

GEOLOGY

Notes by-

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Soil classification & Tunnelling method.

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Types of soil :- ① Hard Rock / self supporting
② Soft soil / Require support (Temporary)

Ideal soil for tunnelling :-

- ① It should remain unaffected when exposed to air.
- ② It should be composed of homogeneous matl.
- ③ It should not have any water bearing strata.
- ④ It should be capable of being easily excavated.

* Factors affecting choice of method of tunnelling :-

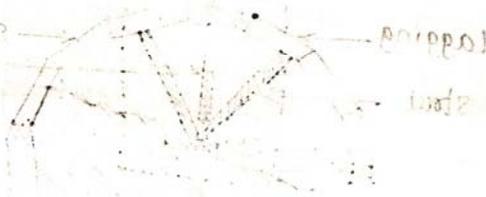
- ① Availability of equipment.
- ② Type of soil.
- ③ Size of Tunnel.
- ④ Properties of soil.
- ⑤ Economy.

* Methods of tunnelling (soft soils) :-

- ① forepoling method
- ② Needle beam method
- ③ Argy mtd / case mtd
- ④ American mtd
- ⑤ English mtd.
- ⑥ Belgian mtd.
- ⑦ German mtd.
- ⑧ Austrian mtd.
- ⑨ Linear plate mtd.
- ⑩ Stiffening ribs.
- ⑪ shield tunnelling.
- ⑫ compressed air tunnelling.

* Tunnelling in Hard Rock

- ① Drift mtd.
- ② Heading & bench mtd.
- ③ Full face mtd.
- ④ cantilever car dump mtd.



① Forepoling mtd :-

- * old mtd.
- * Replaced by compressed air tunnelling mtd.
- * slow & tedious process, requires skilled miners.

suitable → small tunnel, for carrying sewage, gas pipe at ordinary depth.

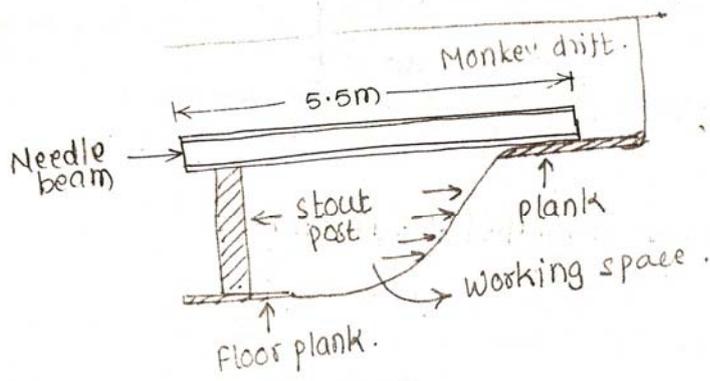
* sequence of operation for 1.5x1.5m tunnel :-

- ① sinking of shaft from surface to the grade level & properly protected by timber sheeting.

- ② wooden bent properly braced is set up a few cm from sheeting.
- ③ a pipe or sheeting above the cap is cut out along top line of holes.

② Needle beam method :-

① Suitable :- For soil which can stand without any support for few minutes. & Brick lining.

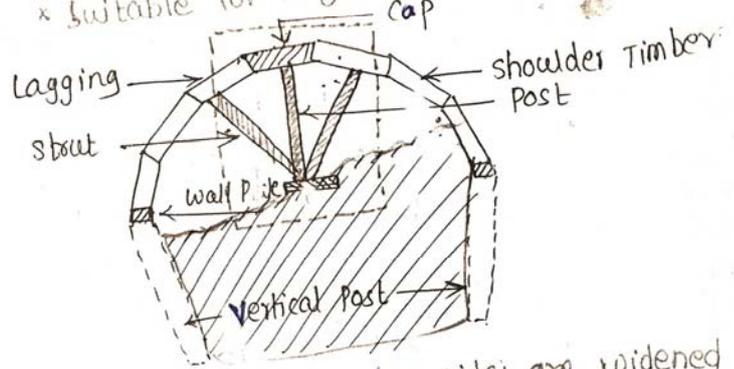


③ Army method or case mtd :-

- * Derived by US Army for small tunnel.
- * Used for underground sewers.
- * Simple, economical & no need of skilled labour.

④ American mtd :-

* Suitable for large sized railway / Highway tunnel.



① Top drift is removed by sides are widened & then supported to top soil is provided by the shoulder timber, cap, stout, post as shown in fig. & as roof load is transferred at springing level, there is no need of support & hence work is continued.

