EXTENSIVE SURVEY PROJECT REPORT ON

NEW TANK AND OLD TANK PROJECT

KAIVARA

EXTENSIVE SURVEY PROJECT REPORT

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Bengaluru, India

SCHOOL OF CIVIL ENGINEERING

EXTENSIVE PROJECT REPORT

CERTIFICATE

This is to certify that the students of 6^{th} Semester, B. Tech Civil Engineering have satisfactorily completed the Extensive Survey Project (BTCE16F6800) prescribed by

REVA University,
Bengaluru during the academic year 2019-20.

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VI Semester

School of Civil Engineering

REVA University

NEW TANK PROJECT

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1.0 INTRODUCTION

New tanks are constructed to provide water for multipurpose irrigation purposes. Tanks and reservoirs require careful planning, design, and operation for which certain observations relating to selection of site, relative merits of different types of tanks, storage capacity, coordinated uses of storage for different purposes, etc. are to studied in detail. The irrigation reservoir is primarily meant to store the excess water during the period of large supply and release it gradually for irrigation when required. A scheme of this type of formation of new tank near KAIWARA has been taken up as mini project work as per university regulations.

2.0 OBJECT OF NEW TANK PROJECT

The main object of new tank project is to construct an earthen dam across the stream which flows through an open natural canal, for the purpose of irrigation. Since the land to be irrigated is very small and the population of the town is very less, it is not necessary to construct a major work but sufficient to provide a minor tank project.

The New tank project [NTP] involves three major operations

- ***The selection of site for proposed dam.***
- ***The selection of site for waste weir.***
- ***The selection of site for canal alignment.***

3.0 IRRIGATION

Irrigation may be defined as the process of artificial supply of water to soil for raising crop. It is a science of planning and designing of efficient low cost, economical irrigation system tailored to fit the natural conditions. It is the engineering of the controlling the various natural sources of the water by the construction of dam and reservoir, canal and headwork and finally distributing the water to the agricultural field. Irrigation engineering involves the study and design of work in connection with river, controlled drainage of the water logged areas and generation of the hydro – electric power.

3.1 METHODS OF IRRIGATION

Irrigation is classified as two methods

- ***Flow irrigation.***
- ***Lift irrigation.***

3.1.1 FLOW IRRIGATION

Flow irrigation is the method of taking water to the land to be irrigated by the flow or gravitation. The water is stored at such a level in reservoirs, tanks that it can be easily transmitted to the irrigable lands by gravitation through canals.

3.1.2 LIFT IRRIGATION

When the water available for irrigation is at a lower level than the land, then it has to be lifted by pumps or other water lifting devices and this method is known as lift irrigation. This water is sometimes stored in the tanks and then distributed to the lands by gravity system.

4.0 THE CLASSIFICATIONS OF FLOW IRRIGATION ARE

- ***Perennial irrigation.***
- ***Inundation irrigation.***
- ***Direct irrigation or River canal irrigation.***
- ***Tank irrigation or Storage irrigation.***

4.1 TANK IRRIGATION

Tank irrigation may be defined as the storage irrigation scheme which utilizes the water stored on the upstream side as a smaller earthen dam called as "Bund". These earthen bund reservoirs are thus in fact called as "Tanks". This terminology is limited to use in only India. There is no technical relationship between the reservoir and tank except

that a large sized tank will be termed as reservoirs. Moreover, a reservoir will be generally formed by dam of any materials such as masonry dam. concrete dam, earthen dam (also known as earthen bund). South Indian tanks have a maximum depth of 4.5m while a few is as deep as 7.5m to 9.5m and only a few are exceptional ones which exceeds 11m depth. When the depth of the tank exceeds 12m or so then the tank is generally known as a reservoir. Like all earthen bunds, tank bunds are generally provided with sluice or outlets for discharging water from the tank for irrigation and other purposes. These tank sluice may be of pipes or rectangular or arched opening passing near the base of the bund for carrying the water to the downstream side channel below the bund to a distance where required through pipes or canals. Sometimes these supply sluices may not be carried adjacent to it through hill side one end of the bund. Similarly, tanks are provided with the arrangements for spilling the excess, surplus water that may enter into the tank so as to avoid overflowing of the tank bund. These surplus escape arrangements may be in the form of the tank bund or some other arrangements like siphon spillway may be provided in the case of the earthen dam project. The surplus escape weir in a masonry weir with its top i.e., crest level equal to full tank level [F.T.L] when the tank is full up to F.T.L and extra water comes in, then it is discharged over the surplus escape weir, which will also be designed such that water level in the tank never exceeds the maximum water level. The top of the tank bund will be kept at a level so as to provide a suitable free board above the maximum water level [M.W.L]. Since the surplus escape weir is a masonry weir then it will have to be properly connected to the earthen bund by suitably designed tank connection.

5.0 SOME IMPORTANT TERMS RELATED TO IRRIGATION

GROSS COMMANDED AREA (G.C.A)

It is the total area lying between drainage boundaries which can be irrigated by a canal system.

CULTURABLE COMMANDED AREA (C.C.A)

It is the area in which the crops can be grown satisfactorily.

INTENSITY OF IRRIGATION

It is the percentage cultural commanded area proposed to be irrigated during a crop season.

CROP PERIOD

It is the time taken by a crop from the instant of its sowing to its harvesting.

BASE PERIOD

It is the period during which the water supplied to the crops to bring the crop to maturity. The base period is slightly less than the crop period. It is denoted by the letter B.

DUTY OF WATER

It is defined as number of hectares brought to maturity by a constant flow of water per second during the crop period or it is the relative ship between the volume of water and area of crop brought to maturity. It includes both cultivable and non – cultivable area.

It is given by the formula

$$D = 864 \times \frac{B}{\Delta}$$

Where,
Δ in cm [Delta]

B in days [Base period]

D in hectare/comics [Duty]

DELTA

Each crop requires certain quantity of water at regular intervals of time throughout its period. If this total quantity of water is made to stand without any lose on an area, the depth of water required per hectare for the full growth of crops is called as delta. It is expressed by the symbol Δ

Delta = depth of each watering X number of watering.

6.0 WATER REQUIREMENT OF CROPS

For the full successful growth of the crops, every crop requires a definite quantity of the water, suitable agricultural soil, good irrigation and the proper method of cultivation. The total quantity of water required by a crop from the instant of sowing till it comes to the harvesting is known as water requirement of crops. It depends upon the following.

- ***The season in which the crop is grown.***
- ***Its period of the growth i.e., its crop period.***
- ***The climatic conditions of the region.***
- ***The rainfall in the season.***
- ***The water requirement of a crop varies from the place to place and from season to season.***

6.1. RESERVOIR

A storage structure for irrigation is formed by an embankment or dam across a natural water course or river and the water collected on the upper side of this structure. Water is drawn by means of the sluices in the dam, through the channels which supply water to the irrigation land.

6.2 NECESSITY

- ***When in an area, the usual rainfall is not enough for the crops, water is stored in reservoirs and allowed to lands whenever necessary.***
- ***In some areas, the rainfall may be confined to certain parts of the year, and even here water will have to be first stored and then distributed to the lands during the other periods of the year.***
- ***In places like Baluchistan and Rajasthan, where the streams flow like torrents for only a few days in the year, storage is a necessity to endure the proper water supply to the crops.***

7.0 REQUIREMENTS OF A STORAGE RESERVOIR

An ideal reservoir should satisfy the following conditions

- ***It should have a channel bringing down an ample supply of water.***
- ***There should be a broad expanse of nearly level ground in front of the embankment or dam to form the bed of the reservoir, having a slight dip towards the bund.***
- ***The land to the rear or the downstream side of the bund should be much greater extent than the bed and slightly lower in level, in order that every portion of it may be commanded by the tank and irrigated by the sluice in the embankment, from which one of two channels take off and lead the water to the fields.***
- ***Rock or other foundation, impervious to water, should be met at only a small depth from the surface.***
- ***Stone, fuel, lime and other materials required for the construction should be available within a reasonable distance for a masonry dam and good suitable earth, as well as stones for pitching, for an earthen dam.***
- ***The soil for the construction of the earthen dam for the reservoir should be of retentive nature.***
- ***Valuable garden lands or wells or village sites should not be submerged under the reservoir contour.***
- ***The site selected should give the required storage with the shortest length of the dam.***
- ***The site should be favorable to locate the waste weir preferably in a saddle, so as to pass off all the flood water into natural drainage stream without artificial ones and protects the embankment.***

8.0 SELECTION OF SITE FOR RESERVOIR

The final selection of site for a reservoir depends upon the following factors

- ***The geological conditions of the Catchment area should be such that percolation losses are minimum and maximum runoff is obtained.***

- ***The reservoir site should be such that quantity of the leakage through it is minimum, Reservoir site having the presence of the highly permeable rocks reduce the water tightness of the reservoir.***
- ***Suitable dam site must exist. The dam should be founded on water tight rocks base and percolation below the dam should be minimum. The cost of the dam is often a controlling factor in selection of the site.***
- ***The reservoir basin should make narrow opening in the valley so that the length of the dam is less.***
- ***The cost of the real estate for the reservoir including road, soil, road welling, etc… must be less as for as possible.***
- ***The topography of the reservoir site should be such that it has adequate capacity without submerging excessive properties.***
- ***The reservoir site should be such that it avoids as excludes water from these tributaries which carry high percentage of the silt in the water.***
- ***The reservoir should be such that the water stored in it is suitable for the purpose for which the project is undertaken.***

8.1 INVESTIGATION FOR RESERVOIR PLANNING

The following investigations are required for reservoir planning

- ***Engineering survey.***
- ***Geological investigation.***
- ***Hydrological survey.***

8.1.1 ENGINEERING SURVEY

The area of the tank site is surveyed in detail and a control point is prepared from the plan.

The following physical characteristics are obtained.

- ***Area elevation curve.***
- ***Storage elevation curve.***
- ***Map of the area.***
- ***Suitable site selection for tanks.***

8.2.2 GEOLOGICAL INVESTIGATION

In almost all civil engineering projects geological advice is most essential. Geological investigation cost very little in the comparison to the total cost of the project. Geological investigations are required to give detailed information about the following items.

- ***Water tightness of reservoir basis.***
- ***Suitability for foundation of the bund.***
- ***Geological and structural features as floods and faults.***
- ***Type and depth of the rocks at basin.***
- ***Location of permeable and soluble rocks if any.***

8.2.3 HYDROLOGICAL INVESTIGATION

The hydrological investigations are very important aspects of reservoir planning. These investigations may be designed in two needs.

- ***Study of runoff patterns at the proposal bund site to determine the storage capacity corresponding to the given demand.***
- ***Determination of the hydrograph of the worst flood at reservoir site to determine the spillways capacity and design.***

9.0 STORAGE ZONES OF RESERVOIR

DEAD STORAGE

It is the volume of the space provided for the deposition of the sediments in a reservoir. It is the level below which water is not stored. It is not of much use in the operation reservoir.

LIVE STORAGE

The volume of the water stored between dead storage and full tank level is called as live storage. Live storage assures the supply of water for specified period of time to meet the demand.

