-:TUNNELS:-

Introduction :-

Geological & Geotechnical consideration :-
Following are some of the parameters that are required to be thoroughly studied in order to construct a successful tunnel.

① NATURE OF THE UNDERLYING ROCK :-

ⓐ Igneous rocks :- These are the favourable site for construction of a tunnel and the tunnel so formed will be strong and durable, but the cost of excavation could be high. In this no inner lining is required.

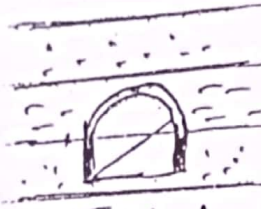
ⓑ Sedimentary rocks -
clastics - like sandstones are quite durable and can provide a strong foundation for tunnels.
Non clastics - like limestones are also durable but the presence of cavities should be properly checked.

ⓒ Metamorphic rock -
foliated - like schists are not durable and therefore need some sort of support like rock bolting

Non foliated - These rocks are also suitable for tunnel construction because they contain minimum weak zones.

② ORIENTATION OF BED's:-

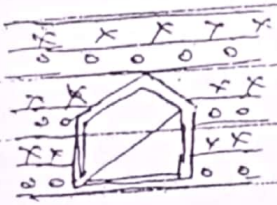
(a) In case of massive horizontal bed's :-



The bed's itself overhanging the tunnel & acts as a natural beam

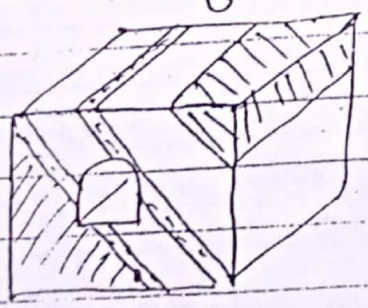
stable/safe * Effect on lining pr:- Uniform vertical pressure

(b) In case of thin horizontal beds :-



pointed arch/roof required. and extra support such as roof bolting is required.

(c) In case of dipping beds :-

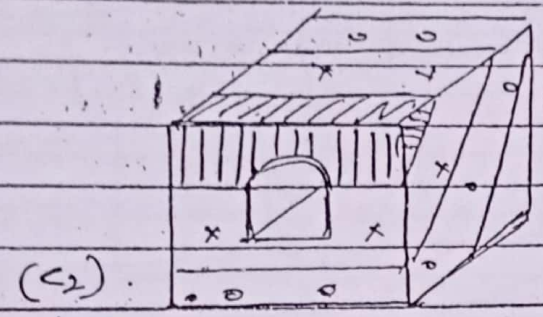


(c.) • Effect on lining pr. - Pressure will be from one side only & hence unsafe.

c₁ - If tunnels are aligned along the direction of strike of the bed then the condition will be unfavourable for Tunnelling

c₂ - If tunnels are aligned along the direction perpendicular to strike then it would be

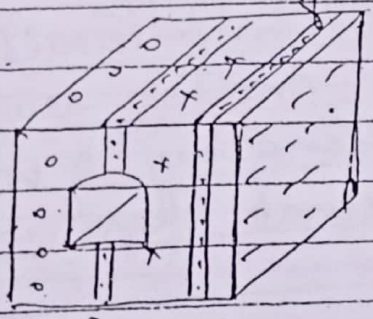
favourable condition.



(c2).

(d) In case of vertical bed's -:

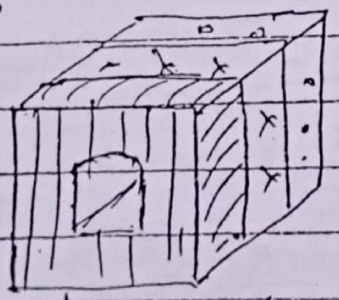
- Effect on lining pressure - Most of the pr. will be concentrated on top of the arch or roof & hence unfavourable. (d) fig.



(d) & (d1)

d_1 - If tunnels are alinged along the direction strike then unfavourable

d_2 - If $\perp^r$ to strike of bed then favourable.



