

# DESIGN AND PROTOTYPE OF TUNNEL BORING MACHINE

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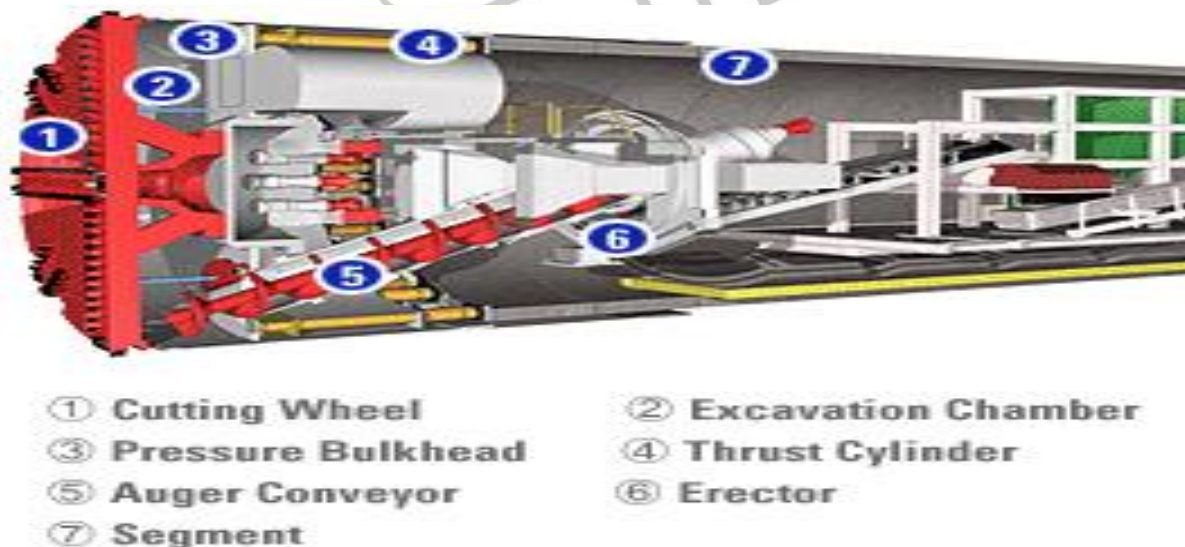
## Abstract-

This project aims at study of Tunnel Boring Machine and using this reference thus making a model of Tunnel Boring Machine which will in turn produce the same visual effect as that of the known Tunnel Boring Machine but at small scale and with reduced mechanical complexities. A tunnel boring machine (TBM), also known as a "mole", is a machine used to excavate tunnels with a circular cross section through a variety of soil and rock strata. Nowadays industries looking for advance machines which can bore through rocks with reduced disturbance to surrounding soil. Noise, bore and disturbance of a soil are not only concerns the biggest concern is the safety. So to overcome the above problems tunnel boring machine is design which also produce smooth tunnel wall reducing ventilation requirements and increase the speed.

*Keywords- Tunnel boring, drilling and blasting, axial stress, cutting tool*

## 1) Introduction-

In India, there are very few industries that use Tunnel Boring Machine on a large scale. The important aspect of the Prototype of Tunnel Boring Machine is to demonstrate the working and important components of Tunnel Boring Machine on a small scale thus keeping it as authentic as possible. Tunnel boring machines are used as an alternative to drilling and blasting (D&B) methods in rock and conventional "hand mining" in soil. TBMs have the advantages of limiting the disturbance to the surrounding ground and producing a smooth tunnel wall. This significantly reduces the cost of lining the tunnel, and makes them suitable to use in heavily urbanized areas. The major disadvantage is the upfront cost. TBMs are expensive to construct, and can be difficult to transport. However, as modern tunnels become longer, the cost of tunnel boring machines versus drill and blast is actually less. This is because tunneling with TBMs is much more efficient and results in shortened completion times.



## 2) Working Principal

TBM can bore through hard rock, sand, and almost anything in between. Tunnel diameters can range from a metre (done with micro-TBMs) to 19 meters. Tunnels of less than a meter or so in diameter are typically done by horizontal directional drilling rather than TBMs. A tunnel boring machine (TBM) typically consists of one or two shields (large metal cylinders) and trailing support mechanisms. At the front end of the shield a rotating cutting wheel is located. The cutting wheel will typically rotate at 1 to 10 rpm (depending on size and stratum), cutting the rock face into chips or excavating soil (muck). A TBM can cut through rock at up to one kilometer a month. Powerful hydraulic rams force the machine's cutting head forwards as the rock is cut away called the feed. The action here is very much like an earthworm. The rear section of the TBM is braced against the tunnel walls and used to push the TBM head forward. At maximum extension the TBM head is then braced against the tunnel walls and the TBM rear is dragged forward.

## 3) Major components of Actual TBM are :-

- Cutter Wheel – To excavate rock or soft ground by the rotation of an assembly of teeth or cutting wheels under pressure against rock face.
- Excavation Chamber – To collect all the soils and debris from the cutter wheel and pass it to the conveyor.
- Pressure Bulkhead – It provides the sustainable pressure required for sustainable cutting.
- Thrust Cylinder – To be in full contact with the erected segment and extend by the hydraulic as the cutter wheel turns and thrusts forward.
- Auger conveyor – To move the spoil at the cutter disc and feed onto a conveyor system.
- Erector – To erect the segments to form a complete ring after showing at the tail of the TBM.
- Segment – To keep the soil form getting in to the machine and to provide a safe space for the workers.

