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Case Study on the Construction of Main Tunnel and Parallel Safety Tunnel From Tupul to Imphal Railway Line under Northeast Frontier Railway, Manipur.

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ABSTRACT
As India's Northeast region comes under the 6th most earthquake- prone belt in the world, the soil of young Himalayan region is weak due to the heavy monsoon for a longer period and working season is very less in the hilly region. The capital of Manipur, Imphal is the fourth capital city in the mountainous North-Eastern region to be connected with railways after three other Northeast states. The soil or the earth bearing capacity of the North Eastern region is much less as to compared other parts of the country. It had caused many problems that led to the deformations of the soil around the primary supports of the faces of the Tunnel-12 especially.

Thus, geoconsultants and expert committees consisting of the various international consultants are also studying and giving guidance on the deformations formed on the strata of the earth.
Keywords: earthquake, hilly region, deformations, geoconsultants, strata.

1. Introduction

The project "Construction of main Tunnel and Parallel Safety Tunnel from Tupul to Imphal Railway Line under Northeast Frontier Railway, Imphal" has been taken up by the Northeast Frontier Railways, Imphal under the Ministry of Railways, Government of India. It consists of two parts - the main tunnel and parallel safety tunnel. The nature of work for both the projects is construction of tunnel only. The state of Manipur lies at a latitude of 23˚83´N to 25˚68´N and a longitude of 93˚03´E to 94˚78´E. The total area covered by the state is 22,327 sq.kms. The capital, Imphal, lies in an oval-shaped valley of approximately 2000 sq.kms., surrounded by blue mountains, at an elevation 790 m (2590 Feet) above sea level. The slope of the valley is from North to South. The mountain ranges create a moderated climate, preventing the cold winds from the North from reaching the valley and baring cyclonic storms. Thus, the valley area in the state is only about 11%.

The Tunnel no.12 is the longest railway tunnel on the Jiribam–Tupul–Imphal new broad gauge railway line. The 111km long Jiribam–Tupul–Imphal new broad gauge railway project was taken up in 2008 and was declared a National Project owing to its importance. on this stretch, the 12.5 km Jiribam to Dholakhal section has been completed and commissioned.

The Tunnel No 12 of the Tupul – Imphal section lies in the three districts of Manipur viz, Noney, Kangpokpi and Imphal West Districts, and is situated in the western part of the Imphal Valley.

2. Experimental Methods or Methodology

This article addresses the ongoing project for the construction of new railway lines connecting Manipur to other parts of the country, India in exploring and transporting goods in an easy and affordable way than to transport the heavy goods by travelling to the hilly slopy terrains of the state and consuming a lot more time as compared to other means of transport. It provides a great tourism potential for the people to explore more scenic beauty of the state. Tunnel No. – 12 will be serving as the longest tunnel in the northeast. The process of construction is a long process as it takes place in the different types of strata and soil types of the Earth. Drill and blast method by using explosives and Tunnel Boring Machine (TBM) has been adopted for excavation. After this process, primary supports are installed so as to give the shape to the tunnel. The shape of Main Tunnel is a horseshoe shape. The horse shoe provides a wide flat floor for equipment and provides a pleasant working