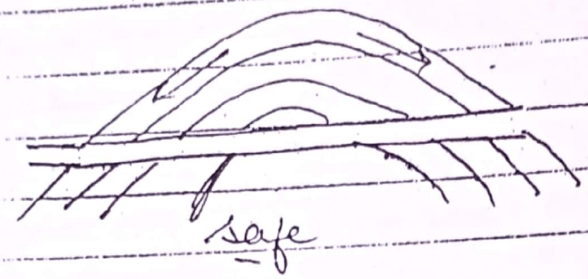
favourable.

(3) GEOLOGICAL STRUCTURES :-

(a) In case of folded strata -

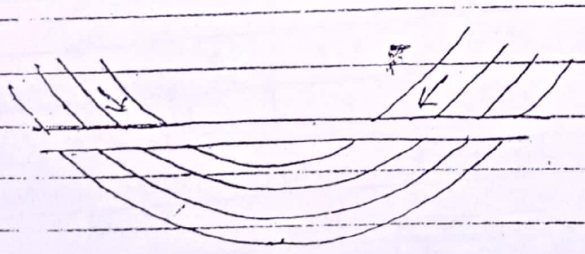
(a.) Anticlines ⊥ Site selection for tunnel alignment in folded rock's

are generally avoided because there areas are considered to be relatively unstable however in case of anticlines; the tunnelling is considered to be safe because the vertical pressure is dissipated horizontally & all the pr. seems to be moving away from a point



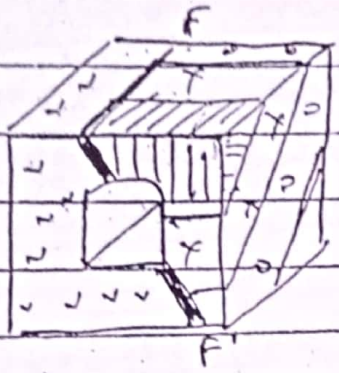
safe

(a) Synclines -: Are relatively unsafe wrt anticlines because all the pressure seems to be concentrated towards the core of the syncline. Another reason is that there will be the tendency of water to flow towards the synclinal core which will make the tunnel weak.

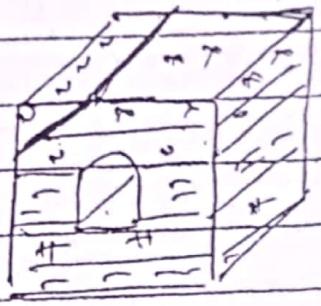


unsafe

(b) In case of faulted rock's :- Tunnelling in faulted areas are unsafe.



highly unsafe



relatively safer.

* Tunnels along the F.W & H.W side - (Safer)
* Tunnels along the Fault plane - (unsafe)
* Tunnels crossing the fault plane but firstly present the either FW or HW side - (Unsafe)

(c) In case of jointed rock's - chances of water seep will be there & hence unfavourable.

(4) POSITION OF WATER TABLE :-

(4a) Tunnels located above water table - Safer.

(4b) Tunnels located below water table - Unsafe.

Because if below water table then water can percolate inside the tunnels. In real actually there highly idealised conditions are not there. So if Tunnelling is going to be done & water can drawn out by various means to lower the water table. In such conditions soft rock's are favourable as compared to hard rock.

(#) Stress conditions in tunnel :-

Rock's inside the earth remains in an equilibrium condition until and unless that equilibrium is destroyed nothing happens. Due

Tunnelling we disturb that equilibrium conditions and so the tunnels to constructed tolerates heavy stress and which is observed by spalling off the walls, swelling of the ground, setting up of small tremors within a tunnel. Nature tries to regain that lost equilibrium by natural archings of the roof around the tunnel

