

Application of BIM Technology in Water Distribution Network for Beed City

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Abstract With the rapid evolution of construction engineering in recent decades, water supply and drainage technology has gradually matured and with time, people's demands on the water supply system are getting higher and higher. There is a lack of decision-making tools for water supply design and construction to increase project benefits and water conservation. And with time, number of research studies have increased which indicates that Building Information Modelling (BIM) can improve the coordination with in the involved parties, work efficiency, and conduct simulation and analysis of sustainability performance in building projects.

By the application of BIM technology, the idea of building water supply and drainage designs can be related to the model, the various factors which affect the water supply and drainage design can be considered more comprehensively. BIM technology helps in improving the design process of building water supply and drainage, promoting the building water supply and drainage planning, improving the water supply and drainage system design level and over all building structure.

Index Terms – BIM, water supply design, drainage designs,

1. INTRODUCTION

With the continuous progress of modern social and economic level, and improvement in people's living standard, the level of water supply and drainage work which plays a very important role in construction engineering must be improved to meet the people's growing demand for building quality. However, at this stage software used by designer are 2D software like CAD which lacks in designing the most effective water supply and drainage system. Therefore, in order to meet the total efficiency of buildings water supply and drainage design, it is necessary to improve the design quality and adapt advanced technology for better outcomes from the design.

Building Information Modeling (BIM) – is introduced by Dr. Chuck Eastman (Georgia Institute of Technology in 1975). United States. BIM is an advance technology and one of the most promising recent developments in the architecture, and construction industry. The very aim of BIM is to make sure that appropriate information is created in a proper format at the right time so that the decisions made in the design, construction and operation of built assets will be accurate and flawless. Architects, engineers, and constructors get benefitted from it in many different ways like visualizing the structure in a simulated environment to identify any future design, construction, or operational problems in advance to overcome them eventually.

2. OBJECTIVE

- 2.1 To study the importance of BIM technology in construction industry.
- 2.2 To study Application of BIM Technology in Water Supply And Drainage Design.
- 2.3 To propose the scope of work of BIM technology in Water Distribution System. (Beed, Maharashtra.)
- 2.4 To study implications, hurdles and suitability of BIM in India

2 NEED FOR STUDY

The use of BIM is increasing rapidly and it is becoming one the most important tools for modern day infrastructure which allows users in design and creation of environment economical projects from the early stages thus saving time and reducing the cost as well as promising better project delivery and insuring satisfactory results.

According to the United Nations survey by the year 2050 the worlds population will almost be near 10 billion the authorities and global AEC industry must take whatever action necessary and take a smarter and convenient approach to the problem and come up with more efficient designs which not just for as a means to balance and keep up the global demand but also help to create more smarter and resilient structures

It not only allows improves the communication between design and construction teams so that they can work efficiently but also it allows them to store and capture the data that is being created during the process which benefits the operation and maintenance activities. This is the reason the demand for BIM is increasing globally.

Methodology

The methodology proposes introduction of BIM platform for management in a water distribution project where it commences with a brief overview about the project and terminates with typical BIM tools to be used for a collaborative approach in water supply projects. This paper intends a proposal that directs towards BIM driven approach. Despite enormous amount of energy and resources that go into treating our water, we lose an average more than 40% of it by the time it reaches our taps. This loss happens owing to pipeline leaks, breaks, poor efficiency, or even theft. Utilities are escalating to endure the growing population, simultaneously meeting more stringent drinking water guidelines / service level benchmarks. It is absolutely ineffective to analyze systems for water losses and manage water infrastructure projects in rote / traditional way. To address this, electronic devices and smart systems (like BIM, Artificial Intelligence based approaches, Internet of Things, etc.) are rapidly build and are connected to the pipes, storages and pump fixtures for a good understanding of infrastructure.

Importance of BIM Technology

- **Effective team collaboration and workflow efficiency:-** Architect, Engineers and all other parties involve in the project need to view different information at different phases of project and if any changes are made, precaution has to be taken that all the other documents related is updated.

BIM gives access to all the parties involve access collective utilization of a single dataset, means that edits made in one file are automatically updated throughout the system, removing the need to update different drafts as plans progress. Teams are allowed to work more collaboratively and are no longer required to waste time cross-checking documentation and files.

