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Safety in Underground Tunnel

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***Abstract*—** Safe drilling of the underground tunnels without any harm to human resource or to the original structure of the tunnel is always a challenging process. To avoid any of the damages to the design or the damage to the human resource we use various precautions. The main aim of the paper is to classify the various methods for safety precautions to avoid such hazardous accidents which could cause in delay of project, increase in labour work and also increase the budget of project and can also cause harm to human life. These all problems will lead to change in original design and will lead to delay of the construction of tunnel which is not acceptable. Hence these paper will lead to various methods which can be used to avoid all these problems while construction of the tunnel.

Keywords*—Excavation,Ventelation,Surveying,Component Person, Safe drilling.*

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I. INTRODUCTION

The safety in construction of tunnel begins with the initial stage i.e. Design of tunnel and ends with the completion of the project i.e. Hand over. The design team must be composed of design and construction engineers and geologists experienced in underground construction. Methods and sequences of excavation affect the loads and displacements that must be resisted by initial and permanent ground support. The basic shape of an excavated opening must be selected for practicality of construction. Although it is good practice to leave many details of construction for the contractor to decide, it is often necessary for the designer to specify methods of construction when the choice of methods affects the quality or safety of the work or when construction will have environmental effects. There are aspects of construction where the design team may have to work closely with the contractor or include restrictive provisions in the specifications [2].

International companies in building and construction are forcing Indian companies to upgrade their safety norms and procedures. Safety in construction is frequently pushed to the bottom rung of priorities by the builders, contractors and engineers. While monetary loss heads the list, loss of man-hours and material progress are equally irreparable when scaffolding fails, a roof collapses or a fatal accident takes place at site of work, the human life is irreplaceable.

Finally the legal actions and vicarious culpability that invariably follow, haunts the management and chief executive too. Many builders have had the experience that once a worker loses his life in an accident at site, the morale of the working force sinks to a new low[1]. The spirit of working and the progress of work never remain the same as before. With all this the safety aspect is often ignored. Only after some untoward incident occurs, do contractors begin to take safeguards. International companies in building and construction are forcing Indian companies to upgrade their safety norms and procedures.

The objective behind the study is to find out the various dangerous areas in tunnel construction & the measures to improve the safety in the same. The main objective is to study the standards provided by the OSHA and comparing these standards with the actual practice followed on site.

Findings of the International Labour Organisation reveal that the accident rate among industrial workers is highest in India, touching 4 per 1000 and a major share of it is accounted by the building and construction sector. Indian construction industry is highly labour-intensive. Though mechanization in construction projects is inevitable, induction of machinery and equipment is taking place in a very slow manner. Unskilled and semi-skilled labour is cheap, unorganised, being unaware of their rights, builders find it convenient and profitable to use manpower than machines[4].

II METHOD

Now, we will see procedure in detail by sectoring it into two sections.

1. EXCAVATION

The typical cycle of excavation by blasting is performed in the following steps:

(1) Drilling blast holes and loading them with explosives.

(2) Detonating the blast, followed by ventilation to remove blast fumes.
(3) Removal of the blasted rock (mucking).
(4) Scaling crown and walls to remove loosened pieces of rock.
(5) Installing initial ground support.
(6) Advancing rail, ventilation, and utilities.

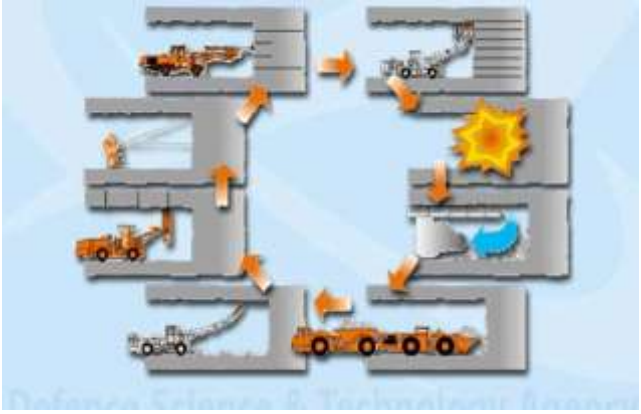

Figure No. 1- Cycle of Excavation

2. Hydraulic Splitter

Water driven splitter, otherwise called rock splitter and darda splitter a kind of ordinary pressure driven device that is utilized as a part of devastation employments which include breaking substantial squares of cement and shakes. Water driven rock splitters comprise of two wedges which are embedded in a predrilled gap and a pressure driven chamber is putting out a middle wedge between the two side wedges constraining them to separate[6].

3. Slurry-shield Machine

Slurry shield are TBM fitted with a full face cutter head which gives face support by pressurizing exhausting liquid inside cutter head chamber. These machines are most suited for passages through unsteady materials subjected to high ground water weight or water inflow that must be ceased by supporting the face with an exhausting liquid subjected to pressure [6].

