertical plane known as vertical curve. These ar4e needed to secure a gradient change in grade so that abrupt change in grade at the apex is not allowed. The vertical curves used in highway may be classified into two categories.

i. Summit curve
ii. Valley curve

Summit Curve

A curve with convexity upwards is called a summit curve. This occurs when an ascending intersect a descending gradient or when an ascending meets on other ascending gradient or an ascending gradient meeting a horizontal a summit curve is provided here as

there is change in gradient matching the requirements of a summit curve. The summit curve is designed end as below.

Valley Curve

A vertical curve, concave upwards is called as valley curve. This is formed when descending gradient intersect an ascending gradient or when a descending gradient meets another descending gradient or when a descending gradient gains a horizontal path, they should be designed for:

i. Comfort
ii. Head light sight distance condition

Design of Transition Curve

Length of the transition curve is calculated based on three conditions and the higher value is considered for the design.

Length of Transition Curve by Rate of Change of Centrifugal Acceleration.

Allowable rate of change of centrifugal acceleration C is given by

$$\mathbf{C = \frac{80}{75+V}}$$

$$C = \frac{80}{75+50}$$

C = 0.64 m/sec^3

Obtained value of c should lie between 0.5 and 0.8 as recommended by IRC.

Therefore

c = 0.64 m/sec^3 is adopted.

Now length of transition curve, $\boldsymbol{L_S = \frac{V^3}{46.5xCxR}}$

$$L_S = \frac{50^3}{0.64X90X46.5}$$

$\boldsymbol{L_S}$ **=46.669M**

Length of Transition Curve by Rate of Introduction of Super Elevation

Width of the pavement W = 7m for n = 2 lane.

Width of the wheel base l = 6m, R = 90m, V = 50kmph.

Total width of the pavement B = width of the carriage way + extra widening

B = W + W_e

Extra widening is given by $W_e = \frac{nl^2}{2R} + \frac{V}{9.5\sqrt{R}}$

$W_e = \frac{2X6^2}{2X90} + \frac{50}{9.5\sqrt{90}}$

W_e=0.955m

∴B=7+0.955

B=7.955m

Allowable rate of introduction of super elevation = **1 in 60**, **pavement to be rotated about the inner edge** to effect better drainage.

Now, E=B x e Where B=7.955m, e=0.07

∴ E=7.955 x .07

E=0.556

Now length of the transition curve is given by **L_S = E xN**

L_S = 0.556X60

L_S = 33.36 m

Check for minimum value of L_S as per IRC.

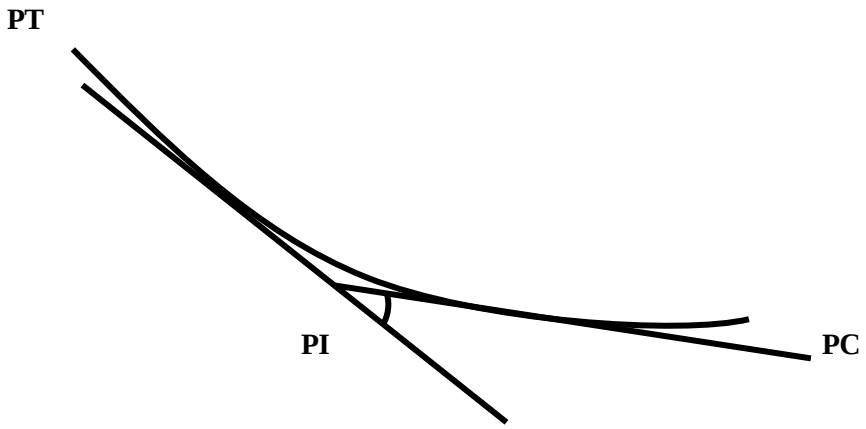
L_S Is given by **$L_S = \frac{2.7V^2}{R}$**

$L_S = \frac{2.7X50^2}{90}$

L_S= 75.0m

Therefore adopt length of transition curve= 75.0m

Design of Valley Curve



As descending gradients meeting another ascending gradient at chainage 450.00m

They are $n_1 = \frac{-1}{63.966}$ and $n_2 = \frac{1}{33}$

∴ Deviation angle N = $n_1 - n_2$

N = $0.046\ m$

Length of the valley curve can be calculated based on two conditions

Based on Comfort Condition

As per **IRC,** the allowable rate of change of centrifugal acceleration C may be taken as 0.6 m/sec^3.