## 4) Components of Prototype of Tunnel Boring Machine are-

Hollow pipe, screw conveyor, belt conveyor, bearing, drive, shaft and electric A.C. motor. As the name suggests, the project aims at the study of the Tunnel Boring Machine and by using its basic idea to design a prototype of Tunnel Boring Machine. The prototype of the Tunnel Boring Machine depicts the mechanism of the Tunnel Boring Machine in non-esoteric way providing a simpler view of the complex mechanism of the actual Tunnel Boring Machine.



Actual Prototype of Tunnel Boring Machine

## 5) DESIGN REQUIREMENTS AND RESULT

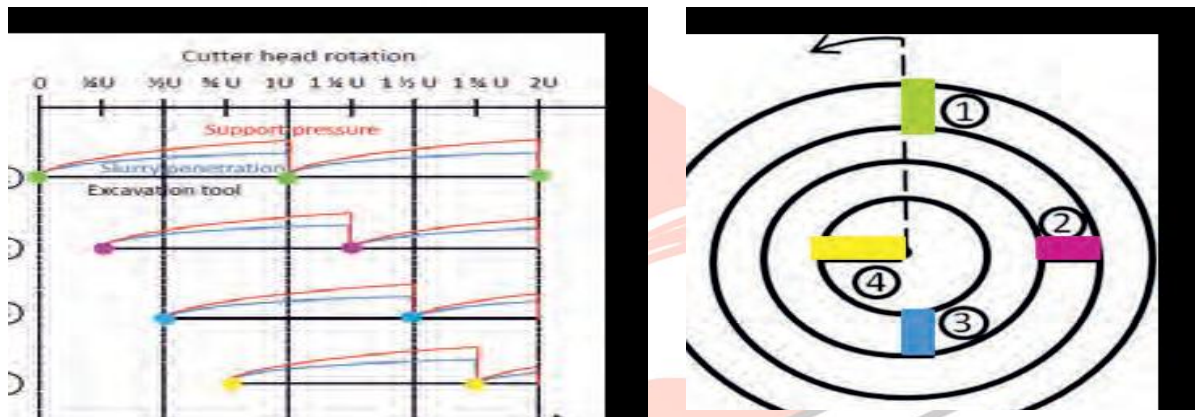
### 1) Requirement of Axial Stress for different materials

Experimental investigations (innovative soft-oedometer) on structured and reconstituted soil samples under isotropic and anisotropic boundary conditions and stress paths are being conducted for parameter calibration and model validation.

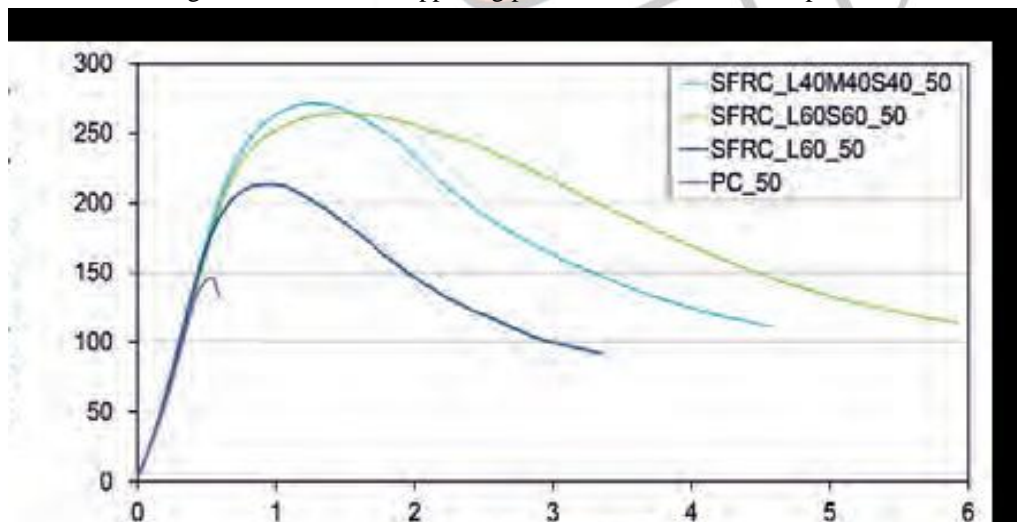
Compression behavior of structured and reconstituted soil in oedometer tests. Comparison of experimental (symbols) and numerical (lines) results.

### 2) Arrangement of cutting tool

The chronological superposition of the penetration process of the suspension and the soil excavation results in a local transient process at a particular point on the tunnel face (Fig.2). By periodical passing of a cutting tool through the particular point, the pressure transfer mechanism is herein partially or even completely damaged. The slurry may penetrate again into the soil between the subsequent passing of a cutting tool, and thereby the Arrangement of the cutting tools on the cutter head (right), Superposition of the processes: slurry penetration and soil excavation (left).



The experimental investigations performed within this project aim at a time-dependent description of the possibly occurring soil-mechanical, hydro-mechanical and rheological changes, and furthermore, at visualizing and understanding the simultaneous happening penetration and excavation processes.



Stress-displacement behavior of PC and SFRCs under partial-area loading

**BILL OF MATERIAL:**

Sr No.	Part	Quantity	Material
1)	Pipe 8 inch dia 2 feet	1	MS
2)	AC MOTOR	2	Standard
3)	SCREW CONVEYOR	1	MS
4)	BELT CONVEYOR HOOKS	1	Mild Steel
5)	SHAFT	1	30C8
6)	BEARINGS	3	BRIGHT Steel
8)	MISC.	1	Standard
9)	CUTTER	1	BRASS

**DISCUSSION:**

- Wherever speed and safety becomes the main criteria, use of tunnel boring machine despite its heavy capital cost is preferred.
- Tunnel boring machine provides accurate functioning with improved personal safety and cost of lining.
- It is basically constructed for railroad tunnel and mining operations.

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