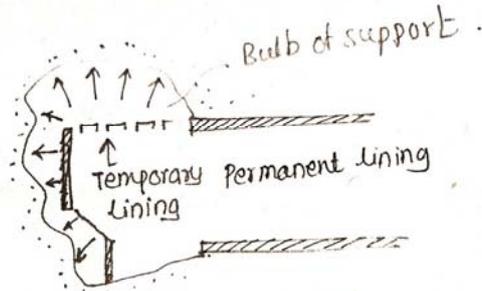
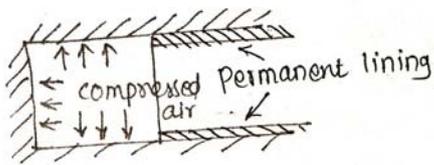
⑤ English method :-

* Plenum process / compressed air mtd:-

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- * Suitable for soft soil & water bearing ground.
- * The method consist in forcing air under suitable pressure into enclosed space to force back percolating water or mixture of water & soil & thus stabilize the area of excavation.

- Equipments:-
- ① Air lock & ass accessories.
 - ② Bulkhead to fix the air lock.
 - ③ Blow line
 - ④ Air compressor.



- * clay is ideal 'soil' for tunnelling by compressed air mt.
- * Gravel is worst soil

* Tunnelling in Rock:-

- * Rock is self supporting material.
- * costly
- * Extreme care is reqd.
- * Over cutting should be avoided.
- * Operations of tunnelling can be started at various sections.

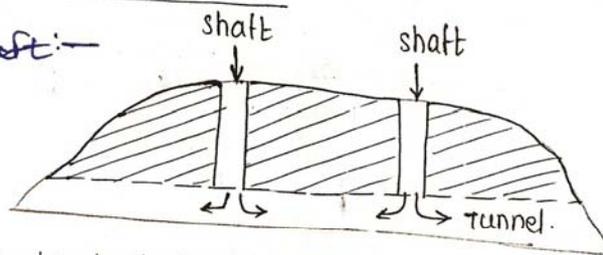
* Sequence of operation:-

- ① Constⁿ of shaft
- ② Transferring centre line to the inside of tunnel.
- ③ Deciding mtd. of excavation.
- ④ Setting up & drilling holes for blasting.
- ⑤ Filling holes with explosives.
- ⑥ Blasting.
- ⑦ ventilation & removal of dust
- ⑧ Dewatering.
- ⑨ Lining
- ⑩ Use.

* faces of operation:-

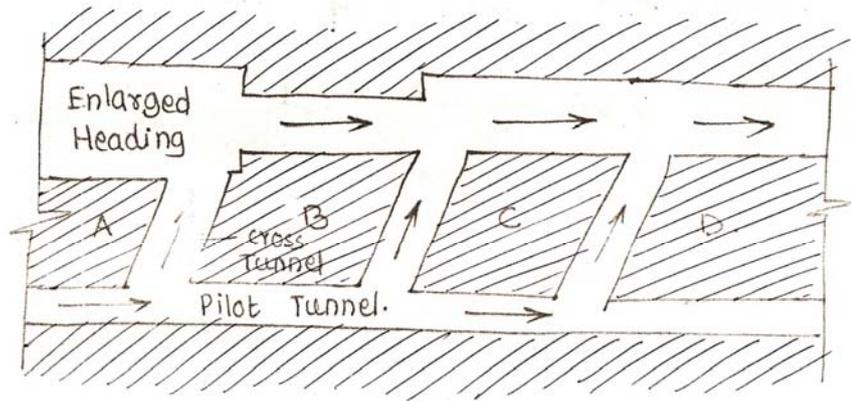
- ① Vertical shaft
- ② Pilot tunnel.

① Vertical shaft:



Vertical shafts are drilled at a suitable distances & thus additional faces are exposed for work.

② System of Pilot tunnels:-



Sometimes lateral approach to the tunnel line is nearer than vertical shaft, in such case, a small tunnel called as "pilot tunnel" is driven parallel & close to proposed main tunnel & "short cross connecting" tunnels are driven from it to reach the proposed main tunnel to create operational faces.