Assume L >S,

Here S = 62.205 m

L is given by,

L **= 0.38 ($\sqrt{NV^3}$)**

L = 0.38 ($\sqrt{0.046X50^3}$)

L = 28.815 m

L< S

Therefore, Assumption is wrong

Now assume L<S

L =$2x\left(\frac{NxV^3}{C}\right)^{0.5}$

L = $2x\left(\frac{0.046x13.89^3}{0.6}\right)^{0.5}$

L =28.667m

Therefore, Assumption is correct

Based on Head Light Sight Distance

Length of valley curve can be calculated by comparing it with the stopping sight distance (SSD).

Here SSD = 62.205 m

If L>SSD,

L is given by $\mathbf{L = \frac{NS^2}{1.5+0.035S}}$

$$L = \frac{(0.046)X62.205^2}{1.5+0.035X62.205}$$

L = 48.405 m,

Obtained value of L is less than SSD, therefore assumption is wrong.

∴ L<SSD,

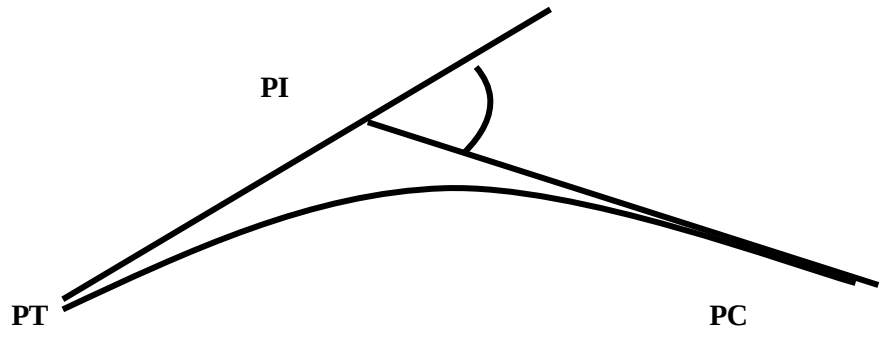
L is given by $\mathbf{L = 2S - \frac{(1.5+0.035\,S)}{N}}$

$$L = (2X62.205) - \left(\frac{(1.5+0.035X62.205)}{0.046}\right)$$

L =44 .471m

Therefore length obtained is more than IRC recommended value for 50kmph. According to its length of valley curve for 50kmph and maximum grade change of 1%, do not require a valley curve. But in the design the grade change is 1.48% (is more than 0.1%). Therefore minimum length of 30m valley curve is provided.

Design of Summit Curve



As ascending gradients meeting another descending gradient at chainage 1200.00m

They are $n_1 = \frac{1}{45.758}$ and $n_2 = \frac{-1}{199.536}$

∴ Deviation angle N = n_1-n_2

N = $0.027\ m$

Assume **L>SSD,**

$$L = \frac{NS^2}{4.4}$$

$$L = \frac{0.027x62.205^2}{4.4}$$

L = 23.744 m

.***Assume*** **L<SSD,**

Obtained value of L is less than SSD, therefore assumption is wrong

$$\mathbf{L = 2S - \frac{(4.4)}{N}}$$

$$L = 2x62.205 - \frac{(4.4)}{0.027}$$

L= 38.552 m

Obtained value of L is less than SSD, therefore assumption is correct

Design of Culvert

To design the culvert the discharge and velocity are assumed to be 1.2m^3/sec and 2 m/sec.

To find the diameter of the pipe,

$$\mathbf{A = \frac{Q}{V}}$$

$$A = \frac{1.2}{2}$$

A= 0.6m^2

But $\mathbf{A = \frac{\pi d^2}{4}}$

$$\therefore \frac{\pi d^2}{4} = 0.6 \qquad \therefore \mathbf{d = 0.874m}$$

Therefore adopt internal diameter=**0.900m.**To find the external diameter of the pipe add 0.1m to internal diameter. Therefore **D=1.000m.**

Assume length of each pipe=3m, but road width=12m. Therefore four numbers of pipes are required.