- **Higher quality results:-** BIM makes calculations and models design more detailed and accurate, and this results in a higher quality structure. And, because the BIM includes visualization process with the help of multiple tool, the structure becomes more aesthetically pleasing. Architects can also visualize final form of building.
- **More opportunities for prefabrication construction:-** As the working team have all the information and data available with us before actual construction, we can use prefabricated material which is produced off-site and directly make them available at site this lead to saving time, money as there is no need to construct these pieces at site. Which also leads to fewer accidents and casualties at site.
- **Cost and Resource Saving:-** One of the main benefit of BIM is it provide the reasonable and economical construction cost estimation before the construction phase begin these gives the involve agency better idea of estimation of project and this helps them to discover ways to reduce cost.
- **Eg.** Choose more cost effective material
Decide its cheaper to bring prefabricated material or built them on site.
Reduce human error which cause project delay or costly repair.

Various application of BIM technology in water supply and drainage design

Visualization In the previous 2D design mode, designers mainly use traditional drawing sheets or CAD platform, through using the ways of plan, elevation, cross-sectional view to show the content. Building water systems design are independent, and these systems has an effect in several floors. In this operating mode, it is easy to result in fragmented and distorted three-dimensional information, and even cause errors during the process of information transmission, when encountering more complex project or project having short construction period. But easy to understood and real-time features of BIM can ensure information's integrity and unity during transfer process. BIM designers can view the location of the device pipelines in three-dimensional model to judge rationality. Not only designers but Non-designers can also understand project information easily. This highly visual communication process is conducive to communicate and make decision faster than previous.

Synergy BIM has ability to aggregate information into the model from various sectors; you can read the information added by any sectors. When changes are made in one's professional design, BIM software get it updated in the model of other parties involved, it saves a lot of time of communication and coordination.

Integrated Pipeline BIM use the way of 3D visual presentation to reflect all pipelines in structure. Drainage designers can observe if any collision in the model are taking place when drawing and correct it accordingly, and also find errors through BIM collision detection. There are third-party software available in the market, which can detect hard and soft collision in models, such

as Navisworks. In the BIM model, designers not only find collisions within their field, but also detect the collision with other's fields, such as HVAC (heating, ventilation, and air conditioning), electric, etc. thereby reducing the project work of modifications at the time of construction.

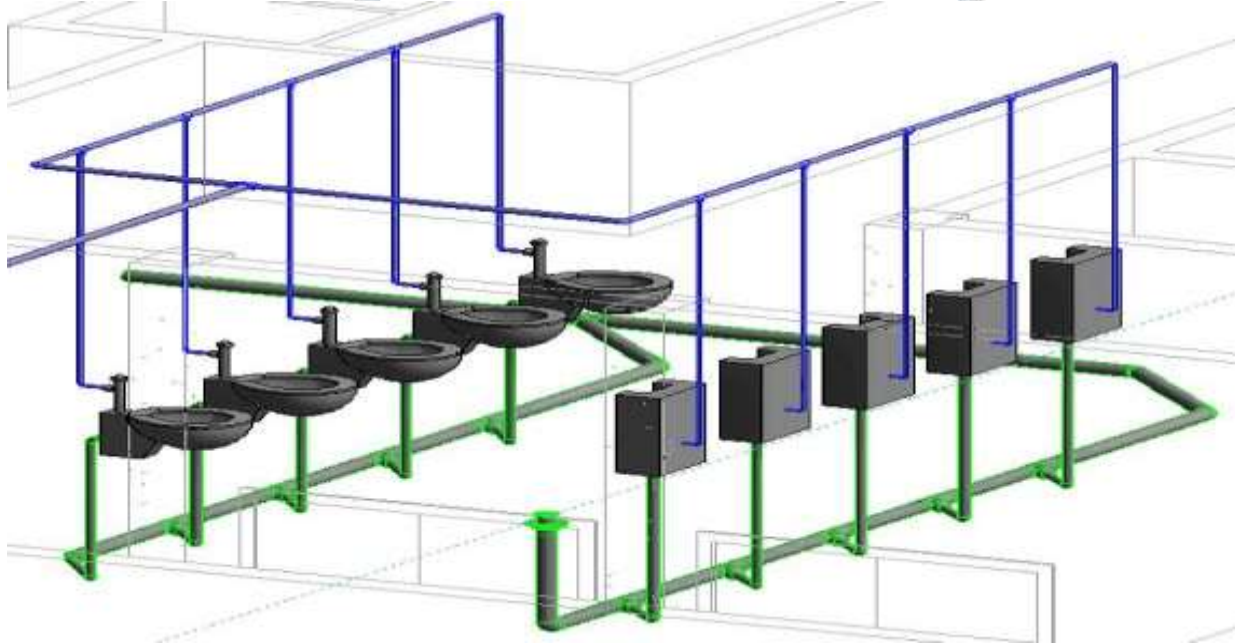
Eg. If any water pipe is colliding AC duct it can be detected earlier.

They can also achieve the clearance height of pipelines easily with BIM.

