

# Effectiveness of Naviswork In Quality Management of Construction

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**Abstract-** *The potential of Building Information Modeling (BIM) to support a transformation of the processes of design and construction has been evident in the construction industry. Although BIM is considered helpful in improving design quality by eliminating conflicts and reducing rework, there has been little research into using BIM throughout the project for construction quality control and efficient information utilization. Due to the consistency of design data with quality data and construction process with quality control process, the potential of BIM implementation in quality management lies in its ability to present multi-dimensional data including design data and time sequence. This paper explores and discusses the advantages of 4D BIM for a quality application based on construction codes.*

**Keywords-** Autodesk BIM, Infracore 360, Naviswork, Revit.

## I. INTRODUCTION

Due to globalization of construction sector, construction projects increasingly utilize multinational, increasing the need for high quality and efficient communication alternatives. Parallel to this, visualisation is receiving increasing attention within the construction industry. However construction companies generally have not gained full advantage of the available visualization tools due to lack of sufficient experience and assistance in the successful implementation of the technologies.

Today many construction companies face many challenges and problems, such as “workmanship defects”, delay, and “cost overrun in complementing their projects in all over the industry. the globalization and competition are the most important reasons that each construction company needs to improve and correct its system for achieving its objectives by management tools.. Nowadays, quality has not just implicated on products and services in the organizations, it can be related to the process, system, and management as well. Quality of construction project is a general philosophy by which process is carried in a total quality infrastructure. The total quality infrastructure consists of several key pieces. The first, and one of the most important, is the quality system as a

business management tool. In 1987, the first edition of quality system was introduced by the International Organization for Standardization (ISO) to aim quality and customer's satisfaction improvement.

Some studies showed that lack of support from Top management is the most barrier to implement QMS in construction industry. Also, the lack of enough evidence concerning how QMS actually affects on organizational practices and performance (lack of awareness in benefits of QMS) is a big problem to motive owners and managers of construction companies in implementing QMS. Thus, this study was carried out with the aim of evaluating the impact of Quality Management by using Modern Tools and Techniques for implementation and comparative study of Conventional Methods of Quality Management over the using of Modern tools like Navisworks for Quality Management. Find out effectiveness of Navisworks software for the quality management by considering main elements of construction project (cost, time, quality/scope) in selected construction project.

## II. OBJECTIVE OF PROJECT

Determine the sectors of problems arise to maintain the Quality Management on construction site.

To Study use of NAVISWORK for effective solutions for quality related issues on construction work.

Investigate the adoption and implementation of Naviswork for ‘cost of quality’ in construction work.

Evaluate the results obtained by using Naviswork for quality management.

## III. BACKGROUND TO THE RESEARCH

Every construction project is unique and quality is ever changing factor i.e. quality change time to time, place to place. But many common activities in construction project like the concrete work, Block work, plastering, etc To eliminate

some amount of lag in quality management can be reduced by using some modern tools like

#### 1. Finance Planning:

Money is important aspect required in any work. Finance is the main factor of construction and in every type of work. Project team had to plan for financial payment to eliminate the risk because it might affect the project. Proper financial planning is very important part to going project smoothly. Without financial planning completion of project becomes difficult task.

#### 2. Building Plan and Construction Detail:

Problems of building plan and construction detail were found such as drawing not clear, drawing mistake, so they also became big problems in construction. Due to poor Detailing on sheets and drawings work execution becomes difficult. There are some small detailing are missing from draftsman that will become major hurdle while execution. There are lots of firms and peoples involved in Construction activity, so many detailed plans and drawing are involved in execution if the details on the drawings are not sufficient or user friendly then the work is not done as per expectation. Ultimately it will affect on the quality of work.

#### 3. Material and Equipment:

Any construction work cannot complete without using Construction Equipment, Some construction works might use special machines or equipment which had to study carefully regarding performances, suitability for work and prepare enough equipment for each work.

#### 4. Time for completion of work :

Completion of work with in time period is prime important thing in any construction project. In Some construction works had to be completed within a time limit such as in cases of urgent works. They caned limitation of work planning and they also caused other management problem. Therefore, contractor had to carefully consider this issue..

