



USE OF ROBOTICS AND AUTOMATION IN CONSTRUCTION INDUSTRY - CASE OF METRO CONSTRUCTION

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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 - Study the use of robotics and automated systems in construction industry: Understanding industry – specific challenges

OBJECTIVES -

1. Understanding implementation of robotics in construction
2. To identify the feasibility of using robots in construction
3. Understanding reduction of time and saving cost in construction using automation
4. Comparison between conventional method and automation

SCOPE -

This study examines the uses of robotics and 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.

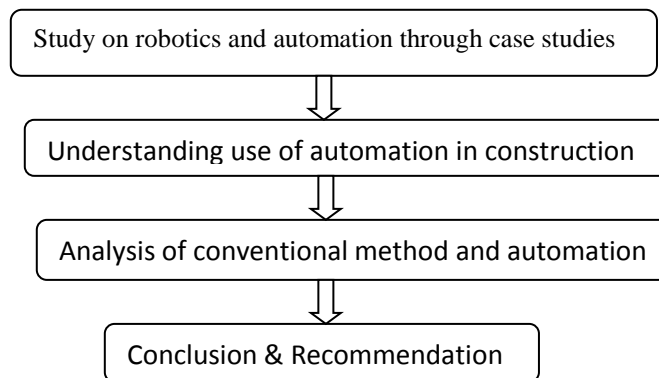
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One end of spectrum is mechanization which involves equipping the process with machinery whereas robotics is on the other end of spectrum is most sophisticated. Task specific, dedicated robots perform discrete tasks with the help of computer and artificial 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].



1. Pune Metro Construction, Kothrud, Pune.



Figure 1 : Pune metro construction site

About Project:

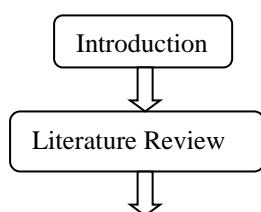
- Corridor Two - Vanaz to Ramwadi
- Length - 14.665 km
- Number of stations - 16
- Completely elevated corridor and both Pimpri-Chinchwad to Swargate and Vanaz to Ramwadi corridor would get integrated at Shivajinagar court.

Paver machine for Road Constricting:



Figure 2 : : Unchecked asphalt paver machine

METHODOLOGY



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METHOD	CONVENTIONAL	AUTOMATION
AREA	400 Sq. m	400 Sq. m
NO. of Labours / Machine	10 Labour's	Single machine
TIME	3 – 4 Hr.	1 Hr.
RENT	Rs. 1500 Per person / day	Rs. 5 Lakh / Month
PRECISION	75 To 85 %	90 To 95 %

Table 1: Comparison of Conventional and Automation
2. Tunnel Construction for Underground Metro Line-3, B.K.C, Mumbai

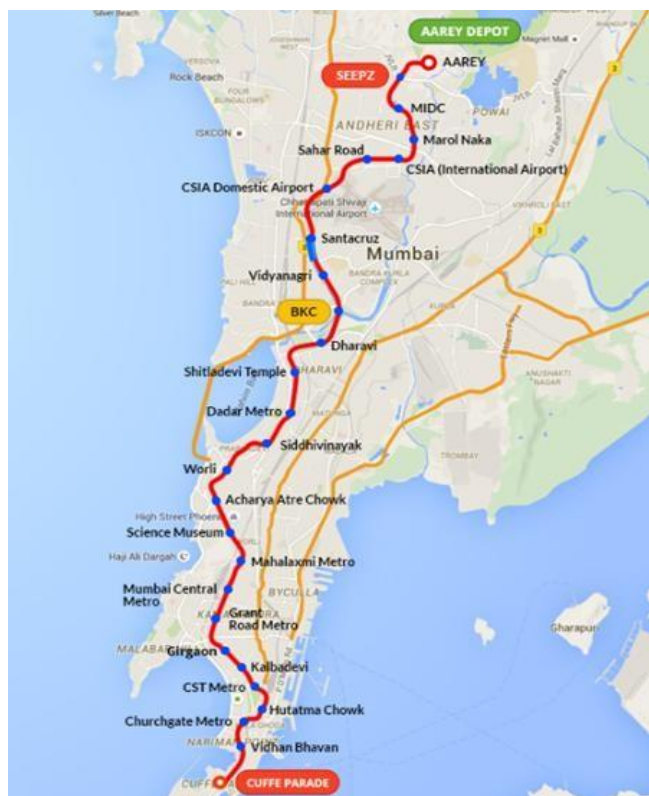


Figure 3 : MML route map

About Project:

Location - Mumbai metro line_3

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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:

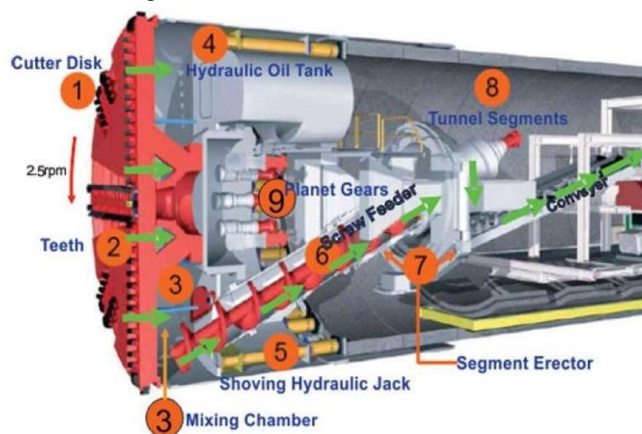


Figure 4 : Section of TBM

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 you mine 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 convey 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:

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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

1. NATM approach of design and execution of the tunneling in soft ground is advantageous and scientific way in comparison to the old way of tunneling.

2.. NATM system monitors rock mass deformation and design the support system with reference to the rock mass type

3. Automation and robotics in construction provides more precise and uniform quality product compare with products produced by experienced worker.

4. It replaces labours in those tasks which involve difficult physical work.

5. It simultaneously declines costs and increases efficiency and productivity.

CONCLUSION

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1. As the main objective of this study was to find the potential use of automation products in Metro construction in India, the results show that there is a very large potential for automation. As all type of firm uses 60 % or more manually controlled machine which can go to higher automation levels i.e. Tele-operated machines, computer controlled machine and cognitive robots.

2. Since India has second largest man - power in the world, automation is not replacements of the human-power but is an important supplement that caters to the need of mega-construction and fast-track construction.

3. It is important to maintain the correct relationship between the speed of processing and the speed of material delivery is essential for automation in construction industry. Use of robots will directly or indirectly save builder/contractor/owner to face legal problem and also the given tasks can be completed at a faster rate.

4. Both small firms and large firms of India have greater potential for adopting automation products.

RECOMMENDATION

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.

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.

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

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REFERENCES

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- i. Robotics in Construction Industry –
V. R. Prasath Kumar, M. Balasubramanian and
S. Jagadish Raj
Indian Journal of Science and Technology, Vol
9(23), DOI: 10.17485/ijst/2016/v9i23, June 2016
- ii. Application of Automation and Robotics
Technology in High-Rise Building Construction:
An Overview
35th International Symposium on Automation and
Robotics in Construction (ISARC 2018)
- iii. Robotics in construction technology
Akshatha D ,Vimala M , Sahana S , Manjula M
Vol.No. 6 , Issue no. 10. October 2017
- iv. A proposed “model for adoption” of high
technology products (robots) for Indian
construction industry
S. Jain and Dr. M. Phadtare
National Institute of Construction Management
and Research, Balewadi, Pune, India