

Modern techniques and automation in the Construction industry

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Abstract - As of now, India is coming up with the dynamic era of the construction and infrastructure. There has to be something that can bear the challenges humanity faces in working with conventional techniques nowadays. The traditional methods result in the involvement of a lot of time and effort. Apart from this, there are chances for human error introduction in these methods, as in most cases, the results are collected for a short duration and are extrapolated to bring out the outcome for a more extended period. These are the challenges with the traditional method. Many countries have come up with certain modern technologies, including automation, that is quite imperative for this growing Urbanization. However, in India, it lacks due to fewer resources and recommendations. It is challenging to get or provide the support which deals with the automation of these things. This paper sets out for the study of the difference in the conventional and modern techniques of construction and the various techniques adopted by other countries over India, which is coping with the challenges with old methods and how we can settle these techniques.

Keywords: Conventional methods, automation, construction.

Introduction

In developing countries like India, there is an extreme growth of technologies, modern trends, and materials in the worldwide Infrastructural market. With the Urbanization, the need for the latest technologies is rising to fulfill the current requirements. In the modern era, automation has a crucial role in the newest construction productivity to meet the demands and challenges in construction projects. There is a need to implement Modern construction techniques to augment efficiency, productivity, enhanced quality, environmental performance, user satisfaction, sustainability, and predictability of project completion. The Conventional practices in infrastructural development are not that adequate, and there is a need to augment the traditional techniques of construction following the global trend. For this purpose, automation is a crucial tool for operating and controlling the various stages of a project by using different electronic devices or systems to minimize human interference. The design and application of such techniques have shown progressive outcomes compared to the conventional methods and are discussed in this paper. Specific suitable methods seem to have a high potential in fulfilling the current industrial needs like 3D Volumetric Construction, Precast Flat Panel Modules, Tunnel Formwork System, Flat Slabbing Technology, Precast Foundation Technique, Hybrid Concrete Building Technique, Thin-Joint Masonry Technique, Insulating Concrete Formwork (ICF) Technique. The paper here presents a review of various conventional and modern construction techniques, their comparison, and the potential of contemporary construction techniques in infrastructural projects

1. Studies and Discussion

The study depicts the various methods used in the construction industry, both conventional as well as non-conventional. It has been observed that the traditional techniques used in the infrastructural market involve a lot of time and effort, impacting the cost of the overall project. To reduce this impact and the price for the project, specific advanced techniques are discussed in this paper, along with the comparison with traditional methods adopted. For developed countries, many of these practices are already taking place while in countries like India, it is still a challenge. Let us first look at the various conventional methods that are described in the following section.

1.1 Conventional methods used in construction

As discussed in [1], the various conventional methods are still widely used in the industry and involve the implementation of work at the given site only. This method includes setting up the various components of the building at the construction site only. This method consists of the installation of formwork, Reinforcement steel, and casting. Most of the parts are

constructed on reinforced concrete frames. Various examples of conventional construction methods (In-situ) are the foundation, framed structures, walls, floors, and roofs. These methods are responsible for incurring higher costs for the construction as the labour cost, material cost and transportation cost for these materials is comparatively higher as the construction periods are quite lengthy.

1.2 Modern Construction methods

The modern or advance construction methods are full of two types, as discussed in [9]:

(i) Off-site construction methods (non-on-site construction methods): All the products that are pre-fabricated in the industry are used at construction sites with their attachments and installation.

The different frameworks of this method are:

- **3-Dimensional Volumetric Construction** - All the products used at the construction site are already manufactured in the factories. The technique is used for the construction of bridges, houses, etc.



Fig 1: 3-D Volumetric Construction

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

- **Precast Flat Panel Module:** Modules that include flooring and primary walls that are manufactured away for the construction sites and after their completion is transferred to the working place.



Fig 2: Precast Flat Panel Module

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

- **Flat slabbing technology** - This method uses the integrity of contemporary formwork for rapidly assembling the slabs, which makes it smooth and quick to place it vertically and horizontally.