MAXIMUM WATER LEVEL

The maximum level to which the water level rises during high flood is known as a maximum water level. During floods, the maximum water level run – off will takes place and water level rises to this level.

FULL TANK LEVEL

It is the maximum elevation to which the reservoir water surface rises during normal operation condition.

SILL LEVEL OF SLUICE

It is provided at the minimum storage level as dead storage level.

TOP OF THE BUND LEVEL

It is fixed considering the aspects of the free board to prevent overtopping of the dam.

10. RESERVOIR SEDIMENTATION

The deposition of sediment in the reservoir is known as "reservoir silting" or "reservoir sedimentation". Every river carries certain amount of sedimentation load. The sediment particles try to settle down at the bottom of the reservoir due to the gravitational force that may be kept in the suspension due to the upward currents in the turbulent flow which may overcome the gravity force. These sediments will settle down in the reservoir because of the less velocity inside the reservoir. The deposition of the sediment will automatically reduce the water storing capacity of the reservoir and if this process of deposition continues longer a stage likely to reach when the whole reservoir gets silted up

and becomes useless .In order to see that the capacity of the reservoir does not fall short for requirements even during the design period. The silting should be taken into the account, the total volume of the silt likely to be deposited during the designed life period of the dam is therefore estimated and approximately that much of the volume is left unused to allow the silting and it is known as a dead storage.

10.1 DAM

A dam is an impregnable and impervious barrier thrown across a natural drainage line to impound water up to a certain limiting height which is usually lower than the top of the dam on its upstream side. Its main function is to store water either for irrigation or water supply or to produce power.

10.2 CLASSIFICATION OF DAMS

Dams are usually classified as,

10.3 RIGID DAM

- ***Gravity dams.***
- ***Arched dam.***
- ***Arched buttress dam.***
- ***Steel dam.***
- ***Timber dam.***
- ***Reinforced cement concrete panel and Buttress dams.***

10.4 NON – RIGID DAMS

- ***Earthen dams.***
- ***Rock fill dam.***

10.4.1 EARTHEN DAM

Earthen dams and earthen embankments are the most ancient type of embankment as they can be built with the natural materials with a minimum of processing and with primitive equipment.

10.4.2 EARTHEN DAMS ARE CLASSIFIED AS FOLLOWS

- ***Type A – Homogeneous embankment type***

- ***Type B – Zoned embankment type.***
- ***Type C – Diaphragm type***

10.5.1 HOMOGENEOUS EMBANKMENT

The simplest type of an earthen embankment consists of a single material and is homogeneous throughout sometimes a blanket of impervious material may be placed on the upstream face. A purely homogeneous section is used when only one type of material is economically or locally available such sections is used for low to moderately high dams and for large dams are designed as homogeneous embankment.

10.5.2. ZONED EMBANKMENT

Zoned embankments are usually provided with a central pervious core, covered by a comparatively pervious transition zone which is finally surrounded by much more pervious outer zone. The outer zone gives stability to the central impervious fill and also distributes the load over a larger area of foundation.

10.5.3. DIAPHRAGM EMBANKMENT

Diaphragm type embankments have a thin impervious core, which is surrounded by earth or rock fill. The impervious core called diaphragm is made up of impervious soil, concrete, steel, timber or any other materials. Its acts as a water barrier to prevent escape through the dam. The diaphragm may be placed either at the central or at the upstream face as a blanket.

11.0 THE COMMONLY ADOPTED STANDARDS USED FOR A FINDING THE DIMENSION OF TANK BUND IN THE SOUTH INDIA

SL NO.	DEPTH OF DEEP BED LEVEL BELOW F.T.L(M)	FREE BOARD (M)	WIDTH OF TOP OF BUND (M)
1	1.5 to 3.0	0.9	1.2
2	3.0 to 4.5	1.2	1.5
3	4.5 to 6.0	1.5	1.8
4	Over 6.0	1.8	2.7

The favourable soil, such as red and white gravel, red and black looms, etc… the side slope of the bund may be kept as 1.5:1 for smaller tanks with water depth not exceeding 2.5 and 2.1 for larger ones above 5m in depth. In tight sandy soils PR black cotton or clay soil however the slope may be kept between 2.1 and 2.5:1. the upstream face of the tank bund is generally lives bed against stone apron or so as to protect it against erosion and if this is done then the upstream face is generally adopted and 1.5:1 even up to 6m depth for inferior soils are greater depth however the riveted slope may be flatter , say 2:1.

12.0LEVELLING

- ***Direct levelling***
- ***Indirect levelling***

12.1 DIRECT LEVELLING

- ***SIMPLE LEVELLING***

When the difference of level between two points is determined by setting the levelling instrument between the points. This process is called as a simple levelling. Suppose it is required to know the difference of level between A and B. the instrument is setup at O exactly mid where between A and B. after proper adjustment. The staff reading on A and B are taken. The difference of these reading gives the difference of points between A and B.

- ***DIFFERENTIAL LEVELLING***

This is adopted when

- ***The points are at a great distance apart.***
- ***The difference of elevation between the points is large.***
- ***There are obstacles between the points.***

This method is also known as a compound levelling or continuous levelling. In this method the level is setup there at several suitable positions and staff readings are taken at all these points.

- ***FLY LEVELLING***

When the differential levelling is done in order to connect a benchmark to the starting point of alignment of any project it is called as a fly levelling. In such levelling only back sight and fore sight readings are taken at every setup of the level and known distances are measured along the direction of the levelling. The level should be setup just midway between back sight and fore sight.

- ***LONGITUDINAL OR PROFILE LEVELLING***

The operation of taking levels along the centre line of any alignment. (Roadway, Railway, Canal) at regular intervals is known as longitudinal levelling or profile levelling. In this operation, the back sight, intermediate and fore sight readings are taken at regular intervals at every setup of the instrument. The chainage of points is noted in the level book. This operation is carried out in order to determine the undulation of the ground surface along the profile line.

- ***CROSS – SECTIONAL LEVELLING***

The operation of taking levels transverse to the direction of the longitudinal levelling is known as cross – sectional levelling. The cross – section are taken at regular intervals along the alignment. Cross – sectional levelling is done in order to know the nature of the ground across the centre line of any arrangement.

- ***CHECK LEVELILLNG***

The fly levelling is done at the end of the day's work to connect the finishing point with the starting point on that particular day is known as check levelling. It is undertaken in order to check the accuracy of the day's work.

<u>12.2 INDIRECT LEVELLING</u>

- ***BAROMETRIC LEVELLING***

The barometric levelling is based on the fact that the atmospheric pressure varies inversely with the height. As air is compressible fluid, strata at low level will have a greater density than those at higher altitude. the higher the place of observation the lesser will be the atmospheric pressure. A barometer is used for measuring the difference in pressure between two stations and their relative altitudes can be deduced approximately.

- ***HYPSOMETRY***

The working of a hypsometer for the determination of altitudes of stations depends on the fact that the temperature at which water boils varies with the atmospheric pressure. A liquid boils when its pressure is equal to the atmospheric pressure. The boiling point of water vapour is lowered at higher altitudes since the atmospheric pressure decreases there. Temperature is measured using a sensitive Thermometer.

<u>13.0 VARIOUS SURVEYS CONDUCTED FOR THE NEW TANK PROJECT</u>

- ***RECONNAISSANCE SURVEY***

  A site for the new project will be fixed based on the following preliminary investigations.

  - ***Catchment area of a place.***
  - ***Average rainfall of a place.***
  - ***Suitable site for the bunds, weirs and sluice.***
  - ***Extent land to be irrigation with nature of the crop.***
  - ***Availability of the construction materials.***

- ***Financial feasibility of the project.***

- ***LONGITUDINAL AND CROSS SECTION ALONG THE CENTER LINE OF THE BUND***

    - ***From the permanent benchmark fly levels are carried out to establish a benchmark on the left bank or right bank wherever the work is to be started.***
    - ***The end points of the bund are fixed and the wooden pegs are driven at regular intervals.***
    - ***The centerline bearing is noted using prismatic compass.***
    - ***Form the both the ends of the bund bearing to the permanent object such as transformer, electric pole, building, etc.***
    - ***Above the centerline of the bund already fixed longitudinal section at every 15m interval on centerline and cross section at 30m interval up to or beyond the embankment cases on either side taken at 5m interval***
    - ***Height of the bund = tank bund level = ground level base = width of the bund =***

      [U/S slope X Height + Top width + D/S slope X Height]
    - ***The day's work is constructed at temporary benchmark established.***

- ***BLOCK LEVELING AT WASTE WEIR***

  The top of the weir should be at FTL. Fix the centre line and mark left and right points.

    - ***Construct a block of 60m length on U/S side and 40m length D/S side.***
    - ***Carry out block leveling at every 5m interval.***
    - ***Work is started and closed at established benchmark.***

- ***SURVEY FOR CAPACITY CONTOUR***

In order to plot the contour at FTL, LWL, MWL, Surveying for water spread contours was conducted due to certain physical constraints, indirect leveling is adopted.

<u>14.0 RADIAL LEVELLING</u>

Radial levelling is carried out at u/s side using the following procedure

- ***Prismatic compass was fixed on the centerline of the bund such that main area could be covered on the U/S side.***
- ***Radial lines at an angle of 0, 30, 60, 90, 120, 150 and 180 were set out from the compass point.***
- ***Fly leveling was adopted to carry benchmark from permanent benchmark to compass point.***

- ***Staff readings were taken along the radial lines at 15m interval.***
- ***Cross – sections are taken along the radial lines at 5m intervals***
- ***The cross section was increased along the radial lines such that the whole upstream side is covered.***
- ***The work is closed by the fly leveling on established benchmark.***

15.0 WEIR

Weir is a structure constructed at right angles to the direction of the flow. Its purpose is to raise the water level and then divert it into the canal. As the tanks are the small storage works constructed to meet the local requirements obvious by attempting is not made to contain full run off coming down from the catchment area. It is therefore necessary to make suitable arrangement to pass from the excess water beyond F.T.L. The structure constructed to provide passage to excess water is called as "escape weir". It is also called as a "Tank surplus weir". The water starts spilling over the weir as soon as tank is filled up to its crest. However, temporarily due to rush of the incoming water the level in the tank rises above the F.T.L, the new level is reached is called as "maximum water level" [M.W.L.]. It depends on the extent of the flood. For the design purpose M.W.L is calculated taking in to account the maximum likely flood discharge and the amount of water that may be available at the site for the escape weir. The surplus water as spillway water is carried down through a channel which is generally a natural discharge and has enough capacity. A weir may be constructed in the masonry, rock fill, cement concrete, etc.

