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AUTOMATION IN METRO CONSTRUCTION INDUSTRY CASE OF INDIA

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Abstract:

Automation system used in construction sites can efficiently reduce construction time and increase safety by replacing human in dangerous operations. Construction robots are defined as field robots and while operating in dynamic environment. Robotic systems have become common in many manufacturing and production operations because they have proven to be more robust, safe, efficient, accurate and productive. There are specific areas of application in which robots could benefit the industry. Feasibility of using robots in building construction is determined from comparison of robotic versus manual performance of pertinent building tasks.

Key words – Automation system, Construction robots

INTRODUCTION

India is the seventh largest country in the world and still its record of implementing major projects is far from satisfactory. The success or failure of any project mainly depends on two factors time and cost, apart from its quality which are the lifelines of each and every project. From the observations made one can infer that many of the construction projects in India is involved with extra time, money and resources.

In the situation as such the advancement of technology in recent years that have been found to be playing a major role across sectors such as manufacturing are finding their way into construction industry. Robotics and automation which has been the crux of scientific developments for the last century has been playing a major role in all other sectors except construction. A process to apply the same technologies in this field also will greatly benefit the outcome of construction activities.

AIM - Understanding the use of automated heavy machineries in construction of metro railways

OBJECTIVES -

- Understanding implementation of automation in metro construction
- Understanding reduction of time and saving cost in metro construction using automation
- Comparison between conventional method and automation

SCOPE -

This study examines the uses of automated system in metro construction

LIMITATION -

Study will be limited to tunnel construction work

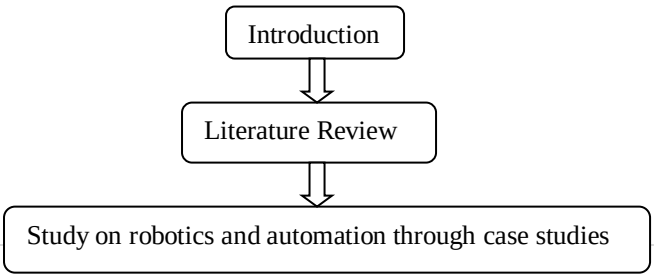
LITERATURE REVIEW

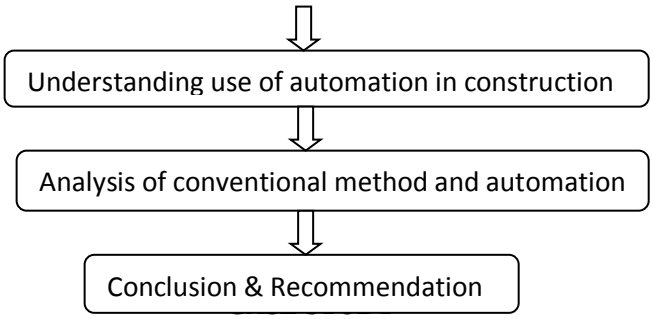
Today the construction industry is one of the most unpractised fields in terms of automation. The importance of construction automation has grown rapidly in developed countries. In developing countries like India, the construction industries need automation technologies such as new machineries, electronic devices, the automation of road, tunnel, and bridge construction; earthwork, etc. The recent developments in the fields of computer science and robotics have helped to develop new technologies in the field of construction industry.

One end of spectrum is mechanization which involves equipping the process with machinery whereas robotics is on the other end of spectrum is most sophisticated. Task specific, dedicated robots perform discrete tasks with the help of computer and artificial intelligence [i]. Mechanization helps in automation of processes which are not only supported by machine but also with a program which regulates machines. Japan industrial robot association (JIRA) defines robots as per degree of autonomy as: Manual handling devices; Fixed sequence robots; Variable sequence robots; Playback robots; Numerically controlled robot; Intelligent robots. (Van Gassel, and Maas, 2008) considered a mechanization graph in which energy and control provided by equipment and various mechanization phases are observed. Results showed that mechanization phases can be represented as a chain in which traditional method can be mechanized in phases as from hand tools; manually controlled device; Tele-controlled devices (remote control devices); pre-programmed devices (computer control devices); and cognitive robots [ii]. (Best, and Valence, 2002; Dev, 2008) also observed that modern Robots are developed through many generations. In this paper thus robots are considered with four generations as manually controlled machine, tele-controlled machines, computer-controlled machines and cognitive robots.