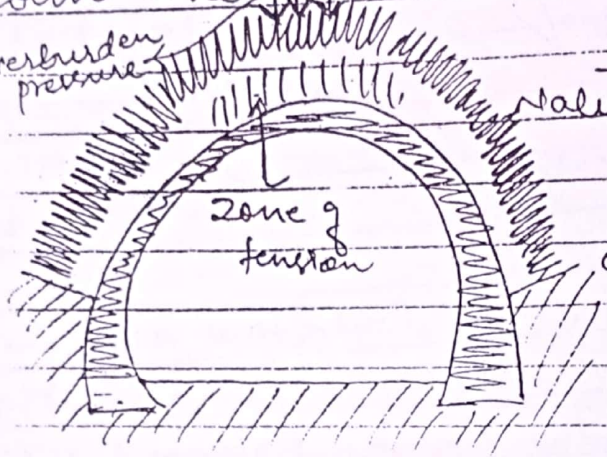
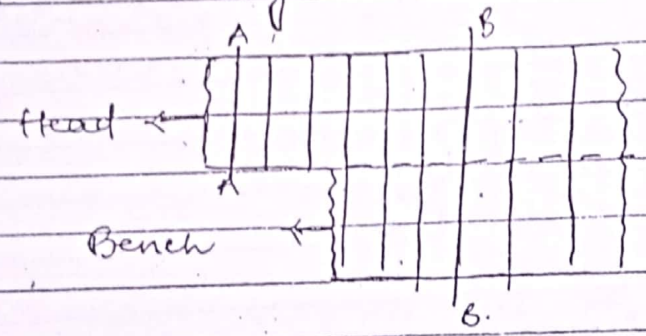


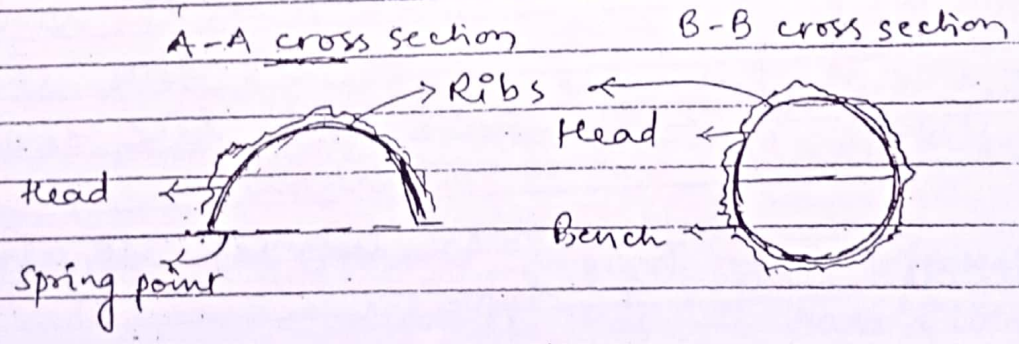
fig -

:METHOD'S OF TUNNELING:-

① Full face tunneling method :- In this method of tunneling (in terms of cross section) whole area (in terms of width) which we want to excavate out is excavated out at same time. This method is generally applied small tunnels