15.1 TYPES OF WEIR

Escape weir constructed in the tank irrigation system is similar to a diversion weir are constructed across the river channel. It may be classified as following types

- ***Masonry weir.***
- ***Masonry with the horizontal floor.***
- ***Masonry weir with depressed floor.***
- ***Masonry weir with the stepped floor.***
- ***Rock fill weir.***
- ***Concrete weir.***

15.2 SELECTION OF SITE FOR A WEIR

Following are the points may be taken into consideration while selecting a site for a tank weir

- ***Tank weir performs the function of the surpassing excess flow therefore it is preferable to locate the weir in a natural saddle away from the tank bund.***
- ***To carry surplus flow existence of a well-defined escape channel is very necessary at a site selected for the construction of a weir.***
- ***The saddle where natural surface level is approximately same as tank level [FTL]***

should be given first performance.

- ***Hard foundation if available at the site reduces the cost of the construction.***
- ***When a site away from the tank bund is not available as for as possible weir may be located on one end of the tank bund.***
- ***Surplus weir may be hosed in the body of the tank bund only as a last resort.***
- ***Care should be taken to see that escape channel surpassing water is not likely to damage cultivated land.***

16.0 CANAL

Canal is a passage for the flow of the water from reservoir or tank to an irrigational field or any other field necessary. Water in a canal flow under gravity and the upper most surface of the water is exposed to the atmosphere.

16.1 CLASSIFICATION OF THE CANAL

16.1.1 BASED ON THE CANAL ALIGNMENT

- ***Contour canal***
- ***Water shed canal***
- ***Side slope canal***

16.1.2 BASED ON DISTRIBUTION SYSTEM

- ***Main canals.***
- ***Branch canals.***
- ***Major distributaries***
- ***Minor distributaries***
- ***Water course***

16.2 *GUIDELINES FOR ALIGNING A CANAL*

- ***The alignment should be straight and follow a falling contour and shall be in cutting.***
- ***The depth of the cutting should be minimum.***
- ***Curve should be long, minimum radius should be twenty times the bed width of the canal.***
- ***Number of cross drainage works should be minimum.***
- ***Longitudinal slope of the canal bed should provide non – silting and non – scoring velocity of flow.***
- ***Alignment shall progress as far away from natural drain to yield large command area.***

16.2.1 LONGITUDINAL SLOPE FOR CANAL

Longitudinal slope for canal shall be as far as a possible guided by minimum permissible velocity in the channel which should neither be silting nor scoring. The value generally varies from 1 in 2000 to 1 in 3000. It depends on the natural terrain and type of the canal.

16.2.2 SIDE SLOPE OF THE CANAL

Side slope of the canal is an important feature in canal generally steeper slope section, narrower, deeper, increased velocity and discharge permits width. It also decreases evaporation and percolation loses. Side slope in filling is 1.5:1 is generally used in hard and rocky soils.

16.3 TYPES OF CANAL CROSS- SECTIONS

- *Fully embankment.*
- *Partial cutting and partial filling.*
- *Fully cutting*

16.4 LINING OF CANAL

The impervious layer which protects the beds and sides of the canal is called as canal lining.

16.4.1 NECESSITY OF CANAL LINING

Following are the necessity of the canal lining

- *To minimize the seepage loses in the canal.*
- *To increase the discharge in canal section by increasing the velocity.*
- *To prevent erosion of the bed and sides due to high velocity.*
- *To reduce maintenance of canal.*

17.4.2 REQUIREMENT OF CANAL LINING MATERIALS

- *The materials used for lining should provide the water tightness.*
- *The materials chosen should be strong and durable.*
- *The materials should withstand the high velocity.*
- *The material used should be able to resist the growth of weeds and attack of animals.*
- *The material should permit the construction of the required slope easily.*

16.4.3 TYPES OF CANAL LINING

- *Cement concrete lining.*
- *Brick lining.*
- *Cement mortar lining.*

- ***Asphaltic lining.***
- ***Soil - cement lining.***
- ***Sodium - carbonate lining.***
- ***Precast concrete block lining.***

16.5 SILTING OF CANAL

Silt, if allowed into the canal, causes much annoyance and expense. Instances are not rare, where the silt, carried into the canal during high floods, depleted its capacity, so that it could not carry the water needed for irrigation. Therefore, it became necessary to close the canal and clean it during the height of irrigation season at great expense and injury to the crops. Hence measures should be adopted to prevent the entrance of silt and sand into the canal.

Silt is of two classes namely,

- ***Bed silt which is also called the dragged or rolled silt.***
- ***Suspended silt.***

The nature of the silt depends upon the

- ***The topography of the area***
- ***Rainfall***

Silt must be prevented as far as possible from entering into the canal, but it is impracticable to do so, measures should be adopted to remove the same from the canal.

16.5.1 FOLLOWING ARE THE MEASURES ADOPTED TO REMOVE THE SILT

- ***When the canal is not carrying the water, the silt is removed by the manual labor.***
- ***Silt is removed by increasing the velocity of the water.***
- ***Using dredges silt is removed.***
- ***Silt entry into the canal can be prevented by the "silt excluder"***
- ***"Silt ejector" is used to remove the silt that has entered into the canal.***

17.0 CAPACITY OF RESERVIOR

Area of the contour at D.S.L (901.68 m) A1 = 1072 m^2

V1 = Volume water stored in D.S.L = 1072*1 = 1072m^3

Area of contour at F.T.L (911m) A2 = 3902.1 m^2

V2 ***= Volume of water stored between D.S.L and F.T.L***
= Difference in elevation b/w D.S.L and F.T.L x (A2 – A1)
= 2*2830.1
= 5600.2 m^3

Area of contour at M.W.L (912m) A3 = 4305 m^2

V3 = Volume of water stored between F.T.L and M.W.L
= Difference in elevation b/w M.W.L and F.T.L x (A3 – A2)
= 1 x (4305 – 3902.1)
= 402.9 m^3

Area of contour at TBL (913m) = 6456 m^2 V4 = Vol of water b/w MWL & TBL
= 0.5V(6456 – 4305) = 0.5(2151) = 1075.5m^3

- ***Total Capacity of Reservoir = V2+ V3 = 63315 + 7138.6 m^3 = 0.7138 Hectare –m***

18.0 DESIGN BUND WIDTH

1) BUND WIDTH

Assume catchment area, A = 2km^2
Maximum storage capacity = TBL-BL
z = 913-901.68
= 11.32m

For top bund width, using
b = 0.55z^1/2 + 0.2z [Since our dam height is <30m]
b=0.55(11.32^1/2) + 0.2(11.32)
b=4.11m.

4.11 is very less, as per code book , the minimum width of the bund should not be less than 6m.
Therefore, b = 6m.

CALCULATION OF YIELD AT SITE

Rainfall intensity = 143mm.
Catchment area = 2km^2.
Bad rainfall intensity = 2/3(143)
= 95.33mm.
Runoff coefficient = 15-20% of bad rainfall intensity
= 20*95.33/100
= 19.06mm.

Yield on total catchment area = (19.06*2*10^6)/100

= 0.38 * 10^6 m^2.

LOSS OF WATER

1} Convenience loss = 15%

2} Evaporation loss = 20%

Therefore, Volume of water available for irrigation = 75% of yield
= 75*0381*10^4
= 2.8*10^5m^3.

Assuming a demand of 200 hectres must be irrigated = (200*2.8*10^5)/10^6
= 56 hectres

Assuming a duty of 45 hectres per cubic metre.
Hence, Discharge = Area/Duty
= 56/45
= 1.24 m^3/s.

DESIGN OF WASTE WEIR

Q = CM^2/3 , M = Catchment area
C = Ryve's constant

Consider C = 10.
Q = 15.87 m^3/s

1} LENGTH OF THE WEIR
L = 3/2 (Q/Cd sqrt(2gh^2/3)) , Cd = Coefficient of Discharge
= 0.6
h = head over weir
= 912 – 911 (MWL - FTL)

L = 8.957m.
For safety conditions lets provide L = 10m.

Provide Dam stones of size 0.2m*0.2m at 1m c/c.
Number of dam stones required = 10-1
= 9.
Therefore, total length of the waste weir = 10+(9*0.2)
= 11.8m.

2} Design of Width of the Weir

i) Top Width

a = 0.55(sqrt(H) + sqrt(h)) , H = FTL – BL
= 911 – 900.69
= 10.31m.

a = 2.31m.

ii) Bottom Width

b = (H+h)/(sqrt(ρ-1)) , ρ = specific gravity of mason work (varies in range 2.4 – 2.6)
= (10.31+1)/(sqrt (2.5-1))
= 9.234m.

DESIGN OF SLUICE

Assume, Gross Commanded Area = 17327.24 hectares
Culturally Commanded Area = 2400 hectares
RAGI = 0.416 m^3/sec VEGETABLES = 0.246 m^3/sec
Total Discharge Q = 0.416+0.246 = 0.662 m^3/sec
Assuming, time factor = 0.7

Total discharge to which canal is to be designed
= 0.662 + (0.7*0.662) = 1.1254 m^3/s

Assuming discharge through large rectangular orifice for sluice,
We have discharge
Q= 2/3 x Cd x b x √2g *[H3/2-h3/2]
1.12 = 2/3(0.62*1*√2*9.81
*[17.363/2 –h3/2] h^3/2= 71.71 h =
17.28 m
Depth of orifice (d) = H - h = 17.36 – 17. 26 = 0.10 m

DESIGN OF CANAL

Let us adopt **KENNEDY'S METHOD** for design of canal.

Assume,

M=critical velocity ratio=1
B/D=2
S=Bed slope=1 in 1000
Side slope=0.5 H:1 V
N=0.0225
Q=1.13m^3/s
We have,

Area(A)= D (B +n*D) = DB+nD^2 =DB +0.5D^2
Q=A*V
1.13= (DB+0.5D^2) * (0.55*m*$Y^{0.64}$)
= ((D*2D) + (D^2/2)) * (0.55 *1 *$D^{0.64}$)

$= (2D^2+0.5D^2) * (0.55*D^{0.64})$
$=2.5D^2*0.55D^{0.64}$
$=1.375D^{2.64}$

D = 0.928m, B = 1.857m
A = D (B +n D)
$= (0.928)(1.857+(0.928/2))$
$=2.154m^2$

$P = B+2D\sqrt{1+n^2}$
$= (1.857) + (2*0.928) * (1+0.5^2)^{0.5}$
$=3.932m$

$V = V_0 = 0.55*m*Y^{0.64} = 0.524m/s$

Hydraulic Mean Depth (R) = (A/P) = (2.154/3.392) = 0.5478m We have
From KUTTER'S Equation.

$$V=\frac{\left(\frac{1}{N}\right) + (23+\frac{0.00155}{S})}{(1+\frac{(23+\frac{0.00155}{S})}{\sqrt{R}})}\sqrt{(R*S)}$$

Where,

N = Co-efficient of Rugosity. S= Bed Slope = 1 in 1000m R = Hydraulic Mean Depth in m

$\frac{1}{0225}\frac{1}{1000}V= \times (1.047)^{\frac{2}{3}} \times (\ )^{\frac{1}{2}}$ = **1.449 m/s**