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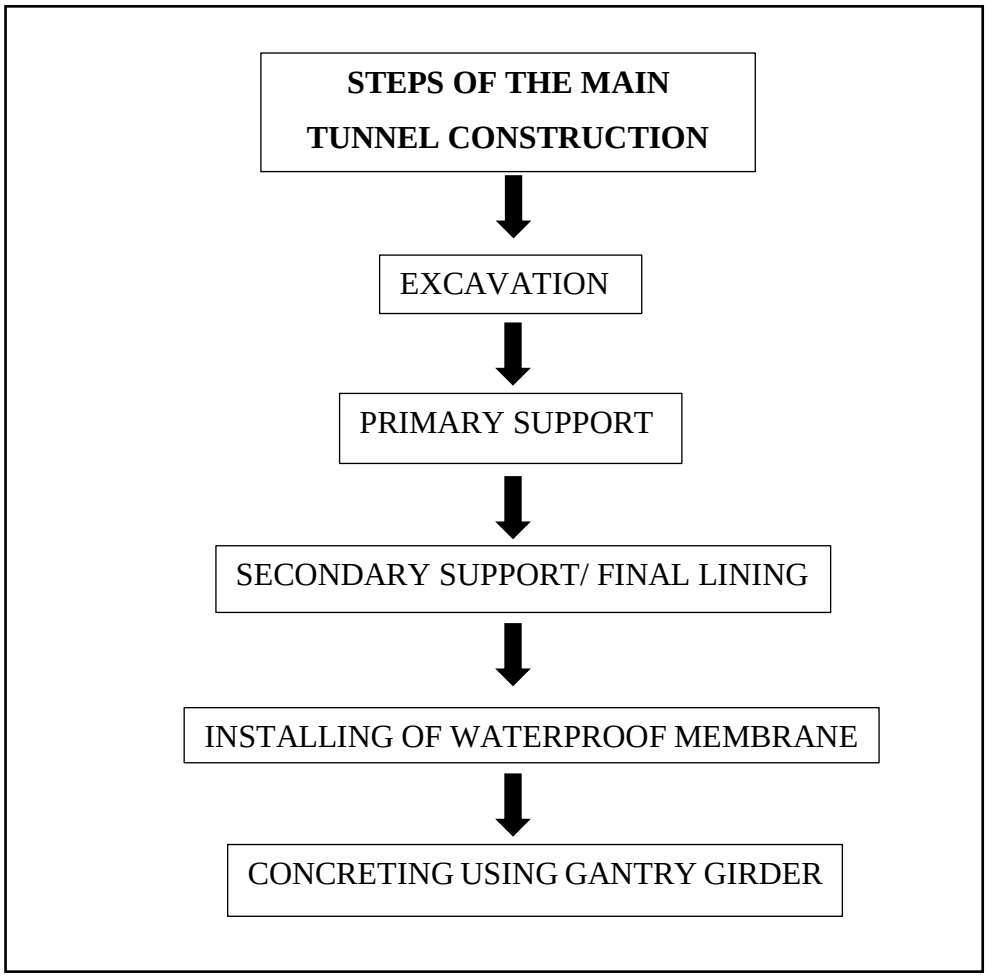
platform. This shape is suitable for shallow tunnels in good quality soil. Horse shape tunnels are commonly used for highway tunnels and there are many hundreds of kilometres of horseshoe shaped tunnels all over the world. For transporting machines and materials too, it is easily transportable in this shape of the tunnel. Secondary supports or final lining will be installed after the checking of deformations to the soil. The deformations used to occur in the sudden shaking or earthquake like natural calamities used to occur. The cut and cover method, a traditional form of tunnelling, that involves opening the ground surface and excavating to the required depth. Once the construction is complete, the excavation is backfilled. The method is used when excavation is possible and economical from the surface, and environmentally acceptable.

Fig 1. Steps followed for the construction of the tunnel



3. Results and Discussion

3.1 Main Tunnel

The main tunnel has been constructed in Broad gauge standard having a rail width of 1676mm for transportation of materials and passengers between Jiribam and the state capital, Imphal. The project covers only for construction of tunnel from Tupul to Imphal about 9551.00metres. Besides, transportation of the above, other benefits like efficient use of underground land, redirecting traffic congestion from town centres, decreasing landscape damage, and reducing air pollution in residential areas.

3.2 Safety Tunnel

A parallel safety tunnel is a tunnel that runs parallel to the main tunnel and is used for emergency purposes such as evacuation, rescue, and firefighting. It is also used for ventilation and drainage

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purpose. Parallel safety tunnels are usually smaller than the main tunnel and are located are at a safe distance from it. They are also equipped with safety features such as fire doors, fire extinguishers and emergency lighting. If the main tunnel is more than 2,000.00 metres, parallel safety tunnels are provided. There are eleven main tunnels along the alignment which does not provide safety tunnels.