Materials Statistics Till now, water supply and drainage designers counts required material according to the traditional ways. They either measure it in CAD or count manually. The work to be done is over and complex, thus leading to cause errors and waste time. The BIM model contains this content-without manual work, it's able to provide reliable real-time statistics of materials and provide effective information for engineering programs selection, final accounts and others.

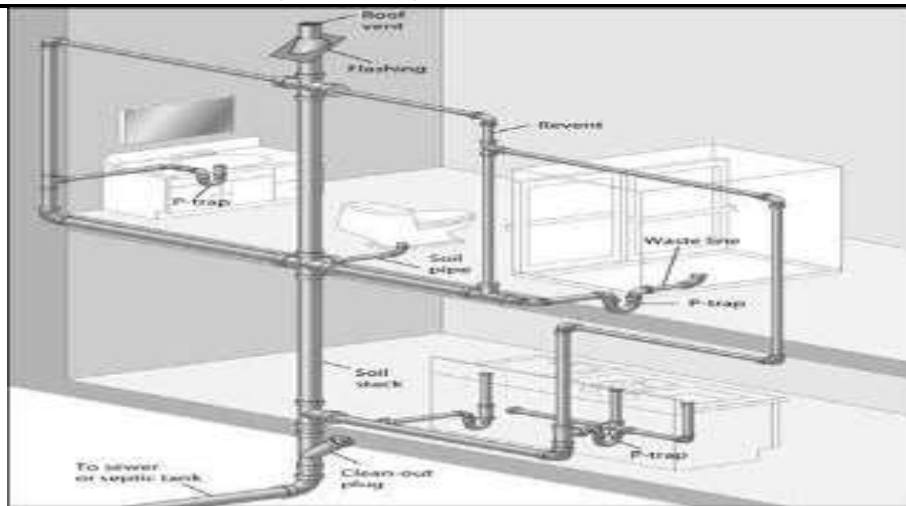
Construction Simulation In the traditional process of construction, project used to delayed because of space conflict among different professions. It often appears the situation that different designers of different sector refuse to compromise on any matter leading to require a longer time to coordinate. The BIM has introduced the concept of time; it helps in planning and scheduling the various stages of construction scientifically and legitimately, evaluate rationality of design integrally and completely, coordinate installation jobs. It also reduces the waste of time due to various factors, raises installation efficiency of any components, giving best aesthetic view to project and achieves projects' pre-visualization completely.

Installation of Sanitary Appliances In BIM design software you can directly use the components like showers, washbasin to setup a three-dimensional model of a building. The 3D BIM software imports the two dimensional CAD design plan and then determines the its axis and elevation.



The designers can choose sanitary equipment's which meets the standards requirements if the size and parameters differ from the standard requirements then they should be changed.

The Installment of Drainage Pipelines Installation of drainage pipe is complex work, therefore its design is needed prior to the actual work. Toilet water supply and drainage system consists of horizontal tubes, elbows and standpipes. The basic parameters of the pipeline are set before they are connected by the designers including its material, the nominal diameter, height of installation, slope and its attachment type, then the pipelines are drawn and installed in their corresponding positions. After the completion of installation they are imported in building model and 3D model is made and rendered we can see and observe the model clearly then after.



Proposed the Scope of BIM Use for Water Distribution System For Beed City :-

Details of Proposed Area:- Beed, Marathwada Region, Maharashtra.



Beed District in Maharashtra

- Project Area:- 45 Km.Sq
- Source of water:- Ground water, Bindusara Dam.
- Present Population (Approx.) 6 to 7 lakh

- Projected Population by 2035 :- 10 lakh
- No. of Storages: 15 Nos
- Total Network Length – 600 Kms including exiting CI & proposed DI and HDPE pipes



Beed City Water Plan

In the near future there will rise in population, the current water distribution system will not be able to fulfilled the water supply need in every household. Therefore they have to make changes in there water distribution system so that this problem are solved.

The purpose of this paper is to introduced the scope of work of BIM application in water distribution system of the city.

Integration of BIM enabled software with scope of work:

S.N.	Component	Details	BIM Integration
1	<ul style="list-style-type: none"> ➤ Survey & Investigations ➤ Consumer Survey , Pipe Condition, Assessment Survey, Preparation of GIS Base Map 	<ul style="list-style-type: none"> ➤ Data Collection, Topographic Survey 	<ul style="list-style-type: none"> ➤ 2D & 3D Maps / Models using Autodesk/ Bentley Subsurface utility engineering software for survey and underground utilities ➤ Geotag of consumers using Arch GIS
2	Design & Engineering	<ul style="list-style-type: none"> ➤ Design Basis Report, Demand Calculation & Network Modelling, DMA Formation , DMA wise Detailed Design & Drawings, Mass Balance of Storage Structures, Design of Feeder Mains, Design for WTP improvements as per BOQ, Preparation of CIP, Procurement of software 	<ul style="list-style-type: none"> ➤ Hydraulic & Structural Design using Bentley product i.e Water-gems and Stadd-pro ➤ Project Planning using MSP/Primavera ➤ Capital investment Plan using Autodesk Navisworks Manage
3	Construction	<ul style="list-style-type: none"> ➤ Improvements to existing Water Treatment Plant, MS Rising Mains & DI Feeder Mains of Various Diameters, Construction of Over Head Tanks, Distribution Network – HDPE and DI pipes, Installation of Bulk Flow Meters (DMA Meters), House Service Connections & Consumer Water Meters, Develop Computerized Billing System and Customer Care Centre, Other ancillary works stated in Contract 	<ul style="list-style-type: none"> ➤ Plan resources / funds and track progress of each activity during construction phase using MSP/Primavera ➤ Prepare as-built drawings of infrastructure components using Autodesk ➤ Instrumentation & SCADA for data monitoring and control using SCADAPro for flows, pressures and water quality ➤ Setup CRM using Customized ERP
4	Operation & Maintenance	<ul style="list-style-type: none"> ➤ Routine Operation & Maintenance, Generate & Distribute Computerized Bills and development of Kiosk for revenue collection, Complaint redressal mechanism, Leak Detection & Repair to maintain targeted NRW levels 	<ul style="list-style-type: none"> ➤ Operate CRM for billing / collection and complaint redressal ➤ Update and record base maps with all activities / works done using GIS platform ➤ Keep track of NRW levels & other service level benchmarks through Ecodomus & ArchiFM

To study implications, hurdles and suitability of BIM in India

The second largest contributor of Indian economy comes from construction industry, this leads to have a significant impact on the infrastructure and future of housing and building projects, the Indian government should start investing in such new modern and advanced digital practices which will directly lead to better quality construction in the country.

India is expected to become the most populated country in the world overtaking China and is expected to have a population of 1.4 billion by the year 2025 this will lead to an increase in housing, educational institutions and good quality infrastructure. Countries like US, UAE, UK and China are already practicing these new construction technologies and have made heavy investments in them and as a result are seeing benefits such as increased productivity, greater efficiency, reduced cost and time period of project.

In the near future India plans to join the list of global economic leaders and as predicted in the earlier survey of 2017-18 Economic survey, India will require a massive investment of approximately 4.5 trillion dollars by the year 2040 to develop its infrastructure and to sustain a desired economic growth. Today in India almost all the infrastructure and construction projects are overspend by almost 20%. This amount isn't something to be neglected and proper steps should be taken to address thus by reducing the cost waste. However this BIM introduction in project delivery is not something new for India but it is the one that's talking it's time for implementation and will eliminate the overspending in time and cost.

As with many regions and industries, BIM is also facing a reluctance for acceptance in India as it has its own new ways of working but for Indian authorities its no different. The obstacles in BIM adoption are not unique. Lack of awareness as for what this technology is, why do we need it and how we should apply it, this impacts to lack of digital skills along with lack of funding.

BIM has been restricted and only used majorly in big projects due to its cost and effort. As BIM is increasing rapidly globally India is lagging behind in the race.

An estimation from the ministry of statistics and program implementation came forward which showed the Indian government has suffered a loss of 3.88 lakh crore rupees in overspending costs and the ministry also estimated that nearly 552 construction projects have witnessed a good amount of overspending in the time of the delivery.

If the BIM use is increased and government setups initiatives to support this digital techniques it'll significantly reduce the overspending which occurs infrastructure and construction projects this is done by reducing working hours, having accurate cost estimates and better supply chain management

India is slowly adopting the use of BIM in India as a result it is being used in many big construction projects but due to lack of skilled BIM operators working in India is another main factor contributing the slow adoption of BIM in the country.

There is a need to educate more people about this digital practices and its benefits and how we can achieve great results, BIM needs to be introduced at the early stages of education in universities especially, when construction and infrastructure which is rapidly growing in India

These new modern practices will not only improve the project delivery on time but will also provide a safe guard for environmental assets from the rapidly growing India's population.

Conclusion:-

Application of BIM model for water supply projects is highly effective due to following reason:

- It provides great efficiency in building water supply and drainage design.
- It provides ease of project completion with minimal errors.
- BIM technology provides architects and engineers with new design methods and ways and is on its way to become one of the mainstream technology used for design.
- BIM applications also help in significantly reducing the overruns caused in cost and materials.
- In water supply and drainage its very effective for pipeline and Sanitary design.

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