(3)

Tunnels Full unit

Tunnels:

3/08/2011

Tunnel is generally a under ground passage that is excavated through a rock or soil or both for uninterupted passage of traffic, water, minerals and other materials

It is generally opened at both ends to the surface.

Types of Tunnels:

1. Ground or tunnel ground:

The material through which tunnel is to be driven is known as ground or tunnel ground.

The excavated material is called muck/tailing ground can be soft ground or hard ground soil is considered as soft rock that other rocks considered as hard rock.

Soft rock: This is divided into four types

1. Running ground: Gravel and coarse sand are known as Running ground

2. Flowing ground:

Wet soil is known as flowing ground

3. Sweezing ground:

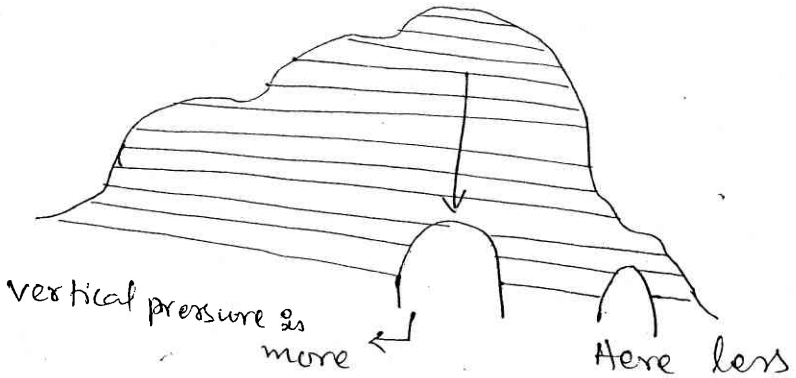
This has less moisture ~~is~~ than tunnel because of clayi soil flowing ground.

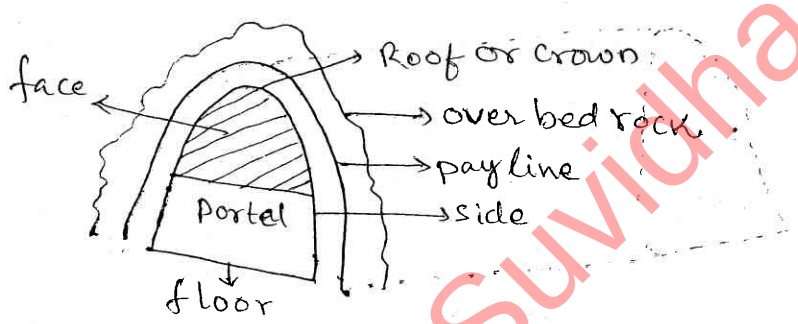
4. Swelling ground:

This swells into the tunnel because of clayi soil

Rocky ground and hard ground:

All the rocks that are campact are called hard ground or rocky ground.





Terminology of the tunnel:

If top of the tunnel is known as "roof"

The entrance of the tunnel "portel"

The walls of the tunnel "sides"

The bottom of tunnels is called floor

The portion or the surface that is exposed at the end of the tunnel that is to be farther tunnel is called "face"

The circumtances of the tunnel is called "perimeter"

Overbreak: Shortering of the rock beyond the perimeter are the payline

Shoft: vertical well like structure that goes into the tunnel

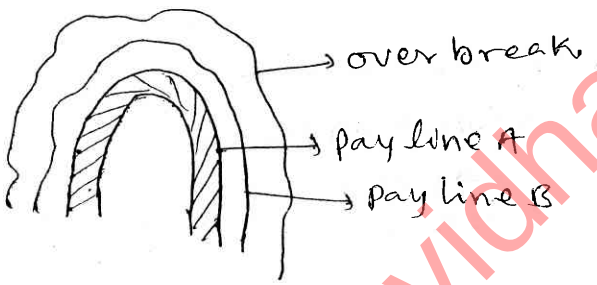
Payline: This is a commercial term in tunnels there are two types of paylines.

Pay line A

Pay line B

Payline A: Payline A is a line minimum concrete require.