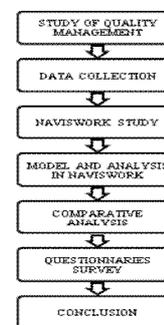
#### 5. Co-ordination among departments:

Coordination is very important for project successful. Because co-ordination between the departments is failed that may leads to wrong execution or may affect the sequence of work. For example consider the MEP (Mechanical Electrical Plumbing) department not properly co-ordinate with execution

team, now execution team done the plastering work before plumbing works are not done due to lack of coordination. Here definitely rework required so automatically quality is misplaced.

### IV. PROBLEM STATEMENT AND METHODOLOGY OF WORK

There are various tools and techniques are available for the quality management of construction work. Yet there are many difficulties to implement quality management in construction firms. Conventional methods of quality management are quite tedious and somehow troublesome to implement. For quality management and scheduling technique following case study from data collected is analyzed and compared in NAVISWORK.



**Fig 1 Methodology of Work Flowchart**

The objective of this research was to develop a comprehensive, informative and practical 4D BIM-based application for the purpose of construction quality management and to investigate how it can fit into the current construction practice. Also, the research identified potential problems with using Naviswork technology with current quality management methods, and proposes solutions. During the research, quality models that contained process, organization, and product (POP) information were built using national, industrial and local quality standards and codes. Then, a scheduling model and the quality model were integrated into a virtualized 4D BIM-based application to identify quality control criteria and responsibility assignments in the construction process.

A case study approach was adopted to explain the quality management that was developed from a comprehensive review of the site investigation. In the case study, the inspection data was acquired from the project general contractor and CAD drawings and the construction schedule were obtained from the project owner and from contractors.

G+4 proposed building of 24 flats and of 4 shops in Ravet, PUNE under PCMC for plot size 6800 sq.feet.

### V. THEORY CONTENT

## Building information modeling (BIM)

It is a process involving the generation and management of digital representations of physical and functional characteristics of places. Building information models (BIMs) are files which can be extracted, exchanged or networked to support decision-making regarding a building or other built asset. Current BIM software is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain diverse physical infrastructures, such as water, refuse, electricity, gas, communication utilities, roads, bridges, ports, tunnels,

BIM involves representing a design as combinations of "objects" – vague and undefined, generic or product-specific, solid shapes or void-space oriented (like the shape of a room), that carry their geometry, relations and attributes. BIM design tools allow extraction of different views from a building model for drawing production and other uses. These different views are automatically consistent, being based on a single definition of each object instance. BIM software also defines objects parametrically that is, the objects are defined as parameters and relations to other objects, so that if a related object is amended, dependent ones will automatically also change.

## Introduction of Autodesk Navisworks

Autodesk Navisworks reliably share, combine and review detailed 3D design models from multiple file formats. Clash Detection tools let you analyze interferences in a single model environment to find faults before they become problems. Real-time visualization and simulation allow you to validate design performance and reduce waste. Autodesk Navisworks software solutions enable project design, engineering, construction, and manufacturing professionals to unite contributions into a single building or process plant model.

### Architecture, Engineering & Construction Overview

The Autodesk Navisworks software family comprises three 3D design project review products and one free\* viewer application to help you and your extended teams experience enhanced control and confident collaboration on your most completed projects:

By combining the high-quality 3D design data created by AutoCAD® software, Revit-based applications, and Autodesk® Inventor® software with geometry and data from other design tools, Autodesk Navisworks project review products enable a dynamic real-time, whole-project view for:

Effective 3D coordination analysis 4D planning simulation Accurate photorealistic visualization The aggregated whole-project view can be published in both Autodesk Navisworks native NWD format and 3D.

### Autodesk Navisworks Manage

Autodesk Navisworks Manage software is a comprehensive project review solution for design, engineering, and construction management professionals seeking powerful insight and predictability to improve productivity and quality. Autodesk Navisworks Manage software provides all the tools required for smooth-running engineering and construction projects.

### Autodesk Navisworks Simulate

Autodesk Navisworks Simulate software adds the dynamic power of 4D scheduling and photorealism to Autodesk Navisworks Review software. The value of existing design data is extended to create clear descriptive content that demonstrates design intent and simulates construction to drive insight and predictability. When you can virtually experience your project in a visual context before the physical work begins, you can evaluate and verify the materials and textures appropriate to your intended design.