* Methods of Tunnelling:-

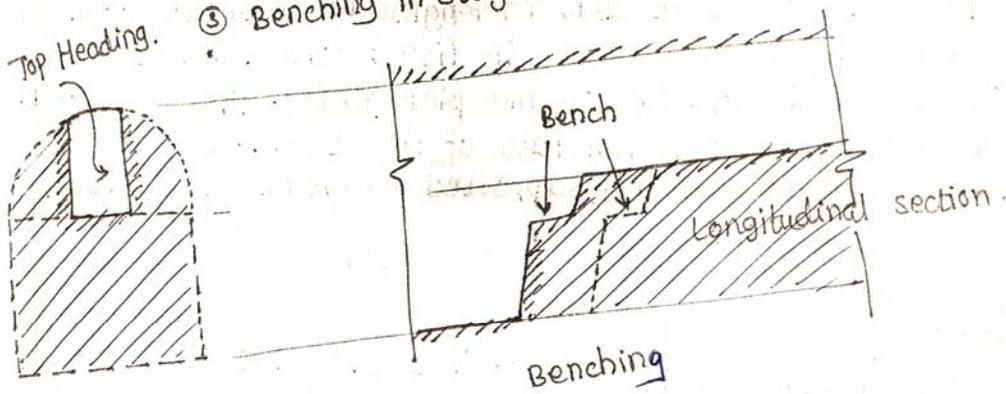
- ① Drift mtd.
- ② Heading & bench mtd.
- ③ Full face mtd.
- ④ Cantilever car dump mtd.

DHFC

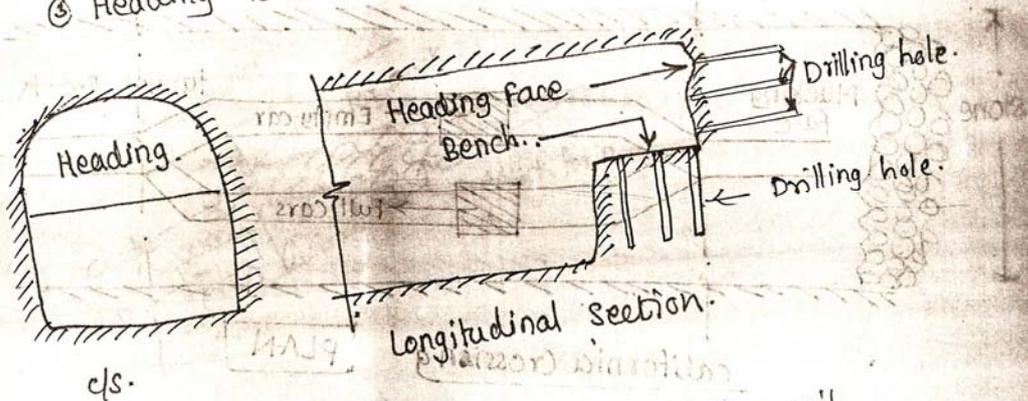
* Muckling :- खोदई

- ①-c ① California Crossing
- ② Cross Hopper
- ③ Cherry Picker.

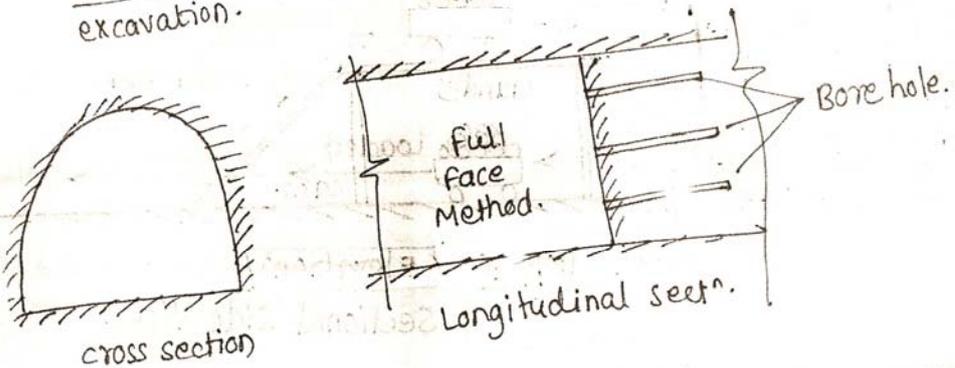
① Drift Method:- ① Boring or blasting at top centre heading of drift, end to end. ② widening & enlarging the drift. ③ Benching in stages. Er. Pravin Kolhe (B.E Civil)



② Heading & bench mtd:-
 ① Driving of top portion in advance of bottom portion.
 ② Benching is used as platform.
 ③ Heading is always ahead.



③ Full face Mtd:-
 * Used for small c/s. & stable, self supporting soil.
 * The full face is opened out once for all & driven.
 * New techniques like "Shield Tunnelling" & "Tunnel Boring Machine" (TBM). are well suited for full face excavation.