The Summary of our Project for Highway is As Follows:

i.	Road length	: 720 m
ii.	Design speed	: 50Kmph
iii.	Width of pavement	: 7.0m
iv.	Width of roadway	: 12.0m
v.	Width of shoulder	: 2.5m
vi.	Right of way	: 24m
vii.	Soil type throughout the route	: Gravelly soil
viii.	Pavement	: Flexible
ix.	Culvert (diameter of pipe)	: 1.00m
x.	Length of transition curve	: 75.00m
xi.	Length of summit curve	: 38.552 m
xii.	Length of valley curve	
	a) Based on comfort condition	:28.667m
	b) Head light sight distance	:44.471m

DETAILS OF OTAL STATION

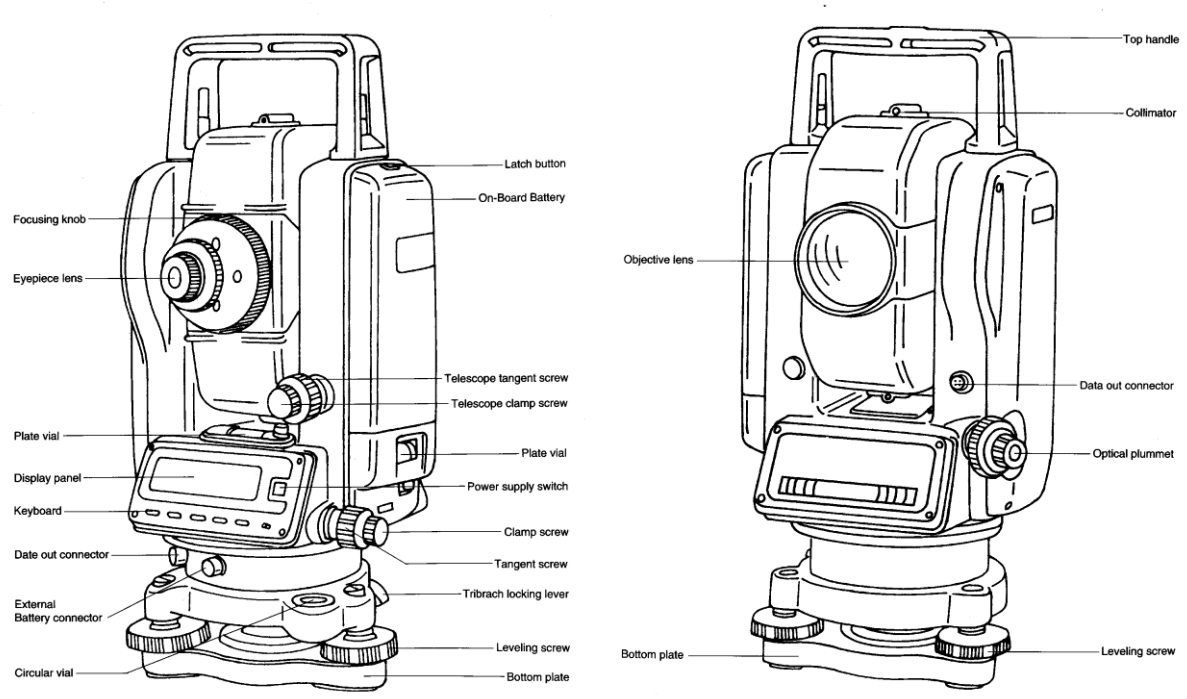


Figure : parts of total station

Total station is the combination of electro magnetic distance measuring instrument and electronic theodolite. It is also integrated with microprocessor, electronic data collector and storage system. The instrument can be used to measure horizontal and vertical angles as well as sloping distance of object to the instrument.

Microprocessor unit process the data collected to compute:

1)average of multiple angles measured.
2)average of multiple distance measured.
3)horizontal distance.
4)distance between any two points.
5)elevation of objects.
6)all the three coordinates of the observed points.

Data collected and processed may be down- loaded to computers for further processing.

There are software like auto civil and auto plotter clubbed with AutoCad which can be used for plotting contours at any specified interval and for plotting cross section.

CHAPTER 4

WATER SUPPLY

4.1 INTRODUCTION

Water is the basic need for all living beings. Water is a chemical compound and may occur in liquid or solid or gaseous form. All these are forms of water are extreemly useful to man, providing him the luxuries and comforts in addition to full filling his basic necessities of life. It has been estimated that two third of human being but also for animals, plants and all other living beings.

It is necessary that the water required for their needs must be good and it should not contain unwanted impurities or harmful chemical compounds or pathogenic bacteria. It is clear that no water is pure and it contains some amount of impurities such as gasses, minerals etc.