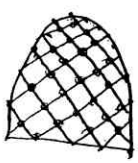
Payline B: is outer line between payline A and over break



Method of Tunnels:

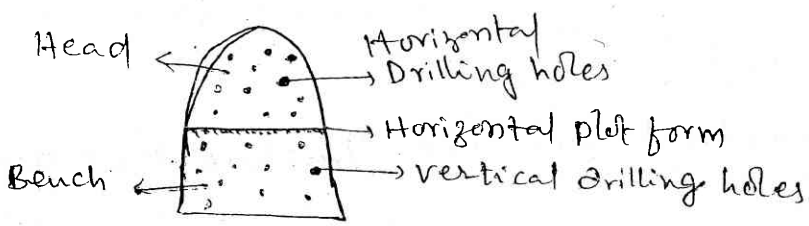
1. Full face method:

In this method the whole cross section of the tunnel is blasted at time



② Heading and bench method:

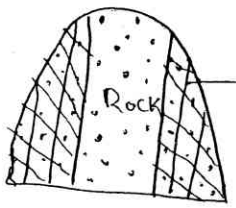
Heading is known as widths of the tunnel bench is the working platform both are charged but bench is blasted first.



In another case heading is remove in one operation on the bench in the second operation in the case of bench (1) vertical holes are drill for the purpose of economy

(3). Side drift method:

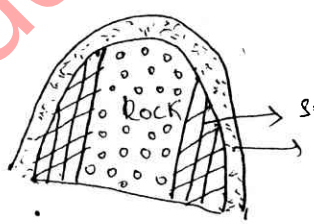
This is done in the case of big tunnels side and drift are driven first and supports are given to prevent any damage before blasting the centre portion supports are remove and the central portion is blasted this method is followed in the rocks that as poor ~~strenk~~ strength.



(4) ~~Mu~~ul multiple drift method:

· In this more than two sides drift are used

The other parameters are same as in the case of side drift method.



In all the these methods the gap between support on the rock should be grouted

Grouting: is a process in which RCC is injected in to the space and the pressure.

Geological report for tunnels:

In addition to normal Geotechnical investigation (GTI) Any geological report in the case of tunnels should have the following aspects in detail

1. Ground:

The characteristic feature of the ground that is soft ground or hard ground has to be brought out clearly

If it is soft ground the nature of the soft ground should be highlited.

Nature of the soft ground:

Geological profile from the begining of the tunnel to the end of the tunnel should be drawn as the tunnel is exicuted the tunnel mapping should be done.

Cross Section of the tunnels

In the geological mapping of the tunnel that are exicuted The sides of tunnel mapped seperately and roof separately This is done on a given scale.

Structural features:

All the structural features especially faults have to be highlited

This is essential as grouting has to be done along the fault plane other wise there will be continuous stipage of material from the fault zone

The other structural features like joints, shears, fractures. have to be mapping detail because these are the weak zone that may creat problem

The Ground water condition:-

If ground water condition that is the depth at which the water table occurring also has to be indicated in the report.

The fluctuations also should be given

Geophysical ~~is~~ investigation:

Gravity and resistivity have been carried out to find out structural features like faulting highly jointed structure zone or the weather zone.

The depth bed rock below the soil cover need to be establish

Nature of the rock in respect of RQD has to be establish

Problems in tunnels:

The main problem in the tunnel is the pressure that act especially on tunnel linings.

Heaving:

Heaving (slightly rock expansion) of the rocks in that when certain amount of rock is remove. either by carring or any other means the remaining portion of the rock will slightely come up or swell

This process is known as heaving

In tunneling and canal cuttings heaving is common

In the soft ground the vertical pressure and the horizontal pressure should be take care of

If the tunnel is for transport of water it creats more problem

In the other tunnel also water is the main problem in terms of leakage.

The leakedout water drifts along the wall of canal to the floor

on the floor small channels are made that's help in driven the water

Some times pumps and walls are used to drain the water out and decrease the pressure

The ground water also causes problem especially when the ground is softy nature

The rise in the water table may help the water getting in to the tunnel.

Provision has to be make for making the floor strong enough and also the drain the water. that gets collected inside the tunnel flow.

Tunnel / Civil unit

Geology

20/07/2011

Engineering Geology:

Any engineering project should have a detail a account of all the geotechequnical information of the entire area.

Infact the investigation that will be carried out will be similar to all the engineering project with slight modification depending upon the type of project that will be carried out.

It is mandatory to carried out detail geological investigation before the commencement of any engineering project

Geotechnical investigation involves.