19.0 DESIGN OF CANAL LINING

Let us use cement concrete for lining for the length of 600.00m

Therefore,

The total quantity of the cement concrete required for canal lining

Q = $\boldsymbol{L} \times \boldsymbol{W} \times \boldsymbol{T}$×W×T

Thickness of the lining =

0.10m W= Wetted perimeter

= 3.932m
L=Length of lining = 600m

Q=600 × 0.10 × 3.93200×0.10×3.932

Q=235.92m²

20.0 ESTIMATION

- Excavator
  Works at a rate of 40 cubic meter per hour, & costs about 800rs per hour
  Therefore, 68295/40 = 1707hrs
  Cost = 1707*800 = Rs 13,65,900
- Tractor
  Carries a capacity of 7.65 cubic meters, & costs about 600Rs per hour
  Assuming tractors works for 2 loads per hour,
  Quantity per hour is 2*7.65= 15.3 m^3
  Therefore, 68295/15.3 = 4463 Hrs
  Cost = 4463*600 = Rs 26,78,247

- Leveller
  Working for 3 days with 2 levellers, @6000Rs per Day,
  Therefore,
  Cost= 6*6000= Rs 36,000

- Road Roller
  Working for 3 days with 2 levellers, @5000 Rs per Day,
  5000*6=30000Rs
  Total cost = 4110182.2Rs
  Adding 10% as misc. charges, = 4110182.2*10/100 +4110182.2 = 4521200.42
  Final Cost = Rs 45,21,500

20.1 DETAILS OF PROPOSAL

- ***SITEPLACE : KAIVARA***
- ***NATURE : NEW TANK PROJECT***
- ***TYPE OF BUND : EARTHERN BUND WITH PUDDLE CORE WALL***

1. *STORAGE RESERVIOR*

- ***CATCHMENT AREA OF TANK : 2 Km² (Assumed)***
- ***AREA TO BE IRRIGATED : 200 HECTARES***
- ***CROPS GROWN : MAIZE, PADDY, RAGI***

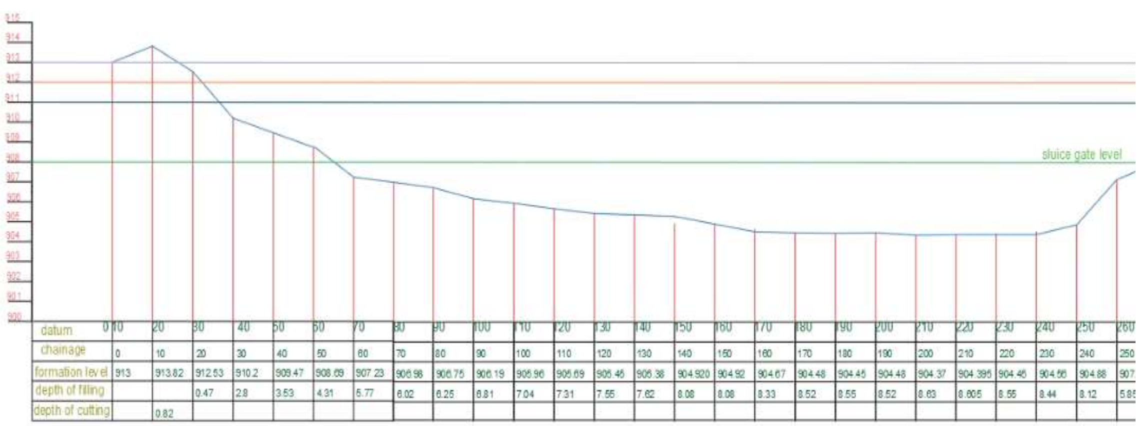
2. <u>BUND</u>

- ***TYPE OF BUND*** ***: ZONED EMBAKMENT***
- ***LENGTH OF BUND*** ***: 280 m***
- ***TOP BUND LEVEL*** ***: 913.0m***
- ***MAXIMUM WATER LEVEL (M.W.L) : 912.0 m***
- ***FULL TANK LEVEL (F.T.L)*** ***: 911.0 m***
- ***SLUICE LEVEL*** ***: 908.0m***
- ***TOP WIDTH*** ***: 2.31 m***
- ***UPSTREAM SLOPE*** ***: 1.5 : 1***
- ***DOWN STREAM SLOPE*** ***: 2 : 1***
- ***ROCK TOE*** ***: D/S BLANKET***
- ***U/S PITCHING*** ***: 30cm THICK STONE REVETMENT***

3. <u>MAIN CHANNEL</u>

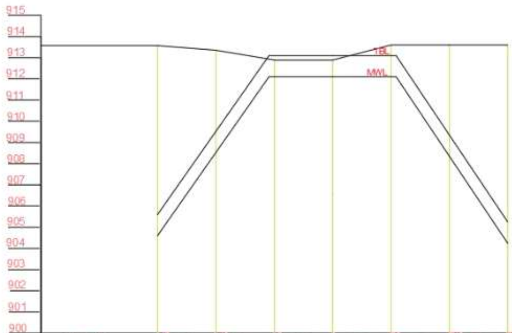
- ***BED SLOPE*** ***: 1 in 4500***
- ***BOTTOM WIDTH*** ***: 4.80 m***
- ***DEPTH*** ***: 1.50 m***
- ***SIDE SLOPE*** ***: 1 : 1***
- ***TYPE OF SLUICE*** ***: PLUG SLUICE***
- ***LENGTH*** ***: 266m.***

LONGITUDINAL SECTION OF BUND



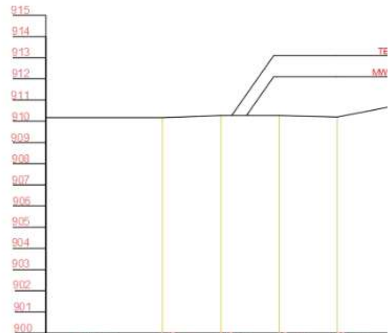
LS of NTP

CROSS SECTION OF BUND



datum	900	900	900	900	900	900	900
RL	912.68	913.57	913.35	912.89	913.6	913.64	913.62
formation level							
depth of filling							
depth of cutting							

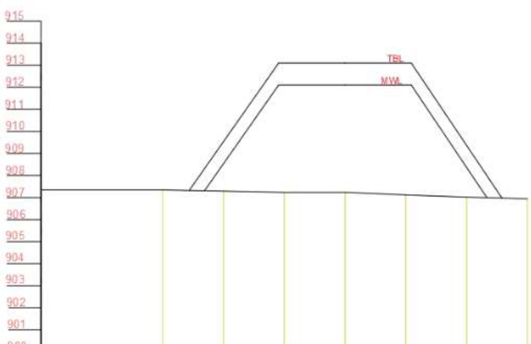
CS at 0m



datum	900	900	900	900
RL	910.10	910.17	910.27	910.20
formation level				
depth of filling				
depth of cutting				

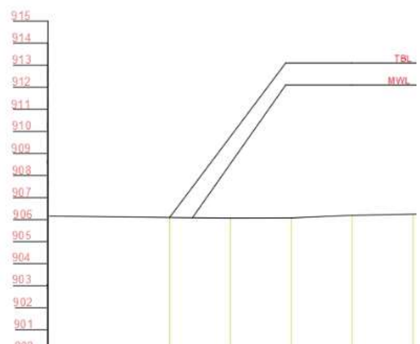
CS at 30m

CROSS SECTION OF BUND(NTP)



datum	900	900	900	900	900	900	900
RL	907.49	907.34	907.29	907.23	907.11	907.01	906.94
formation level							
depth of filling							
depth of cutting							

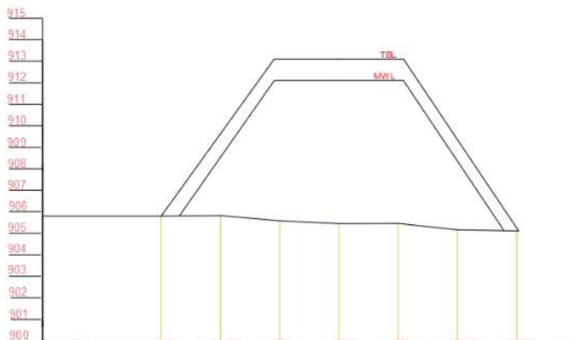
CS at 60m



datum	900	900	900	900
RL	906.09	906.06	906.07	906.19
formation level				
depth of filling				
depth of cutting				

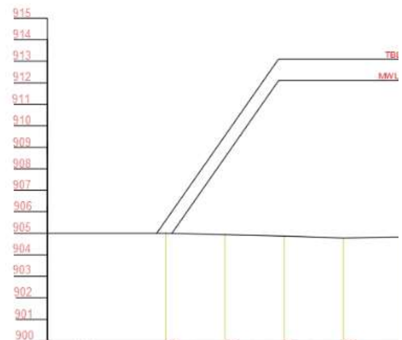
CS at 90m

CROSS SECTION OF BUND(NTI



datum	900	900	900	900	900	900	900
RL	905.80	905.82	905.58	905.45	905.46	905.16	905.11
formation level							
depth of filling							
depth of cutting							

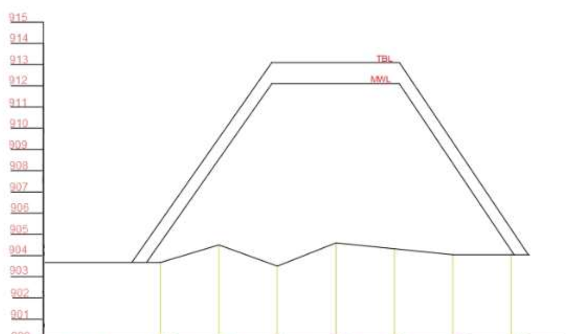
CS at 120m



datum	900	900	900	900
RL	905.00	904.94	904.87	904.79
formation level				
depth of filling				
depth of cutting				

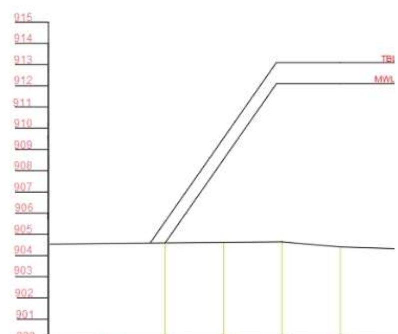
CS at 150m

CROSS SECTION OF BUND(NTI



datum	900	900	900	900	900	900	900
RL	903.67	904.50	903.50	904.60	904.32	904.04	904.04
formation level							
depth of filling							
depth of cutting							

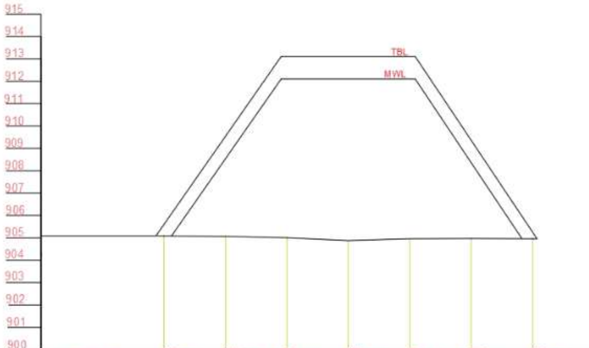
CS at 180m



datum	900	900	900	900
RL	904.60	904.62	904.64	904.40
formation level				
depth of filling				
depth of cutting				