Automation is the technique, method, or system of operating or controlling a process by highly automatic means, as by electronic devices, use of control systems and information technologies, reducing human intervention to a minimum. Automation can be defined as appropriate use of machines, electronic devices and computer software for the construction work to increase the productivity of construction project, reduces the duration and laborious work, and increases the construction safety [iii]. Construction automation has been described as the use of mechanical and electronic means in construction to achieve automatic operation or control to reduce potential exposure, time or effort while maintaining or improving quality [iv].

METHODOLOGY





CASE STUDY

1. Pune Metro Construction, Kothrud, Pune.

Figure 1 : Pune metro construction site

About Project:

- Corridor Two - Vanaz to Ramwadi
- Length - 14.665 km
- Number of stations - 16
- Completely elevated corridor and both Pimpri-Chinchwad to Swargate and Vanaz to Ramwadi corridor would get integrated at Shivajinagar court.

2. Tunnel Construction for Underground Metro Line-3, B.K.C, Mumbai

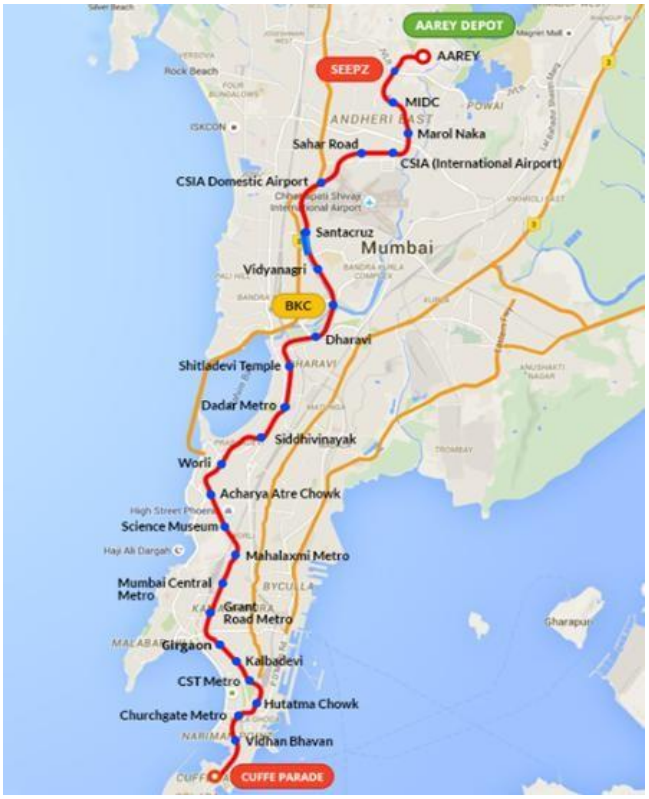


Figure 2 : MML route map

About Project:

Location - Mumbai metro line_3
Organizing Committee – Prof. Sudhanshu Pathak
Speakers - Er. Jamshed, Mr. Mishra,
Mr. Khim Singh,
Mr. Raghavendra Karant
Aim of the visit – To understand the underground tunnel construction.

Tunnel Boring Machine:

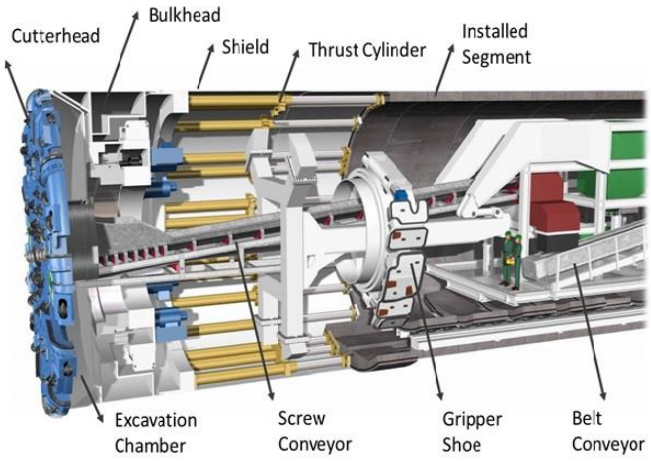


Figure 3 : Section of TBM Mechanism:

1. It is a machine used to excavate tunnels with a circular cross section through a variety of soil and rock strata.
2. In order to put the machine inside earth crust and start working, launching shaft is to be prepared.
3. Shaft of 22 M is prepared. Outer diameter is 6.35M but inner finish diameter is 5.80M.
4. TBM is divided in various parts which carry service lines D.G. set, Mugs etc.
5. Once mile the tunnel a simultaneous action to shielding of tunnel is done. This shield is precast having a length of 1.4 m. This one whole ring is divided in 5+1 segments.
6. Every day 8-10 rings are laid.
7. Cutter head is used to cut the soil while rotating and the screw conveyors conveys the entire soil to shaft from where they are lifted and dumped in Mugs.
8. After a distance of 70M all backup units are installed in tunnel and then it is ready to move without many problems.

Questionnaire Survey:

1. What are the types of automation used in the company?
Ans. – Fully automated and Semi-automated machines

2. What are the advantages regarding time due to automation used?

Ans. – Easy and fast working

3. Do it really affect time and cost?
Ans. – Yes

4. Does the productivity increase due to automation?
Ans. – Yes

5. What automation is used in following activities?
a) Excavation :- Excavator, Power Shovel
b) Footing :- Piling Machine
c) Pouring concrete :- Concrete pump machine

6. How many labours are used for operating those equipment's and software?
Ans. – 2 - 4 (Depends on machine)

7. What automation is used in execution of the project?
Ans. – Fully Automated & Semi-Autonomous Robot

8. How automation affected your company profit?
Ans. – 70-80 % Positively

FINDINGS

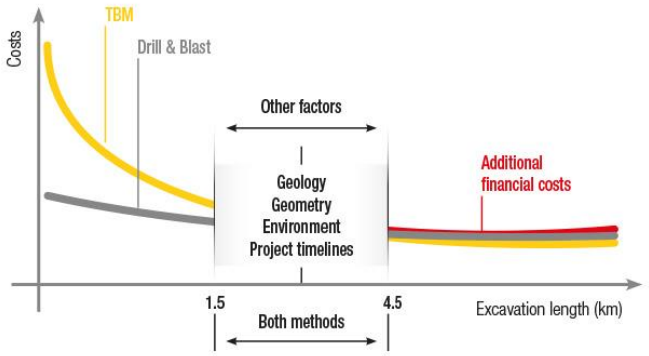


Figure 4 : Costs versus excavation length for TBM and Drill & Blast methods

- As a rule, for excavation lengths longer than 4.5 km a TBM is often recommended, while for lengths not exceeding 1.5 km, the Drill & Blast technique is usually the go-to.
- Bear in mind that this rule is not set in stone, and you may very well come across a 5 km tunnel being excavated using Drill & Blast, and a 1 km tunnel being excavated using TBM. Which is why each case much be studied individually.
- For tunnels with excavation lengths between 1.5 km and 4.5 km, costs are comparable, and so other factors must be taken into account: those relating to geology, geometry, the environment and project timelines.

CONCLUSION

1. To overcome this and to provide safe and comfortable transportation in all terrains tunneling is the best way to it provide easy tunneling even under huge buildings, tough terrains, under river beds too. It is the best suitable method for a fast-developing nation.
2. The main purpose of any organisation is that provide safe environment for worker and TBM is more control and safe than drilling and blasting.
3. Safety improves with increased automation as computerized systems control metro train movements more precisely than humans.

RECOMMENDATION

1. The importance of implementing automation technologies is the need of today's infrastructure project and construction firms in order to increase the productivity and good quality of work.

2. Today, it is evident that the level of automation in construction is very low in comparison with current technological advances. That is why we must make new efforts to increase the automation level of this important sector.

3. It is necessary economic efforts from the private industry and government to provide funds and resources for research and development of robot's technology.

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