1. Lithology.
2. Structure
3. Ground water condition
4. Seismisity of the area.

Lithology:

This involves lithological association the terrain where the engineering structure is likely to come is constituted for igneous rock like granite then they rock should be studied for its association of dykes gneisses etc.

the contact between two lithological units is important has it represents a weak zone

Metamorphic rocks:

The schistosity and gneissosity should studied carefully and intensity of these two is an important factor

The lithological association of different metamorphic rock should be noticed carefully

Sedimentary rocks:

These rocks varying in the competency that plays a major role in any engineering project

Association is different sedimentary rock is important in geotechnical investigation.

Nature of the rock:

21/07/2014

Rocks can be basically classified into hard and shaft rocks

This is done irrespect of the rock been sedimentary, igneous or metamorphic

Any hard rock one is subjected to weathering it becomes shaft. Hence degree of weathering is yet another property that is very important in the geotechnical investigation

Engineering properties of rocks

These are hardness, Tensile strength, Compressive Strength, Shear strength, density, porosity and permeability

The strength of any rock depends upon its capacity is bare are with stand the pressure applied on it

The crushing strength is related to the resistance offered by rock to the pressure generally rocks having higher crushing strengths are used as road metal

Shearing strength as the name idicate is the resistance afforded by a rock to the shear stresses in general rocks having high shear and crushing strengths are use engineering process

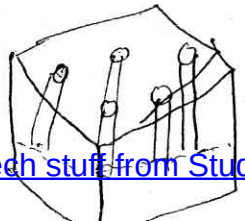
Permeability:

The rock allow that water pass through the factors depend on the composition and porous prsent in the rock if it is a sedimentary block.

If the rock is igneous origin like granite the permeability depends on the fracturing and degree of weathering

If it is volcanic rock the presence of vesicles and they inter connectivity.

If the rock is a metamorphic origin the permeability depends on schistosity and fracturing.



Porosity:

This is expressed as the ratio between the volume occupied by the porous to the total volume of the rock

the rock may be porous but may not be permeable as the interconectivity of the porous may not the higher order rocks having less porosity are prepared to the rocks having higher porosity.

The rocks like carbonates will not have primary porosity but allow the water go deep due to solubility.

This aspect is responsible for the formation of karst topography. Hence if reservoir area or the foundation of any major engineering structure has the presence of carbonate proper precautions have to be taken.

Structure:

Topographic surveys on large scale (1:1000, 1:500, 1:100) with a spectral stress on structural features are faults and associated springs, joints both closed and open. unconformities and shear etc. is the crime requisitive.

These features indicate the weak zones in an area.

In the case of joints the density also important

In addition to all these are fold pattern is also studied and marked if it is present.

Drainage system of any terrain to a greater degree is control by the structure. Hence detail analysis of drainage also helps in identifying structures.

Presence of lakes should be mark

Ground water conditions:

The static water level of the region is essential especially for laying foundation.

Type of water table and the seasonal fluctuations are essential

As it causes problems one it sweeps through

Seismisity:

The seismic data for the last 60 years should be collected.

The data will be available with many central organisation this helps in knowing the seismic zone in which the vision is occuring that interm helps designing the structure

Method of investigation:

1. Aerial survey:

Remote sensing and photogeology are the best tools to understand lithology and structure.

2. Hydrogeological survey or studies:

This involves

(a) Study of drainage pattern

(b) Location and discharge of springs

(c) well location

(d) Depth water table and fluctuation of water table

(e) Precipitation that is rain fall and evaporation

3. Subsurface investigation:

Direct methods are by drilling excuation of pits and trenches

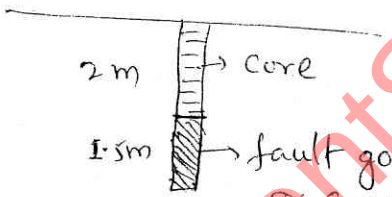
If there are any old workings they should be also study detail

In the case of drilling it should be core drilling

The important parameter is percentage of core recovery

If the percentage of recovery is good it indicate good or RQD (Rock Quality Designing) of the rock

If the percentage of core recovery is less it may indicate that there is possibility of fault gouge or Caverness topography



(powder or slicy material and wont get the core sample)
(RQD is only in sub surface method).

The broad classification of RQD is given below:

RQD:

25 - 50 %	poor
50 - 75 %	Fair
70 - 90 %	good
> 90 %	excellent

Indirect methods:

Geophysical methods like resistivity, magnetic and seismic are considered as indicate because the sub surface information interpreted and certain conclusion drown that have to be verify.