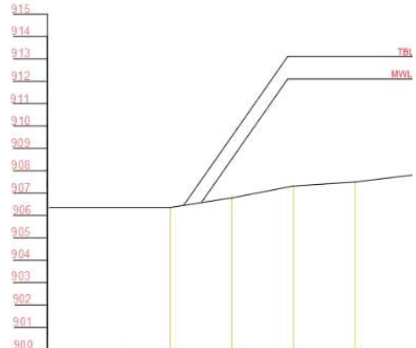
CS at 210m

CROSS SECTION OF BUND(NTP



datum	900	900	900	900	900	900	900
RL	905.09	905.07	905.01	904.88	904.96	904.97	904.96
formation level							
depth of filling							
depth of cutting							

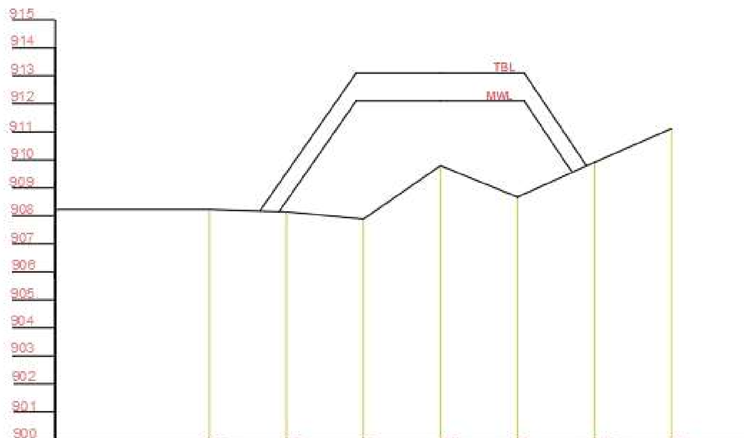
CS at 240m



datum	900	900	900	900
RL	906.36	906.79	907.315	907.50
formation level				
depth of filling				
depth of cutting				

CS at 270m

CROSS SECTION OF BUND(NTP

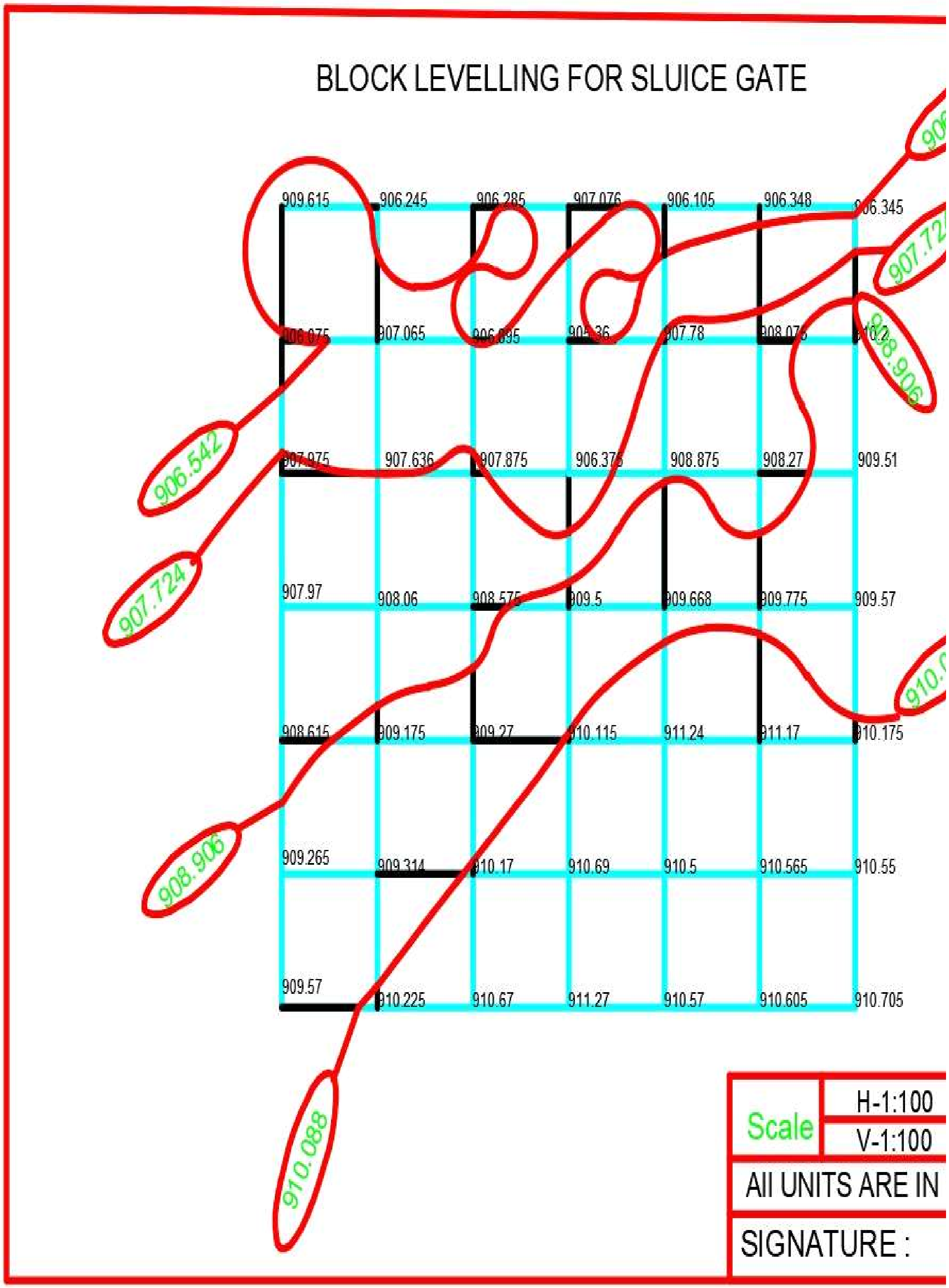


datum	900	900	900	900	900	900	900
RL	908.23	908.14	907.89	909.79	908.67	909.91	911.13
formation level							
depth of filling							
depth of cutting							

CS at 290m

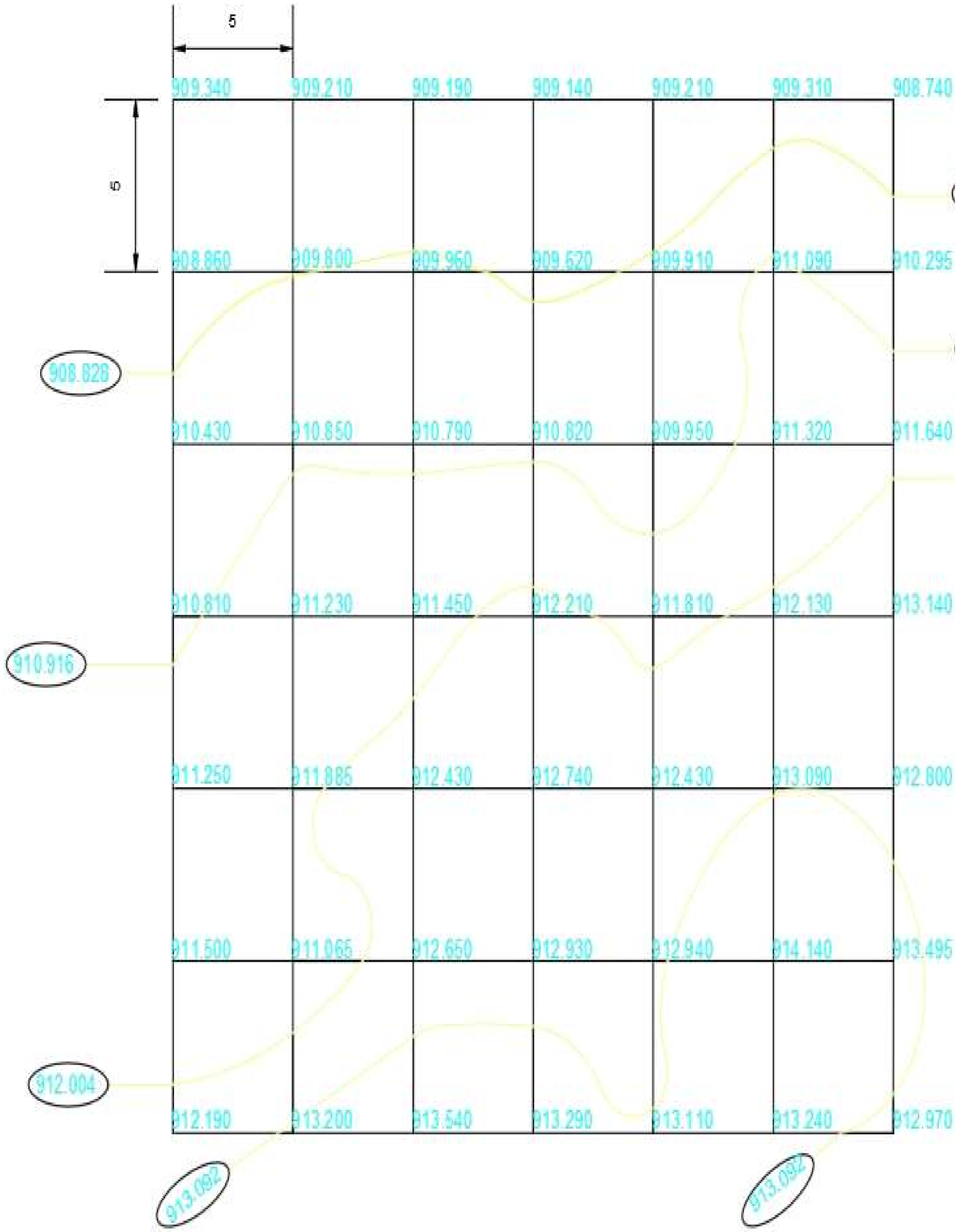
CROSS SECTION OF BUND(I

BLOCK LEVELLING AT SLUICE GATE



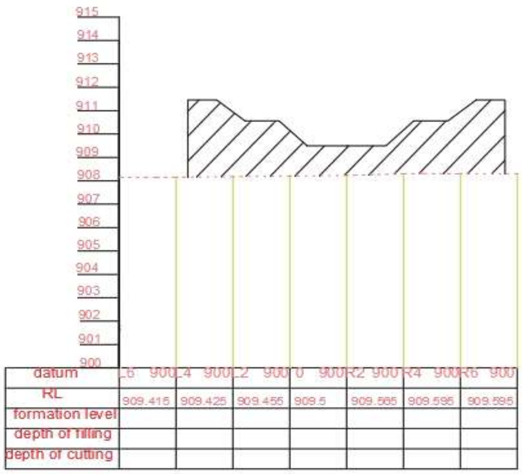
BLOCK LEVELLING FOR SLUICE GATE
909.615
906.245
906.105
906.348
907.065
907.78
907.636
907.875
908.875
908.27
909.51
906.542
907.724
907.97
908.06
909.5
909.668
909.775
909.57
909.175
910.115
911.24
911.17
910.175
908.906
909.265
910.17
910.69
910.5
910.565
910.55
909.57
910.225
910.67
911.27
910.57
910.605
910.705
910.088
Scale
H-1:100
V-1:100
All UNITS ARE IN
SIGNATURE :