## VI. KEY FACTOR TO ADOPT NAVISWORK FOR QUALITY MANAGEMENT

### Faster Navigation and Checking:

Autodesk Navisworks has Real-time visualization which enables fast navigation and review of complex 3D models and all the project information they contain. By using Navisworks Manage to effectively explore designs without the need for pre-programmed animation, advanced hardware, or special skills. This will help in quality management on construction site in such a way that before the execution of the work on

### Consistent, Coordinated, Correct:

Autodesk Navisworks provides the most complete Navisworks design project review solution. Navisworks adds precise fault-finding analysis and interference management to the dynamic 4D project schedule simulation and photorealistic visualization of Autodesk Navisworks Simulate. Enabling consistent, coordinated, and correct construction documentation..

**Clash detection:**

Detecting collisions during design, in real time, gives the team a very efficient method to improve coordination among multiple building systems and ultimately avoid costly remedies after drawing completion and during construction. Enhances ability to filter through building elements quickly and run collision tests between isolated building elements. The same filters and searches can be saved and used throughout the project. Navisworks predicts clashes by combining all of the trades in the virtual world, allowing us to revise plans and schedules to resolve conflicts before construction begins. A clash occurs when elements of different models occupy the same space. There are 3 main types of clashes that clash detection seeks out:

1. Hard Clash: when two objects pass through each other. Most BIM modelling software eliminate the likelihood for this using clash detection rules based on embedded object data.
2. Soft Clash: work to detect clashes which occur when objects encroach into geometric tolerances for other objects (for example, a building being modelled too close to a high tension wire).
3. 4D/Workflow Clash: clash resolves scheduling clashes and abnormalities as well as delivery clashes

**VII. DATA COLLECTION AND CASE STUDY****Overview of case studies:**

As building information modeling is in planning phase, set of drawings are collected from PCMC and PMC area to understand conventional modelling procedure.

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As building information modeling is in planning phase, set of drawings are collected from PCMC and PMC area to understand conventional modeling procedure.

- Case study of a G+4 proposed building of 25 flats and of 4 shops in Ravet, PUNE
- Design Team : Rakesh Jain Associates
- Owner and Developer : DipeshNavlakha
- Architect : Rakesh Jain
- Structural Engineer : Sushil Dateer
- Project Manager : Shashikant Narayankar
- Builder: Yashraj Infracvt.ltd.
- Area : 6800 sq.feet
- Cost of land: 1.98 Cr.
- Cost of construction: 2.5 Cr.

- Area of 1 BHK:464 square feet
- Area of 2 BHK:800 square feet
- Total No. of flats
- No. of skilled labours required:25
- No. of site engineer required :1
- No. of structural engineer required :1
- No. of architect required :1
- Location: Ravet, PCMC
- Set back distance: 14”
- Side distancs-9”
- TDR:20%
- Survey No.93/1 Hissa No.68

**CASE STUDY-I:**

Drawing Shown below these are plan of plinth beam and Plumbing work. There is problem of rework and reconstruction arises on the site. First one is structural drawing provided by structural engineer and another is the plumbing drawing provided by plumbing contractor. In this case septic tank and underground water tank is placed in between plinth beams. As per the method of execution in the construction industry structural part will complete first and after that detailed work will execute but due to lack of coordination between structural engineer and plumbing contractor locations are mismatched. Due to lack of vision at the time of execution project team will not get the problem that will arising in future. Because of the lack of vision and co-ordination plinth beam constructed over the septic tank and this is not as per plan so project team was brake beams coming across the septic tank.

In above site condition if the Autodesk Naviswork was used by project team before execution of work then they will not suffer from the problem. due to this small mistake ample of quality material was wasted as well as there are also lose in manpower, time & cost also. This ‘Cost of quality’ ultimately affect on the budget as well as scheduling.

As the researcher said “Quality is the result of doing the right thing and doing it right the first time on time, so as to meet the customer's expectations and needs.” As per this definition of quality in above work right work is not done on right place in right timing and there is no any customer satisfaction. In short, there is no Quality work is done.