Resistivity: This is give information as the degree of weathering of the rock, incidents of fracture, details about water table on depth water table and nature of the soil.

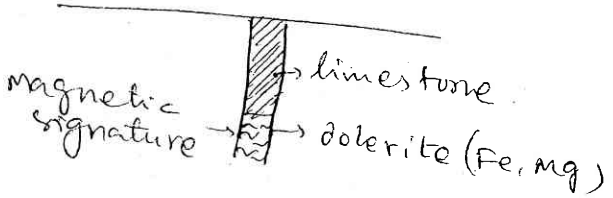
Seismic: The seismic waves that are created by sounding travel with different velocity in different rocks.

Based on this the nature of the quality of the rock can be determine.

Ex: granite, gabbro and quartzite have 5.5 – 6.7 km/sec velocity of waves indicating the hardness of the rock metamorphic have less velocity that 3.5 – 7 km/sec sediments have 1.5 – 7 km/sec

Gravity: This reflects mainly the structural features like domes and other geological structures

Magnetic: This indicates magnetic lows and highs by which the causative body can be determine.



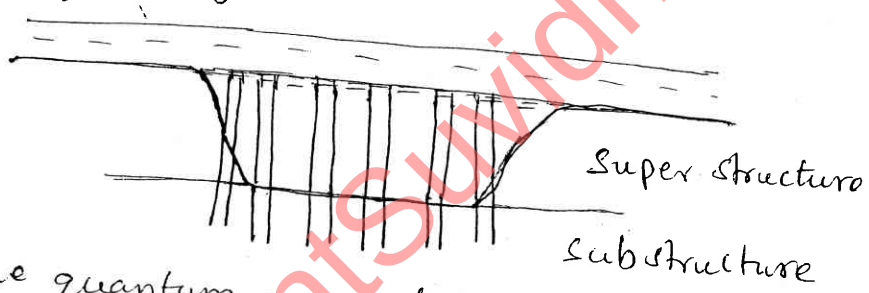
Bridges:

The term bridge indicate connecting link of a gap in engineering structures it is constructed across a river or a gap

Any bridge has two type structures.

1. Super structure: above the ground level and the other one 2. sub.structure: that is below the ground level

The weight of super.structure and the load on it in the form of traffic is transmitted to the foundation through support of bridge.



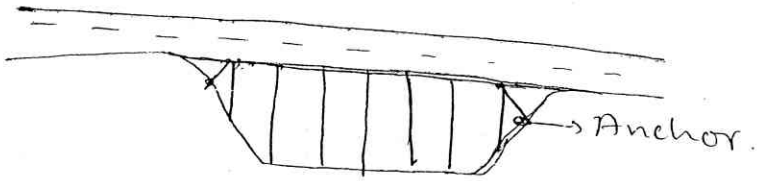
The quantum of the force that is the magnetude of the force in which transmitted should be known

Types of bridges:

Basically these are three types of bridges.

1. In this the vertical load acting on the super structure is directely transmitted vertical to the basement.
2. In addition to the vertical force that are transmitted by support the horizontal thrust that generally tries it push the support outward
3. The vertical forces are generally transmitted to the foundation vertical but for the shake of stability the super structure as to Anchored by a large concret mass

In this type of situation there are forces that try to feel of the encourage.

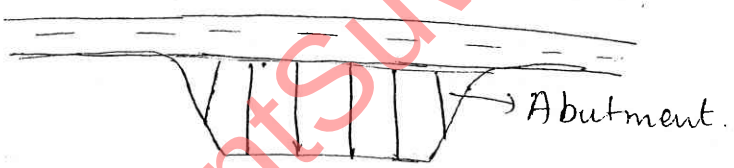


Another type of classification bridges is based on structure and shape.

1. Simple Bridge:

It has simple beam or gudar that stands on two supports

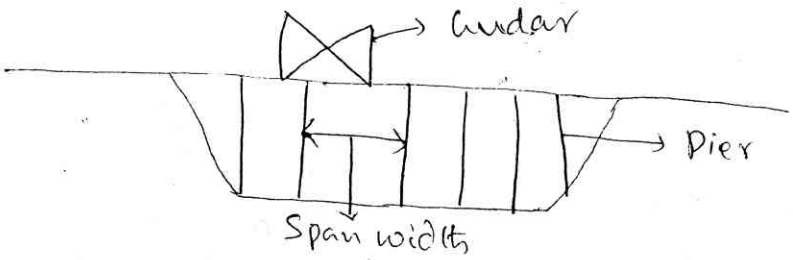
That are half RCC structure or steel or timber it directly rest on abutment.