BLOCK LEVELLING AT WASTE WEIR

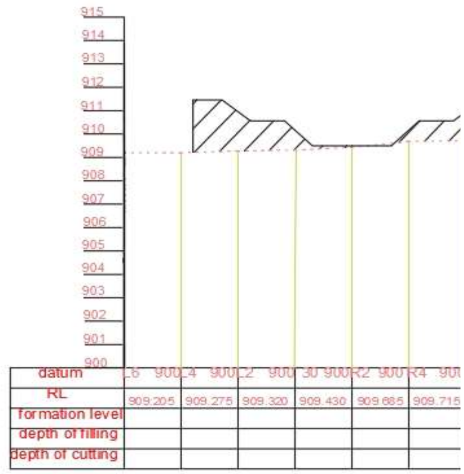


LONGITUDINAL SECTION FOR CANAL

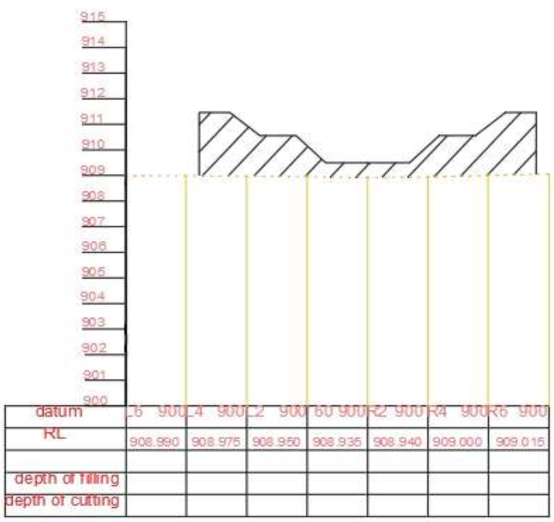
CROSS SECTION FOR CANAL



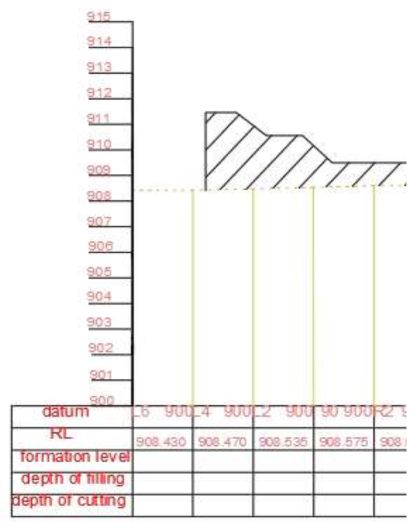
CS at 0m



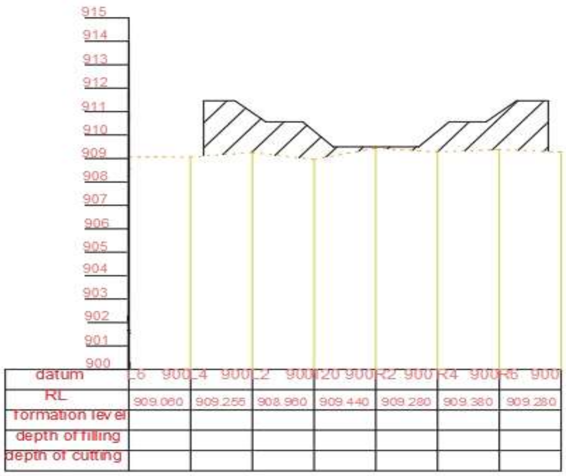
CS at 30m



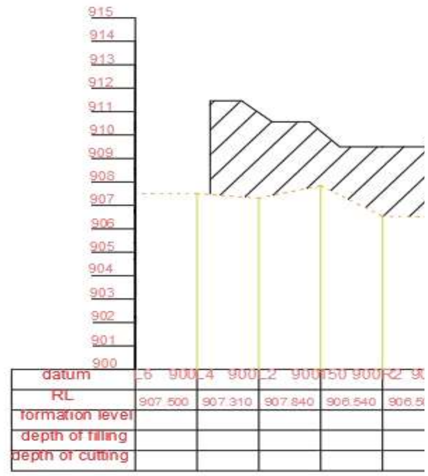
CS at 60m



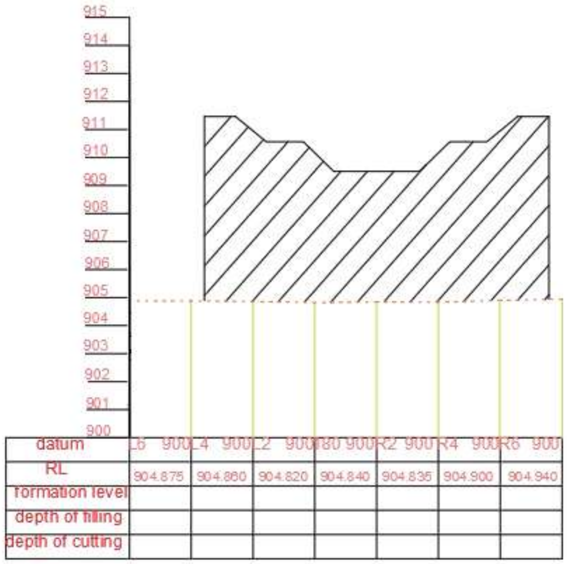
CS at 90m



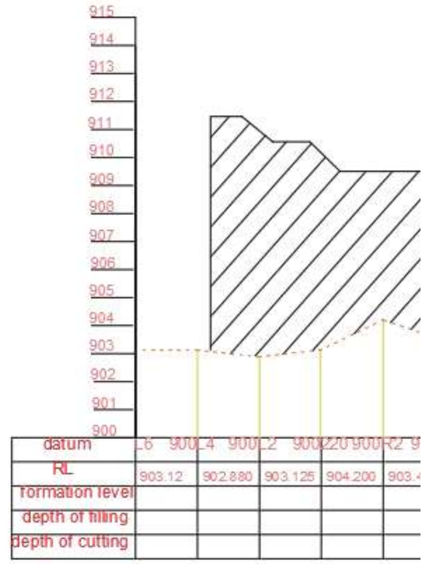
CS at 120m



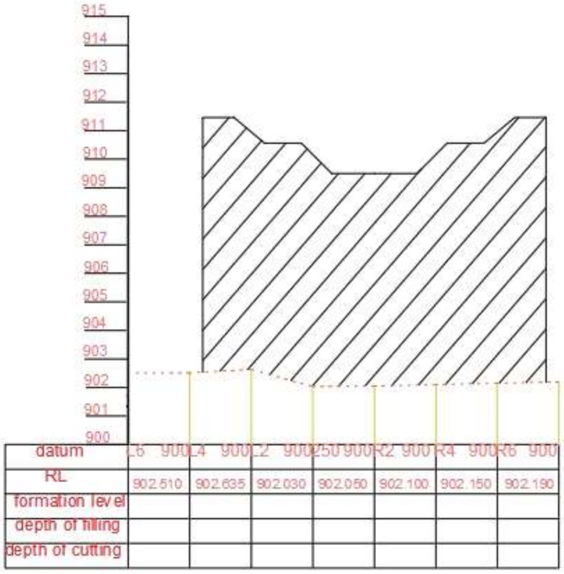
CS at 150m



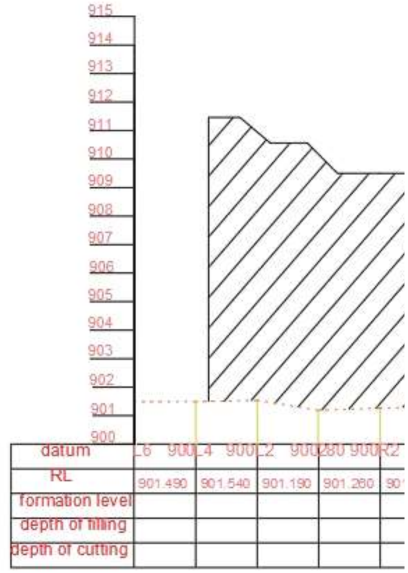
CS at 180m



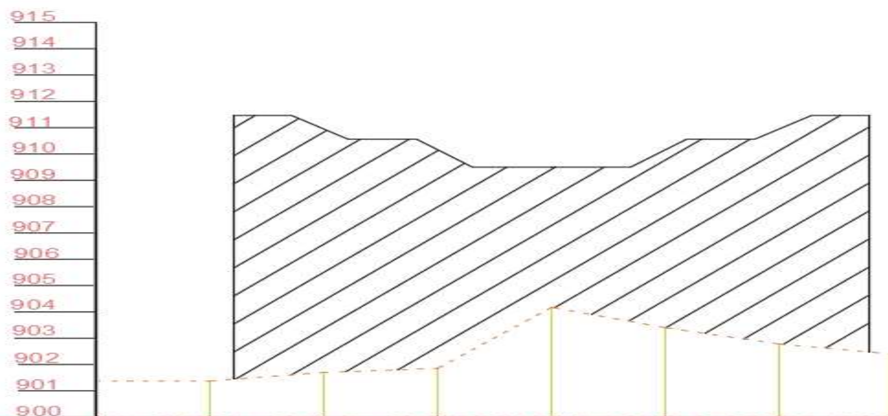
CS at 220m



CS at 250m



CS at 280m



datum	L6 900	L4 900	L2 900	310 900	R2 900	R4 900	R6 900
RL	901.370	901.700	901.850	904.170	903.400	902.780	902.395
formation level							
depth of filling							
depth of cutting							

CS at 310m

OLD TANK

PROJECT

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 AIM OF THE PROJECT

- To increase the capacity of the tank
- To strengthen the existing bund
- To increase the effectiveness of the sluice and the waste weir

The storage irrigation that utilizes the water stored on upstream side of smaller earthen dam called bund. Earthen bund which retains water is called tank. A large sized tank will be termed as reservoir. This may be formed by the materials such as masonry dams, concrete dams and earthen dams whereas the tank is formed by means of earthen bunds only. The tanks are meant for storing water in it during the raining season due to the surface runoff of a large amount of silt will be deposited in to the tanks hence it will reduce the capacity of tank. This reduce capacity of tank may be improved by removing the deposited silt from the tank (restoration) or sometimes due to the bad maintenance the existing slope of the bund may get deteriorated: for this the increasing the bund height should be done. So that the slope maybe retained and hence increase in the storage capacity of reservoir.

- **EARTHEN BUNDS:**

Earthen bund is a main barrier across the valley and stream bed. To store water in the tank. For small tanks, the height of the bund may be around 3 to 5 meters.