4.2 OBJECTIVES OF WATER SUPPLY SCHEME

In order to ensure the availability of sufficient quantity of good quality water, it becomes almost imperative in a modern society to plan and build suitable water supply scheme, this may provide portable water to various section of community in accordance with their demands and requirements. Hence, a suitable scheme shall be provided to ensure constant and reliable water supply to the section of the people for which it is designed. The source of supply considered for this project is the river water.

4.3 DISTRIBUTION SYSTEM FOR WATER SUPPLY:

Following are the distribution system used for the water supply:

Gravity system: in this system, the water is convoyed through pipes by gravity only. The gravity system is the most reliable method of distribution. But it is useful only when the source of water supply is situated at a higher level than that of distribution area.

Gravity and pumping system combined: in this system, the treated water is pumped and stored in an elevated distribution reservoir and it is supplied during the peak period. The pumps are usually worked at constant rate and this rate of pumping is so adjusted that the excess quantity of water stored in a reservoir during of low consumption is nearly equal to the extra demand of water during peak period.

Pumping system : In this system , the water is directly pumped in to the mains leading to the consumers .The number of pump required in this system will depend on the demand of water .

In this project, combined gravity and pumping systems are adopted

4.4 METHODS OF LAYOUT OF DISTRIBUTION PIPES

Following are the method adopted for the distribution of water:-

- **Dead-end method:** This is known as tree system of layout and it consist of one supply main from which sub-mains are taken .The sub-mains again divided in to several branch lines from which service connections are given to the consumer.
- **Grid-iron method:** This is known as the interlaced system or reticulation system .
- **Circular method:** This is also known as the ring system and a ring of mains is formed around the distribution area
- **Radial method:** This method of layout is just the revise of the ring method .In this system, the water is taken from the mains and pumped in to the distribution reservoir which has situated at centres of different zones. The water is taken supplied through radial pipe lines. The radial method of layout gives quick service and the calculation for design of size of pipes are simple .The radial method is most suitable for towns having road laid out radial.

We have adopted DEAD END method in this project.

4.5 CALCULATION OF WATER REQUIRED DEPENDING ON EXISTING AND PROJECTED POPOULATION

- Annual average daily requirement of water in the area in litres can be worked out by multiplying the probable number of person who are going to use the facilities provided by the scheme. This annual average daily consumptions of each person is called per capita demand . The estimated quantity of water required for municipal uses for which scheme has to be designed , should be worked out with due provision for the estimated requirements in future .It is therefore necessary to estimate the future population as accurately as possible .Depending on possibilities of future development of the town the possible future population at the end of design period can be calculated by using following different methods.

- Arithmetic increase method
- Geometric increase method
- Incremental increase method
- Decreasing rate method
- Simple graphical method
- Comparative graphical method
- Master plan method
- The apportionment method
- The logistic curve method

In this method we have adopted geometric increase method

4.6 SURVEYING

The profile levelling that can be carried out to find the difference in elevation between source and treatment plant. Since the proposed site for treatment plant is at higher elevation than the source it is required to carry out profile levelling.

Profile levelling is the process of determining the elevations of points at short measured intervals along a fixed line.

Reconnaissance, plane table and fly levelling survey methods are carried out to find the nature and topography of the area. Higher elevation points are selected for locating tanks and conveyance system and properly planned to have an economical and more advantageous scheme, so that it is not an over burden to the people present in the area to adopt this scheme.

Plane table traversing was conducted to plan the water supply system and to find the total length of pipe required.

Location of site for ground level and overhead Tank

Surface reservoirs are constructed at ground level or above the ground level. They are generally constructed at higher points in the city. If the city is having more than one high point then city may be divided into several zones and separate reservoir may be provided. In gravitational distribution system the water is stored in service reservoir and directly sent to the distribution system. However pumping of water may be required from source to service reservoir.

Elevated reservoirs are erected at certain suitable elevation above the ground level and supported on towers. They are constructed where the pressure requirements necessitate considerable elevation above the ground surface. They are constructed in the areas where the pressure requirements necessitate considerable elevation above ground surface. They are constructed in the areas where the combined gravity and pumping system for water distribution is adopted. Water is pumped into these elevated tanks and sent to consumers.

4.7 DESIGN OF WATER SUPPLY

(1).Calculation of total requirement of water .