Abutment can be strengths and compitent by concrete steel rod.

The vertical structure piers depending upon the lengths of the bridge the no. of piers can be decide.

The distance between two piers is known as "span" width the superstructure between piers is called as gudar



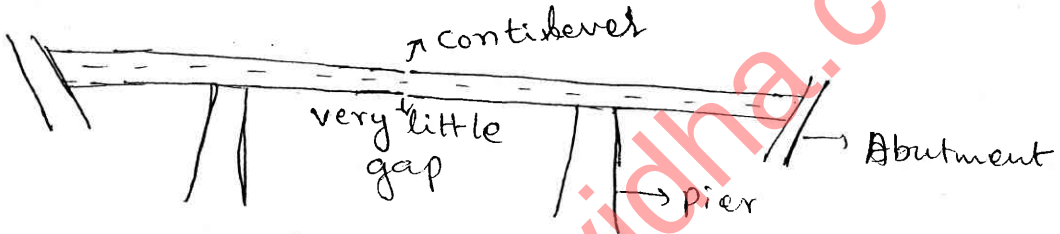
The multi span bridges no. of metal gudars may be use and they will fixed to the abutments & the pier

2. Conti lever bridge:

In this type of bridge in addition to the abutment piers also contribute in taking care of the weight.

The weight of the super structure is transmitted the foundation through piers the additional load on the abutment is negligible.

The gudars have the pattolling harm that is known as the conti lever



3. Arch bridge:

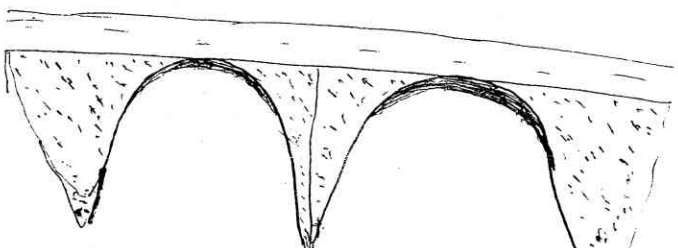
As the name indicate it is the in the shape of an arch

Arch is a rigid frame the produces vertical pressure and horizontal thrust on the support

The rigids are generally constructed with RCC or steel or timber.

Timber arch bridges are generally seen across minor river that have flash floods

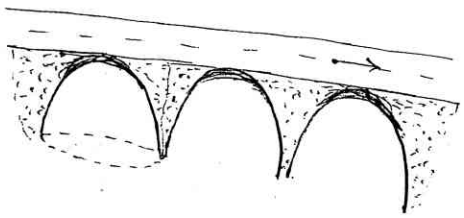
Most of the old bridges are all arch bridges.



4 - Rigid frame bridge:

This is similar to the arch bridge but the arch Like structure in this is like inverted "U"

This structure will be either steel or RCC it will have one or two spans.

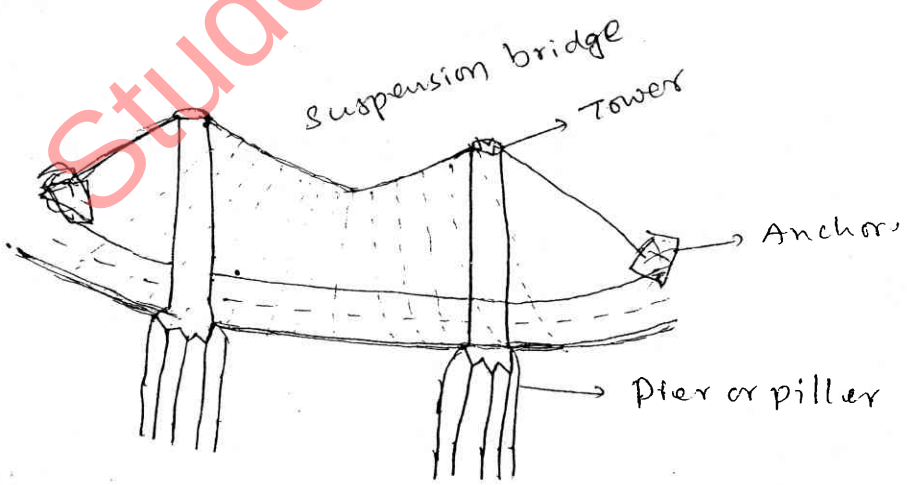


5. Suspension bridge:

This will have two cables of strong wire that rest on saddle that as firmly fixed to the top of a steel tower