- **NECESSITY OF THE RESTORATION TANK**

Bunds would have been constructed across minor streams in order to facilitate collection and storage of water to be used for irrigation at a later stage, these tanks would have been silted or sluice would have become leaky or blocked due to silting or waste weir would have damaged or even worse. The abovementioned effects will have to be rectified and come under the restoration work of the tank. Restoring of these tanks involves bringing the tank to its original capacity either by taking measures to reduce silting or by raising the height of the embankment without disturbing the upstream slope.

The original capacity of tank can be increased by two ways they are as follows

- **RAISING FULL TANK LEVEL (FTL):**

Rising up to the full tank level of reservoir after making suitable modification in the profile of the existing tank bund and surplus weir.

- **DESILTING THE RESERVIOR:**

This would require the employment of sophisticated equipment such hydraulic dredges. Before taking up the project it is necessary to study whether the proposal would yield minimum cost to the original capacity of the reservoir and also to known the soil type in runoff zone.

1.5.1 PROCEDURE:

The field work includes

- Reconnaissance survey of the site,
- Fly leveling,
- Bund tracing,
- Longitudinal and cross section along line of the existing bund,
- Capacity contours at the existing and proposed full tank levels,
- Block leveling at the waste weir, • Detailing of the tank sluices,
- Sill level and its location.

1.5.2 RECONNAISSANCE SURVEY OF THE SITE:

- Studying the existing condition of the bund.
- Location of the tank sluices,
- Location of waste weir

1.6 LONGITUDINAL CROSS SECTION OF BUND:

The main objective of carrying out the longitudinal and cross section at the bund is determining the length of the bund, the area of the bund, and in turn to calculate the earth work quantities.

PROCEDURE:

- Initially on the center line of the bund arrows are fixed at regular interval.
- By taking the TBM (temporary bench mark) located on the bore well the leveling is done to find the RL of top of the bund.
- A point is fixed on the existing bund by the fly leveling.
- This point is considered as the 0 chainage of the bund
- Longitudinal levels along the center line of the bund are taken at every 5m interval and cross section is taken at the place of change the direction of the bund.
- Imported features such as location of any tree, stone, and sluices weir are noted.
- The cross section is taken on both side of the center line of the bund.
- Continue the procedure till the other end of the bund is reached.
- Last point of the existing build is also done parallel to fly leveling with the help of plane table and alidade.
- The cross section is taken on both side of the center line of the bund.
- Continue the procedure till the other end of the bund is reached.
- Last point should be located at some convenient distance from the existing bund.
- The plotting of the existing bund is also done parallel to fly levelling with the help of plane table and alidade.

1.7. CAUSES OF FAILURE OF EARTHEN DAMS:

The general causes for failure of earthen bunds are:

- Percolation
- Slipping of side slopes
- Overflow of toppling of the bund
- Erosion

1.7.1 PERLOCATION:

When the tank is full, water will seep through the bank forming a saturation gradient. If the bank section is not enough to keep the saturation gradient within the tank with sufficient overburden of soil, then the water seeps through the bank up to the saturation gradient will cut the outer slope of the bank. This will slowly work upstream causing failure of the bank.

The other failure is due to seepage under the bank due to porous nature of the foundation materials the percolating water through these porous channels under the bank will appear at the slope and slowly start removing soil particles coming in its path, which results in the formation of pipes.

1.7.2. PARTIAL CUTOFF:

A partial cut off is one which extends down from the impervious section of the dam to the underlying strata. In many cases, it would be impractical land and extremely expensive to continue the cut-off of the impervious layer and so the use of partial cut-off is considered necessary. Owing to the fact that the horizontal permeability may be the order 10 to 15 times the vertical, the effect of a partial cut-off trench is excavated to half the depth of the storage and is back filled and consolidated with impervious layer.

1.7.3. FAILURE BY SLIPPING OR SLIDING:

If the soil with which the bank is formed does not possess the necessary shear strength to withstand the super imposed height of the earth, then the earth will fail sliding. Thus failure may occur at the foundation is of poor nature and at the slopes. If the bank is formed with slopes at which they can be retained by combined friction and cohesion between the particles composing it. While forming banks higher than 10m, it is necessary to test the soils for their various parameters and test the foundation pressure also for bearing capacity.

1.7.4. FAILURE OF OVER-TOPPING:

This generally happens if insufficient free board is provided. In high gates, the wave will be generated high and if enough free board is not provided, the waves while riding along surface may clear the top. The height of the wave depends upon the water spread before the bund and the velocity of the wind. The wave as it approaches to smoothly ride up along the slope. If the slope is a flat one the height of the wave to which the wave ride along the slope will be greater than if the steep slope. The free board should be at least 1.5 times the wave height. If the free board is provided, wave breaks which are generally vertical stones fixed in the rip on the upstream slope in a zig-zag pattern, are also provided. This will help in breaking the waves as they move riding along the slope.

1.8. SALIENT FEATURES OF THE EARTH DAM:

1.8.1. Top width:

This must be wide enough to carry a roadway with enough carriage ways accommodate earth moving machinery to go over it in case of emergency.

1.8.2. Upstream slope:

This slope depends upon the height of the dam and is decided by the stability analysis of soils obtained at the site. Generally, it will be flatter than 0.2 horizontal to 1 vertical.

1.8.3. Bank section:

The main bank section may be homogeneous section or zonal, depending upon the soils available at the site. The section of the earthen dam will be large in case it has to be in a homogeneous section. The top of hearting zone will be taken up to maximum water level.

1.8.4. Cut-off:

In order to ensure that the dam does not fail due to percolation through its body an impervious cut-off, completely preventing seepage from upstream of the dam reaching the toe of the dam along the foundations, is an absolute necessity. The latest technique is to form reinforced cement concrete diaphragm wall, with its bottom well keyed the bed rock and top well keyed to the hearting zone.

1.8.5. Rear slope:

The rear slope of the dam will be flatter than the upstream side slope and will be protective from the surface gullying by turfing. The water that collects on the top of the dam will be lead down the rear slope by means of chute drains construction at intervals along the length of the dam.

1.8.6. Consolidation of Banks:

While forming earthen dams, enough care has to be taken in consolidating the layers of the earth so that the bank does not shrink in rainy season and allow water to percolate through. A weak zone in a tank is enough to endanger the entire bund, even if it is formed well enough. It is desirable that banks are consolidated at optimum moisture content with power rollers to get at least 98% Proctor's density. Moisture content more than the optimum will mean low shear value and less than optimum will increase pore pressure.

1.9. CAPACITY CONTOURS:

The main object of the capacity contours is to trace the contour to find the capacity of the tank and to fix the maximum water levels and sill levels.

Procedure:

- Taking the sill of water weir as benchmark, each contour is located by determining the position of a series of points through which the contour passes.
- The plane table is set up over a good commanding station where maximum points are available and the plane table is oriented.
- The plane table and the leveling instruments are provided as near as possible to each other so that the distance of the contour points to be measures by the principle of tacheometry and plotted on the plane table by method of radiation.
- The contours are plotted on the plane table and the capacity is determined by joining the points of contours.

1.10. BLOCK LEVELLING OF THE WASTE WEIR:

This is an indirect method of locating contours. Block levelling at the waste weir site is carried out to know the direction of flow of surplus water through the draft channel. It is carried out such that it covers the full length of the weir.

Procedure:

The instrument is setup at commanding position where maximum readings are available and all the reduced level of the station of the blocks are calculated. The contours of different elevations are plotted by interpolation.

2.0 RESTORATION OF AN EXISTING TANK

Description of the survey work

Instruments used

- Dumpy level
- Chains and tapes
- Compass and plane table with stand
- Ranging rods, pegs etc.

- **CAPACITY CONTOURING**

Capacity contours were plotted by the direct contouring using plane table and dumpy level. The live storage and dead storage were worked out by multiplying the contour area by the contour interval.

- **ALIGNMENT**

The earthen bund includes waste weir. Longitudinal section and cross section surveying is done in central and terminal ends. The length of bund is 570.00m.

- Name of the work and location: Restoration of an old tank at Kaiwara district, Karnataka.
- Date of commencement of work:

3. Date of completion of work:

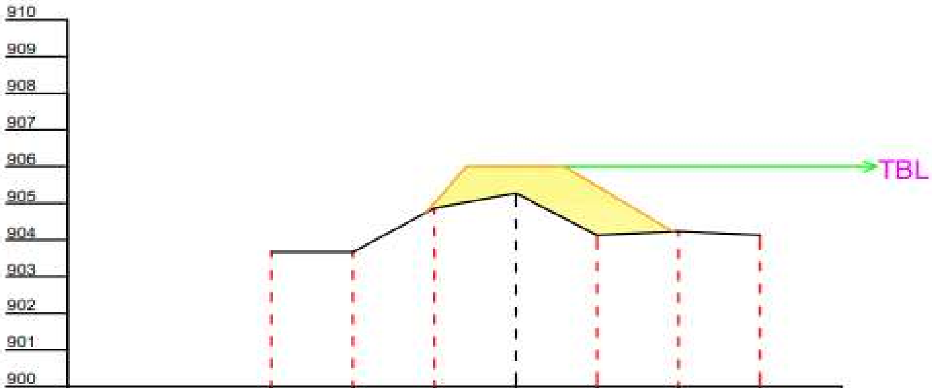
True capacity of water storage = Previous capacity - present capacity = silt deposit

2.3 RECORDS OF PREVIOUS M.I.TANK

- Catchment area
- Average annual rainfall
- Mean monsoon rainfall
- Type and length of dam
- R.L. of the F.S.L of the tank
- R.L. of outlet sill level
- R.L of tank
- R.L. of top of dam
- R.L of existing bed
- Maximum height of dam
- Gross storage including evaporation an absorption losses
- Storage between F.S.L and the lowest sill
- Type and length of the waste weir
- Number and length of irrigation canals
- Area under command
- Irrigable area
- Duty of water

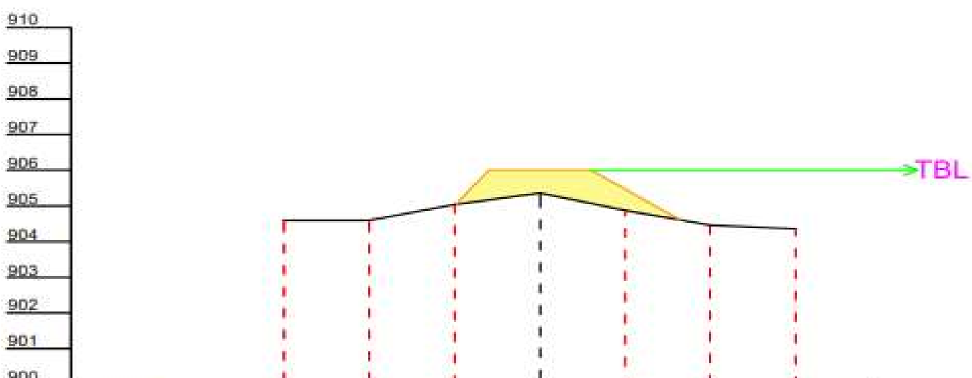
2.4. NECESSITY OF TANK RESTORATION

The primary purpose of an irrigation tank is to act as reliable source of water for agricultural uses. If within the design period of the tank, the command area is supposed to irrigate if not served, then the possible reason for this decrease in the capacity would be the deposition of silt at the basin of the tank rendering the tank unusable over a period of time. It is due to this reason that restoration of the tank is essential in order to maintain efficient operation of the tank.