A) Total population of village ALETTY

1) Present population (P_2)=230

Previous known population

(P_1)=200

P_2=250,t=1(in the year 2013)

$r_{mean}=\sqrt{P_2/P_1}-1x100$

r_{mean}=7.23%

2) Forecasted population after 10yrs,

$P_{2023}=P_{2013}\ [1+r/100]^n$

3)Forecasted population after 20yrs

$P_{2033}=P_{2013}[1+r/100]^n$

$=230[1+(7.23/100)]^2$

$=265$

b) Total population for which water is to be supplied =265

c) percapita demand=120lts/day/person(for population<20,000)

As per national board of fire under writers formula,

$Q=4637\sqrt{p}(1-0.01\sqrt{p})$

$=4637\sqrt{265}(1-0.01\sqrt{2.65})$

Q=71249lts/min

A. Average daily draft

=Per capita demand X Population

=130x265

=34450lts/day

=0.3445Mld

B. Maximum daily draft

Assuming as 180% of annual average daily drafts as per IS recommendation.

=0.0620Mld

C. Maximum hourly draft

Assuming as 270% of annual average hourly drafts as per IS recommendation.

=0.0930Mld

D. Coincident draft

=Maximum daily demand/draft + fire draft

=0.0620+9.805

= 9.867Mld

2] Design of over head tank for storage and supply of water

Now taking maximum water to be stored at any time = the coincident draft

=9.867Mld

Assume height of tank =5.5m + 0.5m (free board)

=6m

Therefore diameter, D =5m

3] Design of distributor conduits

Assuming velocity through the pipe = 1.2m/sec.

q= a x v

a=q/v

=0.0219/1.2

$a=0.18m^2$

d= 0.15m (or) 150mm

4] Design of pump

BHP = WQH/75n where, n=80%

= (1000x0.456x28.66)/(75x0.80)

BHP =217.8HP

CHAPTER 5

SANITARY PROJECT

5.8.1 Introduction

As the population goes on increasing, the production of waste materials also increases. if these waste materials are not properly disposed it will affect the surrounding atmosphere and makes pollutants, it will in turn affect the health of the people. Therefore now a day there is rapid progress in the sanitary engineering.

The basic principle of sanitary engineering is to find a way to remove any waste as early as possible after its formation. The waste may be in the form of solid, liquid, gases. Proper treatment should be given to the collected waste. It can be thrown into natural river or stream or used for vegetation after it has been harmless.

In this project attempt is made to plan the layout the sewage system at ALETTY near SULLIA.

The purpose of sanitary engineering is to provide good sanitation. Sanitation can be achieved by the following

a) Collection and conveyance.
b) Interior decoration.
c) Supply for water and
d) Treatment of waste.

In this chapter an attempt is made to collect details relating to collection and conveyance of waste.

5.9 AIM AND OBJECTS OF SEWAGE DISPOSAL.

1) To reduce insanitary condition due to decomposition.
2) To treat sewage to the desired amount of purification, so that receiving water, land may get polluted.
3) Take out all kinds of waste water from locality immediately after its use, so as to reduce mosquito's, flies, bacteria, etc.

5.10 CARRIAGE OF REFUSE

The general two method of carriage are :

- Conservancy system: in this system different type of refuse are collected separately and then each type is carried and suitably disposed off.
- Water carriage system: in this system water is used as medium to convey sewage to the point of its treatment.

In this project conservancy system is adopted.

5.12 **SEWER MATERIALS**

1.Asbestors cement.

2.Brick.

3. Stoneware or vitrified clay.

4. Concrete

5. Iron and steel.

6.Plastic

In this project concrete sewer pipe is used to carry sewage.

5.13 LAYING OF SEWERS & DISPOSAL

All the sewer pipes are generally laid starting from their outfall ends towards their starting ends. The advantage gain in starting from tail end is the utilization of the tail sewers even during the initial periods of its construction, thus ensuring that functioning of sewerage scheme has not to wait the complete of entire scheme.

Sewage is to be disposed off a suitable place to reduce the harmful effect due to its decay action.

Before taking up the execution of the sewerage project the first and far most important aspect is its proper planning. Faulty planning may create difficulties for maintenance. Hence the sewage project is very specialised job.

Separate system: In this system the two sets of sewers are laid -one for carrying sewage and other for carrying storm water. The sewage is carried to the treatment plant and storm water is directly discharged into the natural outlet in the form of river or stream.

Combined System: In this system only one set of sewers is made to permit early washings by rain into the sewers carrying sewage. But when the quantity of storm water exceeds particular limit it is collected and conveyed in open drains to the natural rivers or stream.