The traffic on this will be on suspended cable

The loaded cable tend to pull the tower inword to counter this cables are anchored to natural rock or to a big block of RCC



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Foundation problems in bridge:

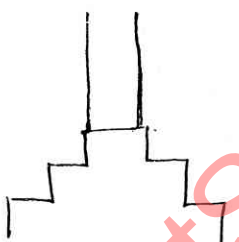
In designing of the bridge the following points should be given to consideration especially in respect of foundation

1. The inflow of water during flood season this can be obtain from the previous record by government or organisation or private organisation.

2. No. of pillers or piers and the span width

The type of bed rock and style of foundation

The base of piller should spread out.



Bridge foundation:

The foundation any engineering structures involves the soil nature in respect of soil pressure and compressive strength.

The common problem in bridges are the effect of scouring (water erosion) and the lateral forces.

The lateral force the rest of bridge in addition to this wind also contribute to the lateral force

This is transmitted to foundation.

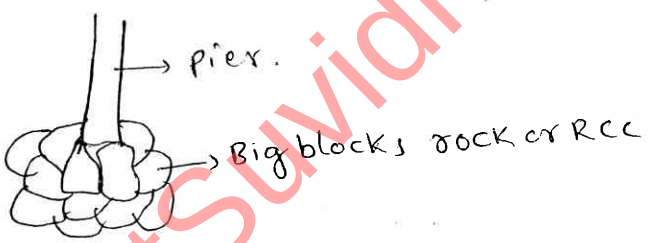
The pressure created by wave action of running water will be effecting the piers or pillers.

If there are vessels they also contribute wave action and will be the effecting the piers.

This type of force will be taken care of in designing the modern style of bridges.

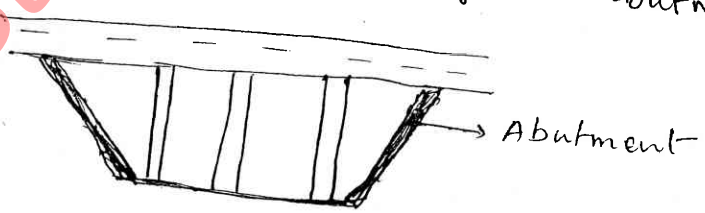
Scour: This can be a permanant feature and if it is not take care of it may effect the piers and the foundation.

There are no clear method to prevent scouring in general big blocks either of rock or RCC will be dumped all the round the pillers to prevent scouring.



Abutment foundation:

There is some amount of similarly in geotechenical investigation for a building and abutment of a bridge



In the case of bridge to prevent scouring effect abutments are strengths and either by RCC are by stone structure.

Pier foundation:

Piers are the main structure of the bridge
These are effected by the lateral forces and scour effect

The bearing capacity of here should be calculated properly water piers (that generally stand in water) should have deeper foundation and must be design for safety from erosion during high water period

If foundation are generally taken deep

The effect of ground water should also be taken care of

The bottom a water hitting even for a small structure should be considerable magnitude.

Geotechnical investigation for a bridge:

1. Preliminary data:

Complete geological in formation should be collected.

In addition to the normal geotechnical investigation the location of hard rock that is suitable for construction should also be mension.

Direct measurment of water waves should be done it means complete information on the minor river and streams that contribute water to the major river also should be studied.

The local farmers and aged people in the villages should be contacted because these are the best people to give the first hand information of the water region.

Environmental studies:

In this study the socio-economic conditions of the people living on the banks of the entire stream lengths should be considered.

The hydrographic studies that involves the basin stream variation in water level etc. should be studied.

Mineral wealth if there is any needs to be detail

Estimate of discharge:

Stream beds debris carried by the river is called discharge

Discharge depend upon the nature of the rock than the Catchment area and the rock from which the river is flowing.

If the rock is soft the catchment area discharge should also be considered in such case discharge can be more. especially when the rock is soft in the catchment area.

If the rock is hard in the catchment discharge will be less as the water cannot remove much of the material from the Catchment

In addition to all these parameters the other details of geological technical investigation should be taken care of including geophysical survey and RQD.