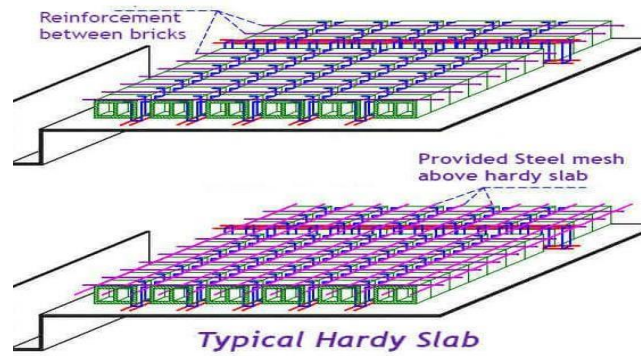


Fig 3: Flat slabbing technology

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

- **Precast Foundation Technique** -Establishments can be assembled quickly with precast reliable concrete units that are delivered in a processing plant and are high on the quality remainder. Quality is bestowed to establish related structure development materials through interconnected substantial concrete heaps.



Fig 4: Precast Foundation Technique

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

- **Hybrid Concrete Building Technique** - This method facilitates development turnaround time by mixing the benefits of concrete precasting with in-situ construction. Quality improves, though the expense of development dives. In this method, we add volumetric construction with a precast panel module.

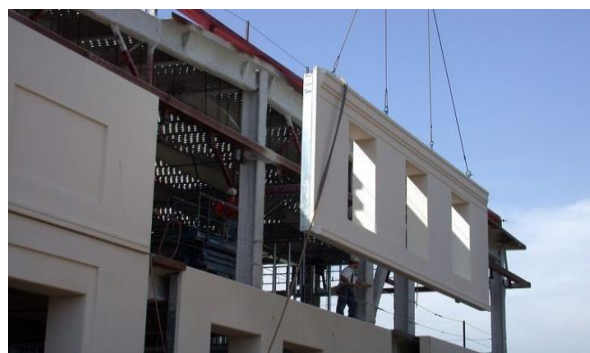


Fig 5: Hybrid Concrete Building Technique

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

(ii) On-site construction methods (Site based construction methods): *Else than off-site, this method deals with the use of traditional methods in a new or ingenious way to save human error, time, and cost.*

- **Tunnel Formwork System** - With this procedure, development is paced up for cell structures of monotonous arrangements through the construction of solid dividers or units in a solitary activity for each day. Quick work is accomplished by conveying formwork and promptly blended cement in with the comfort and spryness of manufacturing plant conditions. Formworks in burrow structures are stacked and utilized at the site with cranes.



Fig 6: Tunnel Formwork System

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

- **Thin-Joint Masonry Technique** - This is also known as Air Crete. Concrete products that were air creted are joined together to make significant parts of the building, such as walls, floors, and roofs. With huge estimated solid squares, higher development effectiveness alongside massive cost decrease can be accomplished. Inside a single day, the quantity of mortar courses laid is higher as restoration of mortar happens rapidly without settling on holding quality bringing about the disposal of drifting issues.



Fig 7: Thin-Joint Masonry Technique

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

- **Insulating Concrete Formwork (ICF) Technique** - strategy utilizes polystyrene bars that component twin surfaces and can be quickly assembled for making building surface formwork. The formwork is then siphoned in with excellent, prepared blended, manufacturing plant made concrete. The structure development process becomes idiot-proof, and the resultant structure has a significant level of sound and thermal protection



Fig 8: Insulating Concrete Formwork (ICF) Technique

Source: <http://sanchetibuilders.com/8-modern-building-construction-techniques/>

2. Automation in Construction Sector

There are various sub-sectors in the construction region such as Surveying, 3-D printing, Automated earthmovers, etc. that have reduced the chances of human error up to the maximum extent. The table [8] depicts the various categories in automation, along with their application in the industry.