② Heading and bench method :-

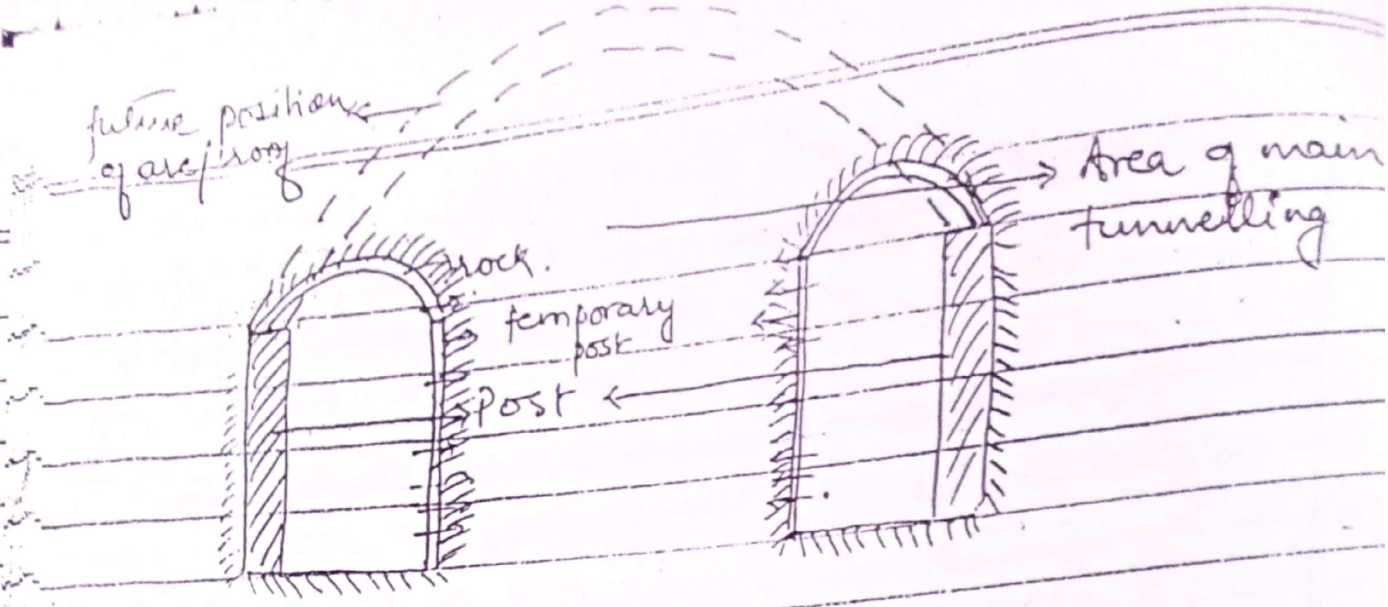




In this method heads are excavate out ahead of bench & bench are used as a pla for tunnelling.

③ Side / lateral drifting method :-

In this method firstly 2 small drift's are made adjacent to each other and then excavations are started laterally towards each other. Temporary lini are also used which are later removed



(4) Multiple drift method:- In this method instead of two drift's several small drift's are made in order to construct a huge tunnel.

: CLASSIFICATION OF GROUND FOR TUNNELING:

There are 2 basic classification of ground for tunneling

① Soft ground tunneling
② Hard ground tunneling.

① Soft ground tunneling - from the name only it's clear that the ground is soft and rock's like shales are taken into consideration

Soft ground tunnels are also divided into 4 types :

ⓐ Running ground - This type of ground is dry and clean and consist mainly of sand and gravels etc

ⓑ Flowage ground - In this type of ground

CLASSIFICATION of ground's

Flowage - occurs due to high moisture content of the ground.

① Squeezing ground - This type of ground is or less similar to flowag ground but the moisture content of this ground less w.r.t flowage and the flowage of material place plastically.

② Swelling ground - This ground also tends to move in the tunnel an but the movement depends essentially upon the moisture content.

③ Hard ground tunneling - Tunneling in hard ground such as sandstones, granites etc. This type of tunnelli is also called CLASSI "FIRM GROUND TUNNE

* Ground :- Ground is an area from which a tunnel has to pass & which is to be excavated out.