Dams & Reservir 16/08/2011

Dams and Reservoir:

It is a man made structure constructed across a river for

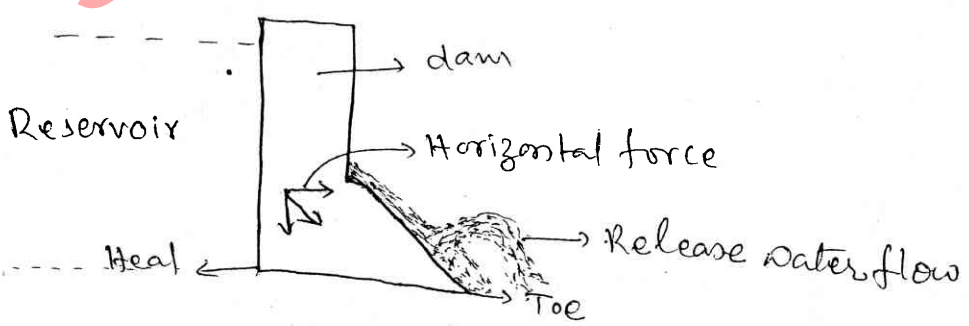
1. Agriculture purpose
2. Generation of electricity.
3. To control floods
4. Acassionally to provide driking water

If the dam have above said feature it is called as "multepurpose dam"

Types of dams:

1. Gravity dam
2. Arch dam
3. Earth dam and
4. Buttres dam

1. Gravity dam:



These dams are heavy and massive wall like structure of concret in which the whole weight act on vertically down ward.

The entire force acting on the down wall it transmitted in to the small area foundation therefore a dam of this nature has to be selected only in such places where very compitent and stable rock occurs in the foundation.

In this type of structure the most important factor of the foundation all the forces acting on the dam that is a massive weight of the dam and the thrust of the infounded water will be transmitted to the foundation.

This type of dams is suppose to be safest.

Gravity dam can be massonary dam or a concrete dam It can be solid or halo if it is halo it is constructed with RCC

Examples:

Bakranangal dam on river satlege in punjab.
Nagarjuna Sagar dam on river Krishna in Andhra Pradesh
mettur dam in Tamil Nadu
Rhind in Uttarpradesh.

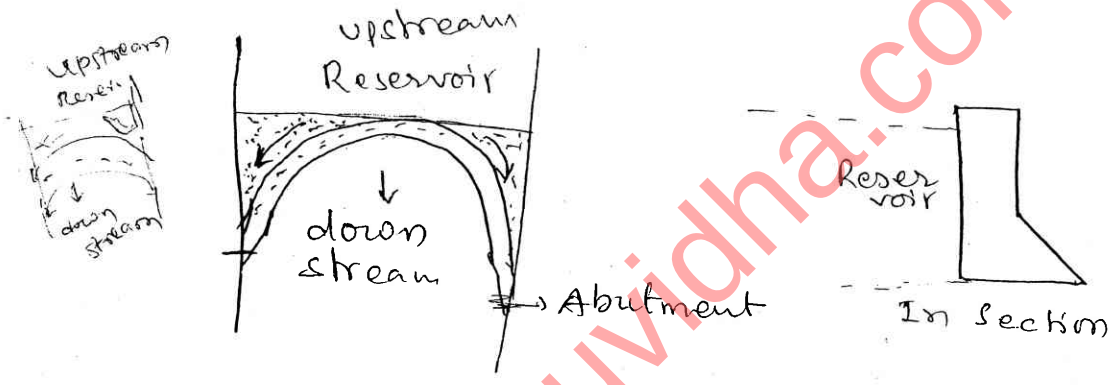
In respect of foundation the underlying rock should be strong to resist stress and should be well below the elastic limit all along its contact plaine.

Height of the dam depends upon the shearing strength and bearing capacity of the foundation.

2. Arch dam:

As the name indicate it is arch shaped and is always solid concrete structure.

A forces acting on the dam will be by the shape of the dam that is arch and they will be transmitted to the abutment. Hence abutment is the main problem.