⊕ Cantilever Car
dump method =

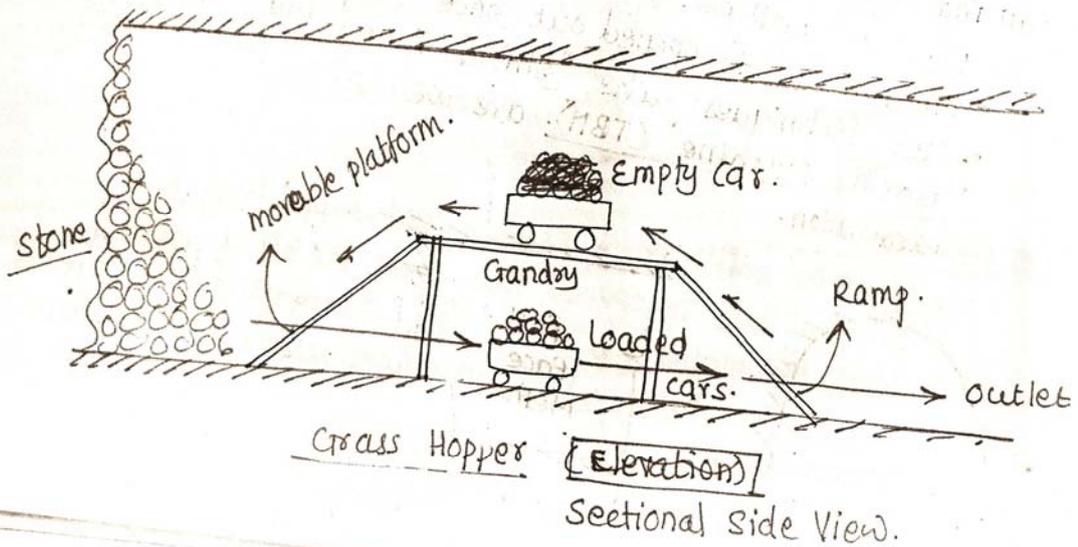
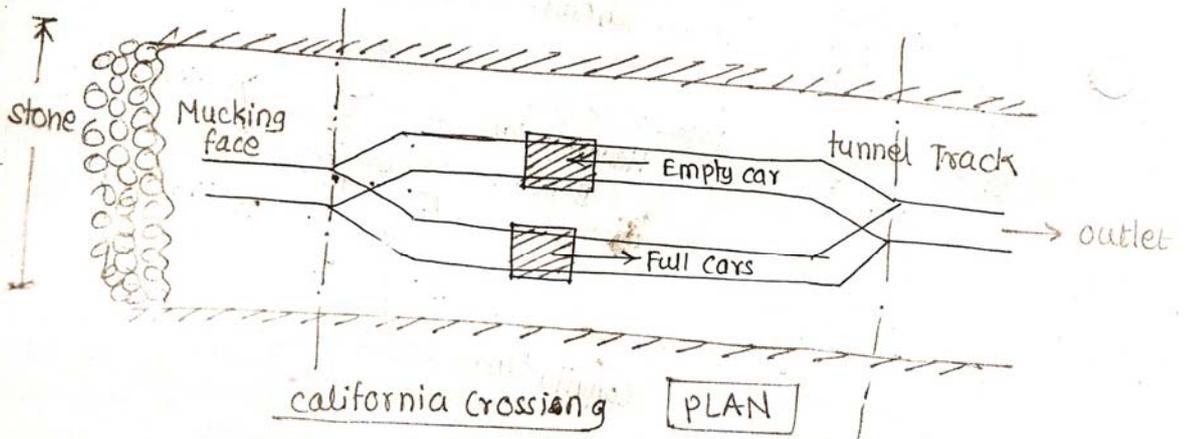
This mt. provides an improved arrangement of throwing muck from bench to the floor of the tunnel. Two plate girders about 23m in length are fixed at 7.5m c/c distance. A belt conveyor is fitted with a number of Jack & it is running on the plate girder. The ends of p.a. project beyond the full face of the bench. The front ends of girders are suitably supported by means of struts from the top of tunnel.