-: SUPPORTS :-

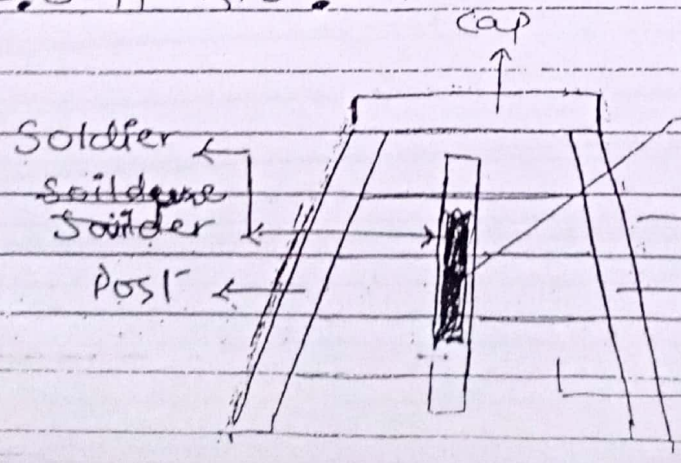


fig - Square heading a dry ground

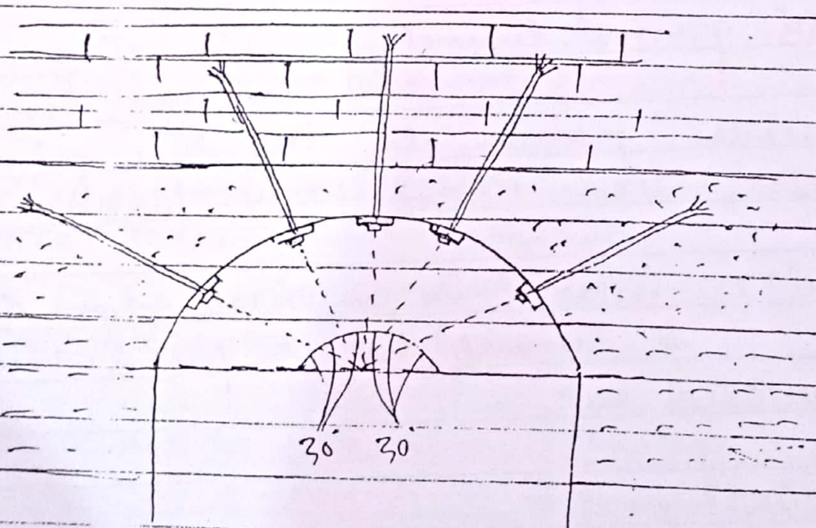
Sloughing - (स्लफ़ आना)

Firstly after excavating, timbers / steel rods are placed in the cross section in order to make frame. Likewise several frames are constructed at 2-5 ft apart. Terms like Between cap, post, sill are used for upper horizontal, vertical & lower horizontal frame's part.

Between the frame and the walls sheathing or sheeting is done. At the face of the frame breasting is done in order to prevent from sloughing.

To support breasting, soldier is placed regal and to fix the soldier, raker is used.

Roof bolting :- is another method for support. In this method firstly hole is made at the upper part of the tunnel above the spring point.



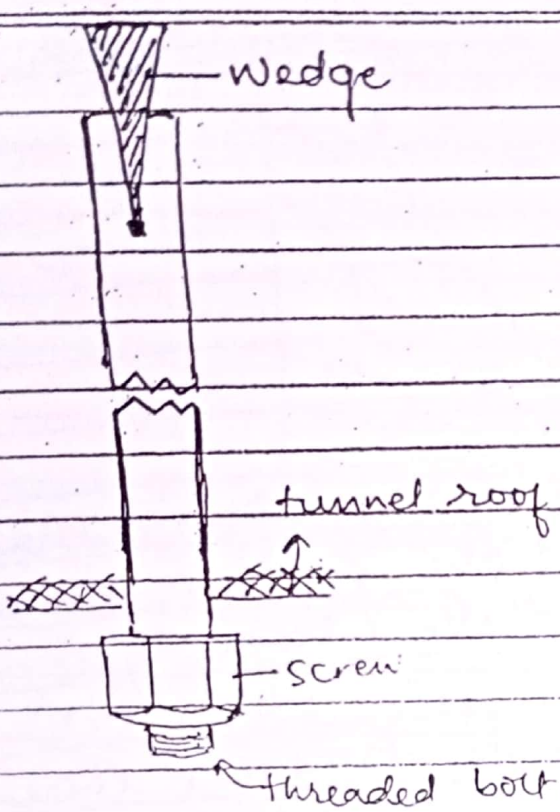


fig- Typical roof bolt.

Then roof bolts contain wedge is introduce in that hole. Wed presence tries to bi the material's or roc as the bolt's are fu penetrated due to it' shape. This help in preventing caving of the overlying roof and becomes intact/firm.