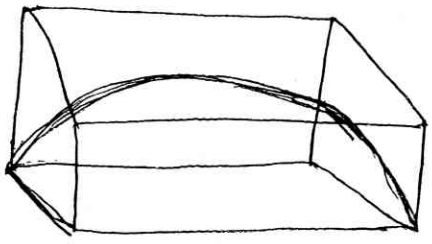


Rocks in the abutment should solid and unbroken Arch dams are best suited in a narrow valley these are thin wall compare to the gravity dam

Arch dams can two types:

1. Constant radius arch dam:

In this the radius of curvature is constant and upstream face is vertical



2. Variable radius arch dam:

In this type the radius of curvature in the upstream and down stream different.

In most of the arch dams the curves side will be towards the upstream

"Idiki" dam in Kerala is the best example of arch dam

Acassionally in wide valley's multiple arch dams can be constructed but the rocks in the abutment should immovable

3. Earth dam/Embank dam/composite dam:

Earth dams planned in such places where the underlying material is very weak to support masonary dams are where suitable compitent rocks occurate a great depth

The earth dams are relatively of smaller height light structures and have broad base

This is characterised by sand, silt and clay in various proportions.

The core of the dam is generally constracted by hard rocks.

Broad valleys are best suited for this type of dam

In this the material that is excavated will be used in the construction

No separate binding material is use

This is best suited when the rocks in the foundations are of compitent and incompitent nature the pressure on the infounded water.

Embankments dams are constructed in earthquake prone areas.

The earthern dams are Hirakud in Ukai in Gujaralth, Gangapur us in U.P.

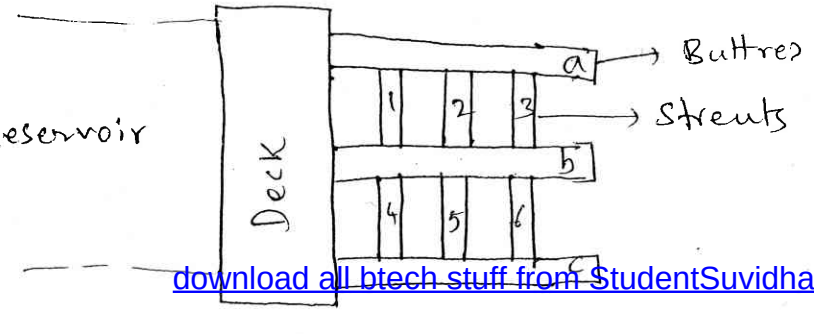
Buttres dam:

These are concret structure in which there is a deck sloping upstream

This deck which takes the entire load is supported from the behind by wall like structures called buttres

Extending perpendicular to the anis of dam such buttreses are further strengths and by cross wall called "streuts"

This constructed in wide valleys



The foundation rock different strengths

The streuts and buttress transmit the load to the foundation this type of dam is more economical than other types of dams.

Basic Environmental problem:

Erosion and land slide:

The reservoir water gets in to the ground water if infiltration at the result the water table rises.

This changes the gradient of the water table.

This reduces the shearing strength of a rock or a soil forther fluctuation of the water table changes the pore water table that cause landslide form the bank.

Evaporation and microclimate change:

Due to the infounding water evaporation will be more this increases a humidity.

If the humidity is more will be change in climate that finally ends up in the disbruction of forest area.

Reservoir induced seismisity:

Fractures, joints, brittle rocks and eaverns terrain experience the effect of the infounded water

If the infounded water in the reservoir is above 100m high it will effect the ambient (uniform) stress

This mainly due to the reservoir water entering in to the fracture.

This disturb the equilibrium, as result earthquake of minor magnetude occur

Ex: Kohina dam earth quake in Maharastra.

Downstream erosion:

The water when released from the reservoir when the inflow more than the out flow

The stream bed gets effect in the down stream especially if it is made up of less resistant rock

This create a new cycle of erosion.

Upstream sedimentation:

In the reservoir silt sediment (load) of the river gets accumulated because of excess inflow of the river due to this siltation the life of the reservoir comes down

Ore minerals submergence:

In certain cases they may be some economic minerals in the reservoir area.

If it is not properly explore and if such an area it occupy by reservoir water the mineral wealth will be lost forever

Farther the area should checked up for toxic minerals - this may cause health hazards due to agriculture and also by drinking the water

If the water is released for domestic consumptions.

Mitigations:

The main and most important major in the constructions of small scale dam for individual purposes like irrigation, power generation, flood control and drinking

The construction small scale dam will cost less and can be completed early for the maintanance easy

Environmental problems will be minor magnetude

In India these are known as small scale dams.

✓ Dams & Reservoirs