3.3 Cross Passage

A cross passage is a short tunnel that connects two parallel tunnels. These passages are an important safety feature that allow people (including emergency services) to move from one tunnel to the other in the event of an emergency**.** There are altogether 31 cross passages provided between the two tunnels.

3.4 Portal

A tunnel entrance is called a Portal. Tunnels may also be started from the bottom of a vertical shaft or from the end of a horizontal tunnel driven principally for construction access and called an Adit. There are two portals P-1 and P-2. The distance between the two portals is about 9551.00m.

Fig. 2. Portal 2

3.5 Adit

An Adit is a horizontal or near-horizontal passageway to a larger underground excavation for the purpose of ventilation, water removal or auxiliary entrance. It provides faces to start construction of tunnel work simultaneously from both the ends. The transportation of construction materials is carried through this Adit. The ruling gradient provided in Adit is 1 in 10m.

Fig. 3. Adit 1

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This overall part of the tunnel has been a crucial part for the engineers and the geologists to see the changes or the deformations taking place near the primary supports to the shape of the tunnel. It further explains and gives more appropriate methods that can be used well by having and knowing the steps to install or to provide new techniques and help in accomplishing the work more efficiently in a better way.

3.6 Ventilation

There are various types of ventilation systems in tunnel construction provided to remove dust and poisonous gas during its construction and operation. These ventilation systems in tunnel construction are discussed in this article. The tunnel construction works are mainly carried out by drill and blast method, which have many safety and health issues due to the emission of dust and many poisonous gasses. Hence it is essential to provide ventilation systems in in tunnel during construction. The main objectives of providing ventilation systems in tunnel are:

- To provide the working crew an environment of fresh air.
- To exhaust out fumes and gasses, that is injurious to health and explosive in nature.
- To remove the drilling, mucking, and blasting gasses emitted.

Ventilation during construction and after completion of tunnel construction is an essential feature that a tunnel should own to facilitate functional, comfortable and a safe tunnel environment for both the road and railway tunnels.

Fig. 4. Main tunnel and Ventilation

3.7 Maintenance of railway tunnels

The P.W.I. usually inspects every tunnel in the section once year after the monsoon season. But he is personally responsible to maintain the track through tunnel in perfect running order. Following points should be noted in connection with the maintenance of the railway tunnels:

- The slopes of portals at entry and exit should be checked.
- It should be seen whether the masonry has crushed, cracked, or deteriorated.
- Any signs of movement of the masonry units should be noticed.
- Rails, fastenings, and sleepers should be examined and it should be seen that they are not affected by corrosion.
- The track through the tunnel should in line and level.
- The dimensions of the tunnel-section should conform to the original dimensions.

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- Linings of the tunnel should be examined and it should be seen whether it is in satisfactory condition or not.

CONCLUSION

The work construction of Main Tunnel No. – 12 from Tupul to Imphal was awarded on 31/12/2015 and the parallel safety tunnel was awarded on 12/02/2017. About 70% of the project has been completed. As the remaining portion of the project lies in a complex soil strata in the valley area of Imphal West district in Manipur, the progress of the work has been slowed down.

The construction of two vertical shafts having a dimension of 20.00m x 13.00m is in progress. The depth of the vertical shaft No. 1 is about 45.00 m and shaft No. 2 is about 35.00 m. The Grab machine for excavation of foundation for such a huge depth is at site. The crane which is going to lift the reinforcement cage for diaphragm wall is also ready at site. The installation of bentonite slurry plant had also been completed. The work is in progress. The casting of concrete shall be done by using method of Tremie.

It is concluded that the construction of different types of structures can be seen along the route from Tupul to Imphal railway project. This route will be one of the most prestigious engineering marvels in the history of Indian Railways. The professional and the engineering students around the country will experience such a beautiful structure which cannot be seen anywhere in the country.

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