In this project we use separate system for sewer line

5.14 PLANNING OF SEWERAGE SYSTEM

Before taking up the execution of the sewerage project the first and far most important aspect is its proper planning. Faulty planning may create difficulties for maintenance. Hence the sewage project is very specialised job.

1. Feasibility of installing sewage system.
2. system of sewage to be adopted may be separate, combined, or partially separate.
3. Quantity of sewage expected to be handled by each sewer line and then total quantity of sewage to be handled at outfall point.
4. Disposal of sewage on land or by dilution can be decided.
5. Need and extent of sewage treatment, if required.

5.15 SURVEY CONDUCTED FOR WATER SUPPLY AND SANITARY

After all the consideration and having decided about the sewage system to be adopted, detail survey should be carried out.

1. Contour of whole city and in surrounding area should be shown in detail on map.
2. A general plan of the should be prepared. All the buildings, streets, main roads, population densities should be marked on it. Reduced levels of the entire street crossing points should be marked on it. The size of the sewer line to be laid and the grade should be shown clearly.
3. If the city is quite big, it may be divided into several zones the detail plan of all the zones should be prepared and all the possible details should be marked on it.
4. Levelling work should be carried out along all the streets in which sewer are to be laid. The work has to be done very precisely. Plinth levels of the basements should also be noted.

5. From the survey and levelling data, detailed longitudinal and cross-sections are prepared. Position of manholes catch basins, street inlets, etc should all be marked on them. Slope of sewer line and its inert levels should be marked at intervals of 30m or so.

5.16 DESIGN OF SEWER

Data:-

1. Population of the village(AFTER 20 YEARS) =265
2. Area of village = 30 Hectares
3. Water supplied to the village = 120lit /capita /day
4. Waste water generated = 80% of water supply **= (80/100)*120=lpcd=96lpcd**
5. Rainfall = 3000 mm /year
6. Bed slope =1:100

United States Ministry of health recommended the following values of constant 'a' & 'b'

Duration of storm	**Constant ‘a’**	**Constant ‘b’**
5 to 20min	**30**	**10**
20 to 100min	40	20

Dry Weather Flow (DWF)

DWF = Population x waste water generated

=265 x 96

=25440lit /day

DWF =0.29 lit/sec

Wet Weather Flow(WWF)

The rainfall intensity is given by

R_i =25.4a/ (t+b) mm/hr (Here t=50min,a=40,b=20)

=25.4x40/(50+20)

R_i =14.5mm/hr = 1.45cm/hr

Hence WWF is given by,

Q=28xaxIxR_i

=28x40x0.3x1.45

The WWF =487.20 lit/sec

Hence the design discharge is given by

Q =2(DWF)+WWF

=2x0.29+487.20

=487.78lts/sec

DWF/WWF=0.29/487.20

Ratio DWF to WWF is not so large hence it is preferable to use a **Combined Sewer**

DESIGN

Circular sewer

Assume manning D co-efficient, N=0.005

Bed slope = S =1:100

Hydraulic mean depth = R =D/4

Q =Area x velocity

When sewer runs half full

d = 0.5D where d =Depth of sewage & D = Diameter of sewer

a=$\frac{1}{2} * \frac{\pi}{4} * D^2$

a=$\frac{\pi}{8} * D^2$

p=πD$\frac{\theta}{360}$ =?$\frac{D180}{360} = \pi D/2$

r=$\frac{\pi}{8} * D^2$*2/$\pi D = \frac{D}{4}$&now

V=$\frac{1}{N} * R^{\frac{2}{3}} * S^{1/2}$

V=$\frac{1}{0.012} * (D/4)^{\frac{2}{3}}(1/100)^{1/2}$

We get D=0.5m

Use diameter of sewer =50cm

Table 4.18 & 4.19 gives the summary of water supply & sewer line project.

5.18 SUMMARY OF WATER SUPPLY PROJECT AND SANITAR

RL of dead sea level	**104.530m**
RL of pump house	**93.100m**
RL of over head tank	**115.350m**
RL of last end point of project work	**109.735m**
Height of water tank	**6m**
Diameter of tank	**5m**
Diameter of main pipe	**0.5m**

5.12 CONCLUSION

- In this project, water supply & sanitary is planned for 20 yrs.
- Separate system can be adopted.
- Suitable sewage disposal points are available and hence it is not unhygienic.
- Gravity & Pumping system is adopted for water supply.
- Volume of earth work for water supply scheme =1.2*length of water supply line.