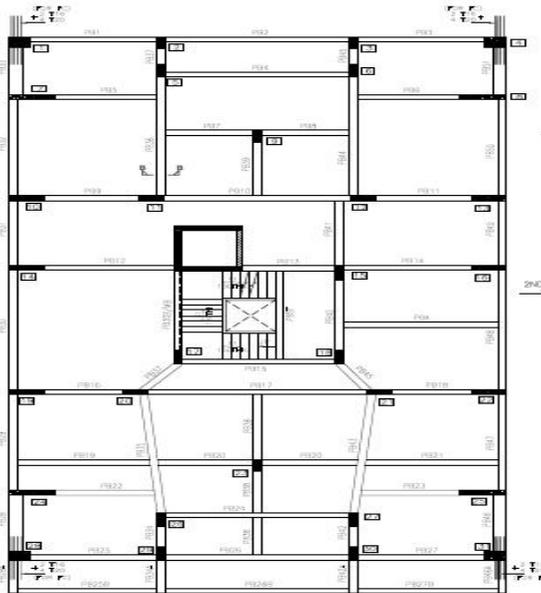


Fig 7.1. PLINTH BEAM FRAMING PLAN

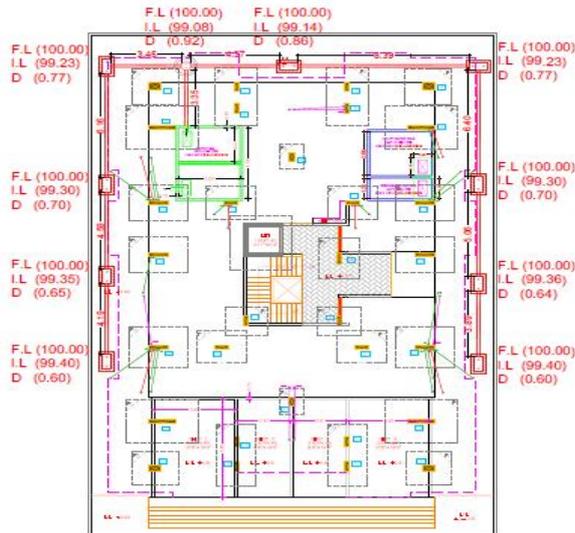
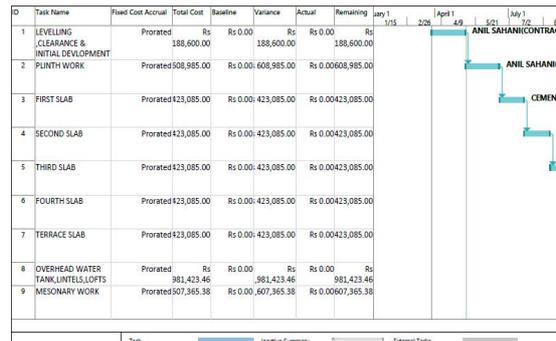


Fig. no 7.2 Drainage and plumbing drawing

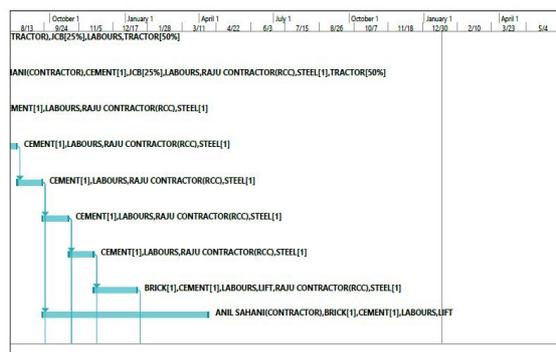
Fig no 7.3 MSP Schedule and Cost for site