III SAFETY PROCESS

1. VENTILATION

Development works dependably include risk and their surroundings is not generally spotless. If there should be an occurrence of burrowing works, particularly in passages to be built with the drill and impact technique, the issues on the wellbeing and wellbeing, for example, the ones by dust and toxic substance gas are not kidding subjects.
Standards on Ventilation in Tunnel-

1. Dust and gas caused by drilling, blasting and loading of excavated materials and concreting
2. Exhaust gas and smoke discharged by diesel
3. Poison gas made from explosive or organic solvent
4. Poison gas, flammable gas or oxygen shortage gas in ground
5. High temperature and high humidity [3].

2. AIR MONITORING

Under the standard, the business is required to relegate an equipped individual to perform all air checking required to decide appropriate ventilation and quantitative estimations of possibly dangerous gasses. In occasions where checking of airborne contaminants is required by the standard to be directed "as regularly as important," this individual is in charge of figuring out which substances to screen and how every now and again, thinking about elements, for example, jobsite area, geography, history, work practices, and conditions.

The air in every single underground territory should be tried quantitatively for carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other dangerous gasses, cleans, vapors, fogs, and exhaust as regularly as important to guarantee that endorsed limits (29 CFR 1926.55) are met. Quantitative tests for methane should likewise be performed keeping in mind the end goal to figure out if an operation is gassy or possibly gassy and so as to agree to other area of standards[3].

3. ILLUMINATION

As in all construction operations, the standard requires that proper illumination be provided during tunnelling operations, as specified in 29 CFR 1926.56. When explosives are handled, only acceptable portable lighting equipment shall be used within 50 feet of underground heading.

4. FIRE PREVENTION & CONTROL

Notwithstanding the necessities of Subpart F, "Fire Protection and Prevention" (29 CFR 1926), open blazes and fires are disallowed in all underground development exercises, with the exception of hot work operations. Smoking is permitted just in zones free of flame and blast dangers, and the business is required to post signs precluding smoking and open blazes where these perils exist. Different work practices are additionally distinguished as preventive measures. For instance, there are restrictions on the funneling of diesel fuel from the surface to an underground area. Additionally, the channel or hose framework used to exchange fuel from the surface to the capacity tank must stay unfilled with the exception of when exchanging the fuel. Fuel is not to be utilized, put away, or conveyed underground. Gasses, for example, acetylene, melted petroleum, and methyl acetylene

propadiene (balanced out) might be utilized underground just for hot work operations. Breaks and spills of combustible or burnable liquids must be tidied up quickly. The standard additionally requires fire avoidance measures with respect to fireproof boundaries, heat proof pressure driven liquids, the area and capacity of burnable materials close openings or access to underground operations, electrical establishments underground, lighting installations, fire quenchers, and so forth.

5. EMERGENCIES

At work sites where 25 or more employees work underground at one time, employers are required to provide rescue teams or rescue services that include at least two 5-person teams (one on the jobsite or within one-half hour travel time and one within 2 hours travel time). Where there are fewer than 25 employees underground at one time, the employer shall provide or make available in advance one 5-person rescue time on site or within one-half hour travel time.

6. OTHER PRECAUTITIONS

At the point when the able individual confirms that there are contaminants exhibit that are unsafe to life, the business must post notification of the condition at all doors to underground work regions and must guarantee that the fundamental precautionary measures are taken[3].

In cases were 5 percent or a greater amount of the LEL for these gasses is available, steps must be taken to expand ventilation air volume to decrease the focus to under 5 percent of the LEL (with the exception of when working under gassy/possibly gassy necessities). At the point when 10 percent or a greater amount of the LEL for methane or other combustible gasses is recognized where welding, cutting, or other "hot" work is being performed, work might be suspended until the fixation is decreased to fewer than 10 percent of the LEL.

IV CONCLUSION

As a developing nation Construction is one of the areas of employment where hazardous conditions are part of the everyday working environment. Safety is important in construction because of the many risks to worker health. The construction industry includes a diverse array of working environments. No two construction job sites are exactly the same. Hence there is need to identify the basic areas in each & every construction site. On tunneling site the main hazardous activities are Drilling and Blasting & Ventilation requirement after blasting. When construction workers report to the job site, their employers are legally accountable for worker injuries. In order to protect the workers and the employers, managers and workers must follow uniform safety procedures so that everyone is safe. A breakdown in adherence to safety procedures can result in worker injury and even death. To ensure the safety of workers at site the safety inspector should be present all the time. As a developing we don't put efforts in safety provision but this really affects the core of nation. This is not about the one life it destroys the whole family. Every year approximately more than 2000 workers died all over India this is really large number. We are losing manpower which is the strength of our country. This is very serious issue we need to overcome this for the betterment of the nation.

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