

Evaluating Factor Influencing Quality Management System in Residential Building

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Abstract - This study includes the understanding of the concepts and implementation of the quality management system in the construction of a residential building.

This project also deals with Physically inspection of all the activities of residential construction projects by standard checklist, and observe the problems arises during actual work which majorly effect on the quality of work. Findings of this study indicates that despite of standard guidelines and work procedures, sub-structure and superstructure activities need immediate attention to improve performance by imparting sufficient training to the workers and site supervisors for proper implementation of procedures. Moreover, Poor control of Middle level Management and inadequate supervisory staff as well as lack of QC personnel is the major problem towards achievement of quality. Preventive measures are suggested for different activities to enhance the quality of a building project.

Index Terms - checklist; Quality control; Quality assurance; Non-conformity; Quality Management System.

INTRODUCTION

Construction is an ever-growing activity across the globe. From economic angle the construction industry is that sector of economy that plans, designs, constructs, maintains, alters and repairs physical immobile structures and facilities like building complexes, transportation networks, power plants, ports and harbors etc. Quality in construction industry can be defined as the attainment of acceptable levels of performance from construction activities. This performance would be attained when the activity meets or exceeds the requirement of the client or the owner. The quality of any product or service is achieved when it conforms to the desired specifications.

Achieving quality in construction industry in long run is a tough issue and has been a problem. Inefficient or

no practice of quality management procedures will result in great loss of time, money, material, resources. The construction industry is one of the main contributors to the growth of economy of the country. It generates nearly half of fixed capital formation, employs large work force and has national and international markets (Chitkara, 2015). The output or the end product that the construction industry delivers is way different from the manufacturing and production industry, Among the various factors which define the success of a project, quality is one such critical factor. Quality has become the most important factor for the survival and success of today's companies. Over the last few decades, the concept of Quality Management has gained momentum amongst the construction companies to solve the quality problems and to meet the needs of its customers. Successful concepts which were derived in manufacturing industry, such as Total Quality Management (TQM), Just-in-Time Production etc. are now being adopted and integrated into the construction industry.

QUALITY

There are many ways found by researchers have to describe the quality into construction projects. Some of them quality Definition as follows:

“The totality of features and characteristics of product or service that bears on its ability to meet stated or implied need” (ISO 8402), “Fitness for use” (Juran, 1988), “Conformance to requirement” (Crosby, 1979). It's important that to satisfy the needs & expectations of customer is prime factor in all definitions.

Quality expressed by the simple formula:

$$Q = \frac{P}{E}$$

Quality Phases throughout the life cycle of construction project

- a) Quality of Concept: -Owner or User State his needs use from the structure which give indication of the quality requirement.
- b) Quality of Design: -Quality parameters incorporated in the designs of the components of the structure which encompass materials and their quality. Designer includes their quality needs in the specifications.
- c) Quality of Construction: - Quality built into the components of the structure resulting from material selector's processes and production stage.
- d) Quality of Conformance: - How well a product meets the specifications derived in stage one determines its quality conformance.
- e) Quality of Performance: - How well product performs in though environmental conditions for desired periods or design life.

OBJECTIVES OF THIS STUDY

The objective of this study is to investigate and understand the prevailing practices followed in the implementation of Quality Management System in construction industry with the help of a case study of a residential project. In order to fulfil Research gap the following objective define:

1. To study the factors influencing Qualities throughout the life cycle of Residential Building.
2. To monitor the performance of different construction activity in residential projects to assess quality.
3. To identify defects/deviations from the standards and carryout root cause analysis of various activities of the project under Case study.
4. To suggest recommendations to improve/enhance the construction Quality.

LITERATURE REVIEW

Project Quality Plan and Quality Management System:

J.Shengeza (2017) evaluated the application of Project Quality Plan (PQP) as one of the implementation strategies of Quality Management System in construction projects. The data was collected by use of questionnaire; interview and document review. The findings have established that PQP preparation and

application in construction building project is done at low key

Neyestani (2016) carried out a research to evaluate the impact of QMS implementation on main factors of construction projects in Metro Manila, Philippines. A questionnaire was designed and then it was distributed randomly among the 37 managers with the aim of collecting the relevant data. Finally, the analysis of data was accomplished by descriptive statistics to find the results and conclusion. The findings have shown that the implementation of QMS can be affected mostly on customer's satisfaction, followed by cost, and time respectively, while minimum effectiveness of QMS was on scope (quality) through QMS implementation in construction projects.

Quality management tools and techniques:

Jogdandet.al. (2017) concluded in their study that "In terms of quality management tools and techniques, construction projects are commonly using the check list followed by flow chart as quality tools. At construction project quality is mostly affected due to insufficient estimation of original contract duration. Customer satisfaction followed by competitive market is the important aspects for maintaining QMS."

Summary of Literature:

It was observed that most of research have presented different factors are affecting construction quality. This factor were identified and measured through a mechanism of Questionnaire survey. Various researchers have demonstrated finding on quality parameters influencing construction activities for Infrastructure project, Residential project and Commercial project. Applications of different quality management tools and techniques to measure the quality are explained in detail. Major problems regarding sampling and testing that affects the efficacy of quality are noticed.