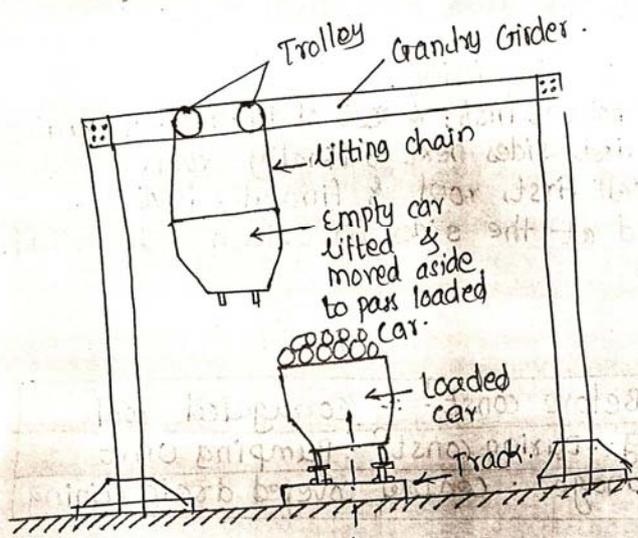
* Muckling:-

Muckling is removal of blasted debris from tunnel. Principal types of muckling are:-

- ① California Crossing
- ② Cross Hopper
- ③ Cherry Picker.

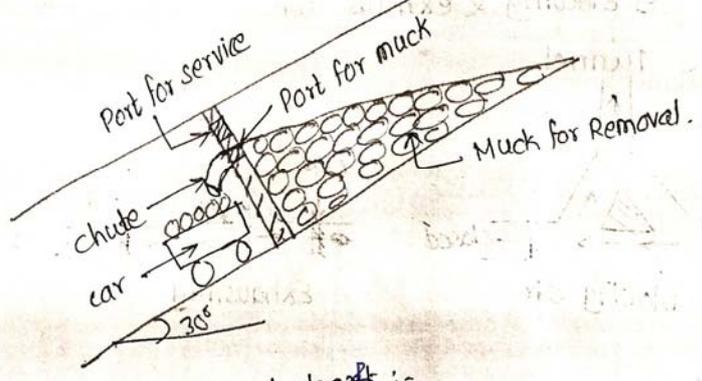
CCGHCeP





Cherry Picker Elevation.

* Muckling in steep grade tunnelling:-



* Types of vertical shaft :-

- ① Shallow
- ② Deep
- ③ Temporary / Permanent
- ④ Vertical / Inclined.

* Materials for Tunnel lining:-

- ① Masonry
- ② Stone
- ③ Cement concrete - common
- ④ Timber
- ⑤ CI

* Sequence of lining:-

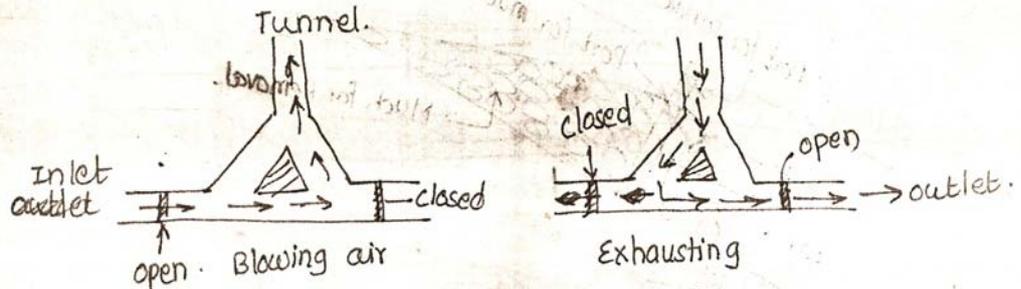
- ① In one operation entire lining.
- ② Placing invert (bottom) first; & rest of tunnelling & lining next.
- ③ Placing invert first, sides next & finally roof.
- ④ Placing side wall first, roof & finally invert.
- ⑤ Curbs installed at the sides first, then walls & roofs & finally invert.

* Drainage of Tunnel:-

① Pre-drainage : Before const ⁿ :-	Corrugated roof
② Pre Dewatering : During const ⁿ :-	Pumping Unit
③ Permanent drainage :-	central covered drain / Lining

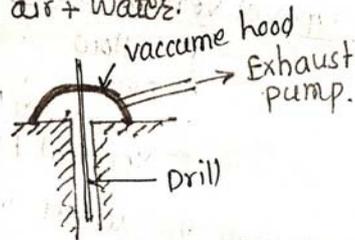
* Ventilation:-

- ① Natural
- ② Mechanical :
 - a) Blowing $\xrightarrow{\text{Blowing of air}} \xrightarrow{\text{outlet}} \text{Tunnel}$
 - b) Exhausting $\xleftarrow{\text{exhausting}} \text{Tunnel}$
 - c) Blowing & exhausting



* Dust control:-

- ① wet drilling :- compressed air + water.
- ② Use of vacuume hood
- ③ Use of Respirators.



* Lighting:-

- ① Lanterns & lamp burning oil
- ② Coal gas lighting : chances of explosion.
- ③ Acetylene gas lighting
- ④ Electrical lighting : commonly adopted.