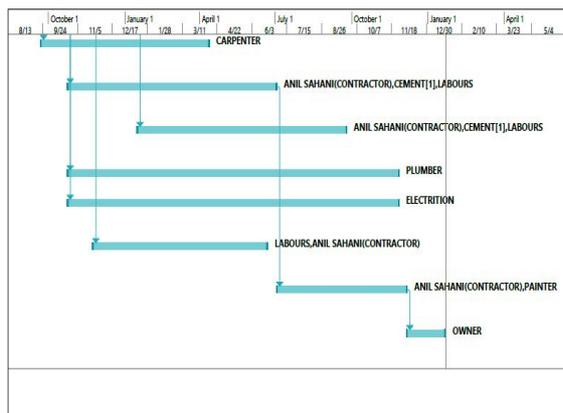
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		LEVELLING, CLEARANCE & INITIAL DEVELOPMENT	24 days	Wed 3/28/18	Tue 5/8/18	
2		PLINTH WORK	24 days	Wed 5/9/18	Tue 6/19/18	1
3		FIRST SLAB	18 days	Wed 6/20/18	Fri 7/20/18	2
4		SECOND SLAB	18 days	Fri 7/20/18	Tue 8/21/18	3
5		THIRD SLAB	18 days	Wed 8/22/18	Fri 9/21/18	4
6		FOURTH SLAB	18 days	Fri 9/21/18	Tue 10/23/18	5
7		TERRACE SLAB	18 days	Wed 10/24/18	Fri 11/23/18	6
8		OVERHEAD WATER TANK, LIFTS, LOFTS	30 days	Fri 11/23/18	Tue 1/15/19	7
9		MESONARY WORK	116 days	Fri 9/21/18	Fri 4/12/19	5
10		DOORS & WINDOWS	116 days	Fri 9/21/18	Fri 4/12/19	5
11		PLASTERING & CURING	144 days	Wed 10/24/18	Tue 7/2/19	6
12		FLOORING	144 days	Wed 1/16/19	Tue 9/24/19	8

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
13		PLUMBING, DRAINAGE & SANITARY WORK	228 days	Wed 10/24/18	Tue 11/26/19	6
14		ELECTRICAL WORK	228 days	Wed 10/24/18	Tue 11/26/19	6
15		WATER PROOFING	120 days	Fri 11/23/18	Fri 6/21/19	7
16		PAINTING	90 days	Wed 7/3/19	Fri 12/6/19	11
17		POSSESSION	26 days	Fri 12/6/19	Tue 1/21/20	16



ID	Task Name	Fixed Cost	Actual	Baseline	Variance	Actual	Remaining	July 1 '18	April 1 '19	July 1 '19
10	DOORS & WINDOWS	Prorated	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00			
11	PLASTERING & CURING	Prorated	Rs 21,950.00	Rs 0.00	Rs 21,950.00	Rs 0.00	Rs 21,950.00			
12	FLOORING	Prorated	Rs 21,950.00	Rs 0.00	Rs 21,950.00	Rs 0.00	Rs 21,950.00			
13	PLUMBING, DRAINAGE & SANITARY WORK	Prorated	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00			
14	ELECTRICAL WORK	Prorated	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00			
15	WATER PROOFING	Prorated	Rs 18,000.00	Rs 0.00	Rs 18,000.00	Rs 0.00	Rs 18,000.00			
16	PAINTING	Prorated	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00			
17	POSSESSION	Prorated	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00	Rs 0.00			





**Problem on site**



**Fig 7.3: Photo. Plinth Beam passing through Septic Tank**



**Fig 7.4: Photo Reconstruction of Tank**

**VIII. CONCLUSION**

Autodesk Naviswork is not only a visualization tool from that we can done simulation of construction site. This software can also be use for the quality Management also.

Quality management is different from quality control. Quality control describes inspection or checking of work products. Quality management is designed to prevent defects by doing the job right. Quality management is concerned with preventing problems by creating the attitudes and environment that makes prevention possible. Naviswork is done preventive work for construction site from Rework.

In present study the quality management through NAVISWORKS is analyzed. The plinth beam and underground septic tank problem can be solved in 4D model of clash Rumane A. R (2011), Quality management in construction projects (Industrial innovation series), CRC press, Boca Raton. detection test total cost benefit analysis in this model was 2,08,200.

One of the most important tasks of while using Navisworks is to effectively recognize the clashes and then group them according to their similarity so we can keep them in mind while execution and it will reduced rework and wastage of material as well as Cost, Manpower and time.

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