Table 1: Different automation equipment and their applications according to various categories

Automation Category	System Type	Application
SURVEYING	Total Station	Measure horizontal, vertical angles as well as the sloping distance of object and contour
	3D Laser Scanner	Discrete and rapid field acquisition for the reliable site and design as well as dimension
	GIS System with an analytical tool	Surveying Planning and measurement; Route analysis
	Deep Tows	Deep-sea research and offshore structural projects
	Drones/Unmanned Aerial Vehicles	Calculating and monitoring of filling and excavated material and 3D modelling
3-D PRINTING	Contour Crafting	Rapid home construction with accuracy and improve site safety

BRICKLAYING MACHINES	Hadrian	Handles the automatic loading, cutting, routing, and placement of all the brick with high accuracy, High level of safety
	SAM bricklaying robot	Checks for vibration and auto-correct itself, improve site safety and faster construction

WALL ASSEMBLING ROBOT	Mighty Hand	Lifting heavy panels including concrete or glass curtain walls
	Shuttle system	Facilitates the construction of extra- large exterior wall panels
	The mechanized panel assembly system	The panels are installation of heavy exterior and interior materials
	Multi-jointed handling robot	Assists in the installation of heavy exterior and interior materials
	Automated Construction System	Erection and welding of the steel elements, fitting of curtain walls and the jacking of the construction operation platform
CONCRETE FLOOR FINISHING	Floor work robot	Successfully applied for floor finishing in large projects
	Mark II	Useful for floor finishing in small areas
AUTOMATED PAVER	Road Robot	Asphalt Paving
	tiger stone paving machine	Road Paving
INSPECTION SYSTEM	Roma; Rest	Steel bridge inspection and Welding robot
	Nero	Nuclear plant inspection

3. Results and Discussion

Certain vital aspects require attention when infrastructural market growth is considered. As per the data available in [5], it has been observed that there is a downfall in labour productivity during the past years. However, there is a rise in manufacturing and the industry as a whole, which is quite alarming for the construction industry. The chart below depicts the labour productivity that is recorded in the past years.

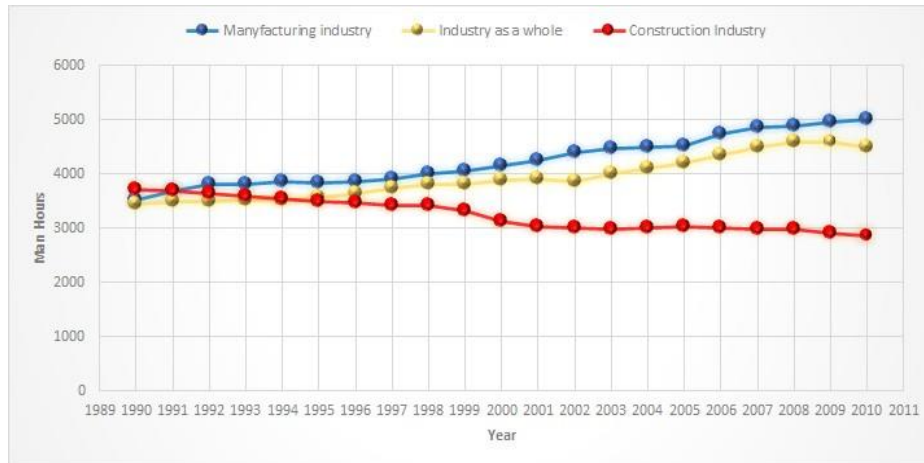


Fig 9: Labour productivity in the manufacturing industry, construction industry, and industry as a whole.

As per the graph, it can be observed that there is a need for automation in our industry to cover the lacking of labour productivity in the construction sector. It will not only increase the overall productivity of the industry but also it will save time, which is another essential factor.

4. Conclusion

On studying about the various types of modern techniques that are being implemented or are proposed for the purpose, it can be concluded that in the modern era of construction, the use of these techniques seems to be quite imperative to save both cost and time of development which are the leading vital indices of any project. Apart from this, automation has changed the whole scenario and has reduced the human effort and the probable human error in any aspect. It can be observed from the study that there is an extreme requirement of automation in developing countries like India so that the future development and level of service can be enhanced qualitatively.

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