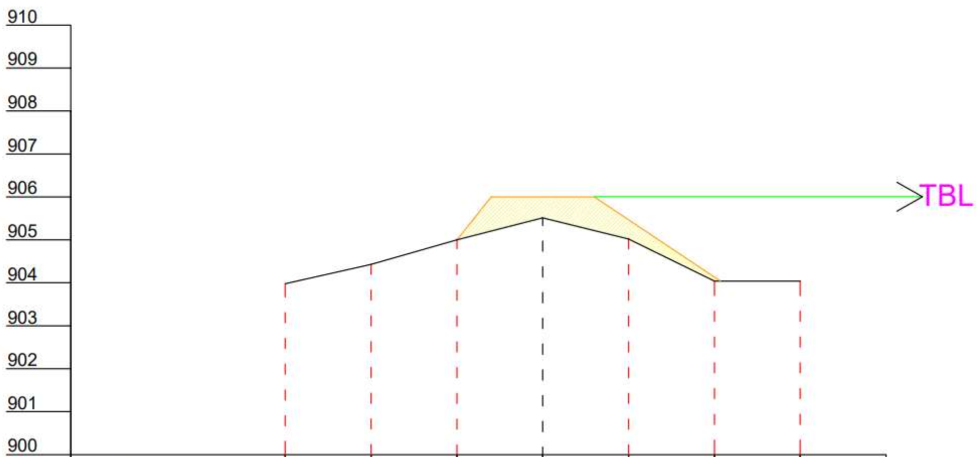
DATUM	900	900	900	900	900	900	900
RL	903.67	903.67	904.86	905.28	904.13	904.23	904.13
FORMATION LEVEL	904.7	905.7	906.51	907	906.55	905.8	905
DEPTH OF FILLING	1.03	2.03	1.65	1.72	2.42	1.57	0.87
DEPTH OF CUTTING							

90 M



DATUM	900	900	900	900	900	900	900
RL	904.6	904.6	905.04	905.36	904.87	904.46	904.36
FORMATION LEVEL	905.1	906	906.51	907	906.52	906.1	905.4
DEPTH OF FILLING	0.5	1.4	1.47	1.64	1.65	1.64	1.04
DEPTH OF CUTTING							

120 M



DATUM	900	900	900	900	900	900	900
RL	903.98	904.43	905.02	905.51	905.02	904.04	904.04
FORMATION LEVEL	904.8	905.8	906.53	907	906.7	906	905.2
DEPTH OF FILLING	0.82	1.37	1.51	1.49	1.5	1.96	1.16
DEPTH OF CUTTING							

30 M

SCALE

X-axis	1:25
Y-axis	1:10

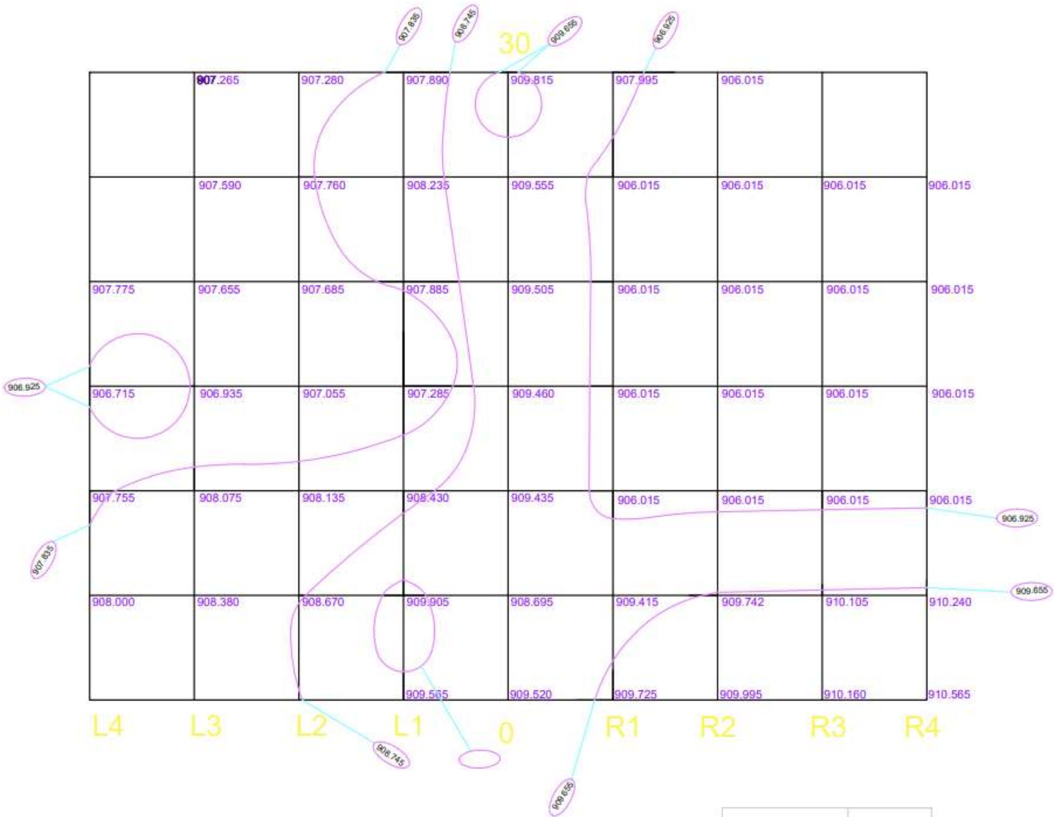
LONGITUDINAL SECTION OF OLD TANK PROJECT

DATUM	900	900	900	900	900	900	900	900	900
CHAINAGE	0	15	30	45	60	75	90	105	120
REDUCED LEVEL	905.52	905.37	905.51	905.47	905.38	905.35	905.28	905.25	905.36
FORMATION LEVEL	906	906	906	906	906	906	906	906	906
DEPTH OF FILLING	0.38	0.63	0.49	0.53	0.62	0.65	0.72	0.75	0.64
DEPTH OF CUTTING									

SCALE USED

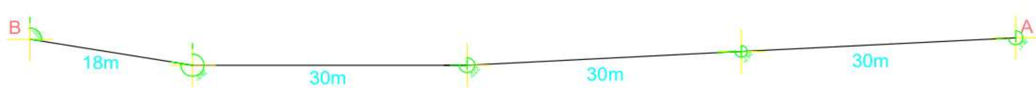
x-axis	1:200
Y-axis	1:50

SURPLUS WEIR BLOCK LEVELLING(OTP)



SCALE USED	1:100
UNITS USED	Mtr

OLD TANK ALIGNMENT



SCALE	1:100

VOLUME OF USEABLE WATER

We have,

Area of Dead Storage Level (DSL, A_1) = 58127m^2

Area of Full Tank Level (FTL, A_2) = 113972m^2

Area of Maximum Water Level (MWL, A_3) = 193757m^2

Now,

Volume of water stored between DSL and FTL = (FTL-DSL) * (A_2-A_1)

= (858.025 – 856.000) * (113972-58127)

= 113086m^3 ≈ 11.3 Hectare-meter

Volume of water stored between FTL and MWL = (FTL-MWL)*(A_3-A_2)

= (858.525-858.025)*(193757-113972)

= 39892m^3 ≈ 3.98 Hectare-meter

∴ Total Useable Water = 11.3 + 3.98 = **15.28 Hectare-meter**

DESIGN OF SLUICE

We know, the formula for discharge through a circular opening,

$$Q = C_d * a * \sqrt{(2 * g * h)}$$

Where, $Q = 1.13\ m^3/s$, $g = 9.81\ m/s^2$, $h = 0.5m$ and $C_d = 0.6$ Now,

$1.13 = 0.6 * a * \sqrt{(2 * 9.81 * 0.5)}$ ∴ a =

$0.27\ m^2$

We know that, area of a circle = $\pi d^2/4$

$0.27 = \pi d^2/4$

∴ $d = 0.59m \approx 0.6m$

Hence, provide a sluice with diameter of opening **0.6m** or **60cm.**

AREA BY PRISMOIDAL RULE

FILLING

V= (h/3) * {(A1 + An) + 4(A2 + A4 + A6+...) +2(A3+A5+A7...)}

=30/3[(31.280+3.43)+4(13.31+11.29+2.177+10.257+5.29+8.23+7.730+2.3)+2(10.8+7.55+11.12 +11.544+5.760+3.740+2.18)]

=3824.34 m^3

CUTTING

V = (h/3) *{(A1 + An) + 4(A2 + A4 + A6+.......) +2(A3+A5+A7.....)}

=30/3{(0+0.25)+4(0.033+2.3035+0.85)+2(1.26))} =

143.16 m^3

ESTIMATION

FILLING

Total Volume = 3824.34m^3

- Excavator

Works at a rate of 40 cubic meter per hour, & costs about Rs800 per hour Therefore, 3824.34/40 = 96hrs

Cost = 96*800 = Rs 76,800

- Tractor

Carries a capacity of 7.65 cubic meters, & costs about Rs600 per hour

Assuming tractors works for 2 loads per hour,

Quantity per hour is 2*7.65= 15.3 m^3

Therefore, 3824.34/15.3 = 250 Hrs

Cost = 250*600 = Rs 1,50,000

- Leveller

Works at a rate of 150 cubic meters per hour, & costs about Rs800 per hour, Therefore, 3824.34/150 = 25.5 Hrs

Cost= 25.5*800 = Rs 20,400

- Road Roller

Assuming it works for 10 hrs at the rate of Rs500 per hour,

500*10=Rs5000

Total cost = Rs 2,52,200

Adding 10% as misc. charges, = 2,52,200*10/100 +2,52,200= 277420

Final Cost = Rs 2,77,420

CUTTING

Total Volume = 143.16m^3

- Excavator

Works at a rate of 40 cubic meter per hour, & costs about Rs800 per hour Therefore, 143.16/40 = 3.5hrs

Cost = 3.5*800 = Rs 2.800

- Tractor

Carries a capacity of 7.65 cubic meters, & costs about Rs600 per hour

Assuming tractors works for 2 loads per hour,

Quantity per hour is 2*7.65= 15.3 m^3

Therefore, 143.16/15.3 = 9.35 Hrs

Cost = 9.35*600 = Rs 5,610

- Leveller

Works at a rate of 150 cubic meters per hour, & costs about Rs800 per hour, Therefore, 143.16/150 = 1 Hrs

Cost= 1*800 = Rs 800

- Road Roller

Assuming it works for 10 hrs at the rate of 500Rs per hour,

500*10=Rs 5,000

Total cost = Rs 14,210

Adding 10% as misc. charges, = 14,210*10/100 +14,210= 15631

Final Cost = Rs 15,631