METHODOLOGY

The purpose of this chapter is to present an overview of the procedures and work instructions related to an acceptance plan of quality assurance specifications while assessing the quality of on-going construction activity. Standard working practices are identified for each activity and process of monitoring and evaluation is discussed in details.

Details of Case study:

In order to fulfil the research objective, field study is carried out on an ongoing residential projects located in Maharashtra, India. Salient features are listed below:

- a) Type of project: Residential building.
- b) Status of the project: In progress.
- c) Commencement of project: June 2019.
- d) Planned Project duration: 24 calendar month.
- e) Expected completion of project : June 2021

Identification of Quality parameters:

Project quality measurements involve observing the activities during design stage, receiving and inspection of incoming raw material and utilization of these materials. It involves study of procedures, construction methods and the use of checklist during construction. Various parameters considered using Quality Management System (QMS) are shown in Figure 3.1.

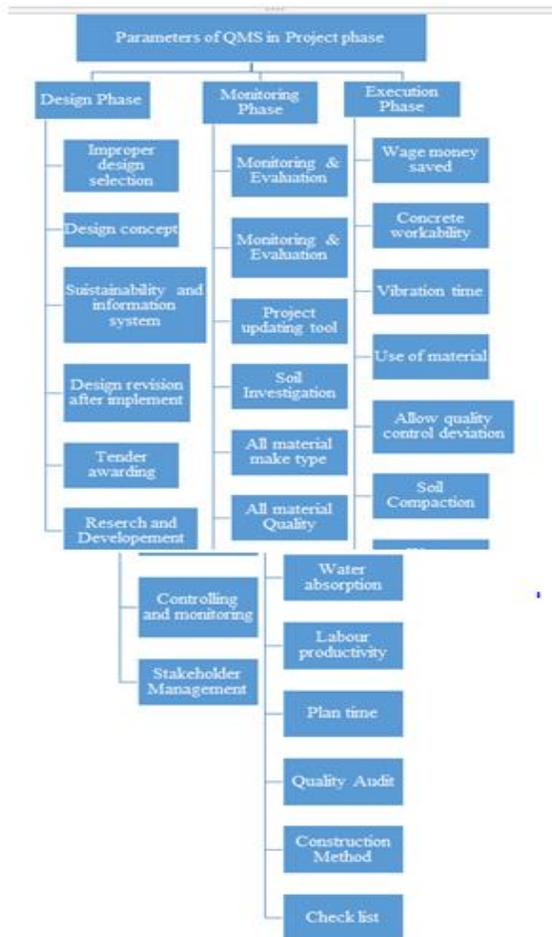


Figure 3.1 Quality Parameters considered in assessment

Observing on-going construction activity along with document verification:

In this process, physical verification of actual construction work is carried out according to procedure designed for performing particular task with the help of standard documents such as work instruction and checklists. Critical observations were recorded to know the deviation from standards.

Analysing Performance:

All the observations were analysed systematically by comparing with standard procedures and work instructions. Remarks from checklists were studied thoroughly to identify defects/deviations in the monitoring process.

Identification of Non-conformity:

After comparing the performance of each construction activity with their standard process; flaws/ deviations are detected in the construction activities. While detecting this defect, the drawbacks in the construction methods/ equipment's, materials etc. also considered in order to carry out root cause analysis.

Identification of construction activity for evaluation of quality:

After the observation of literature survey and the data collected from the construction site several factors that affects the quality of construction and infrastructure projects was observed and it was found that their nature varies through various projects. The factors that affects the quality of residential building project was inspected and measure in the all construction activities which is as follow. (Excavation, Backfilling, ATT, Soling, PCC, RCC (Footing, Column, Beam, Slab), Bloc masonry, Waterproofing, Flooring, Painting, Plaster, Door, Window, Elevator)

Activity, Critical Observation and its preventive solution

1. Excavation-
Critical Observation
 - 1) Soil Falling from the sides
 - 2) Extra excavation required than assumption in tender.
 - 3) Vehicle toppled during shifting of excavated material.
 - 4) Extra quantity for pcc and soling

Preventive solution-

- 1) Maintain sides of slope
- 2) If space between adjacent footings is less; carry out mass excavation.
- 3) Conduct soil investigation work in the preliminary stage
- 4) Provide ramp for access in the excavated area and maintain slope.
- 5) Minimize undulation of excavated surface, dressing to be done properly.

2. Backfilling-

Critical Observation

- 1) Settlement / Cracks observed in the surface PCC during monsoon.
- 2) Filling of stacked material.

Preventive solution-

- 1) Approved murum fill in the pit.
- 2) Layer wise compaction to be done as per standards.
- 3) Sufficient watering to be done for each layer.
- 4) Conduct compaction test.
- 5) At the time of excavation layer wise material stacking to be done to avoid mixing of soil, murum and boulder.

3. Anti-termite treatment-

Critical Observation

- 1) Faulty applying method, Rashes observed on the skin of labors
- 2) After applying ATT, again excavate surface area.
- 3) Storage of chemical.

Preventive solution-

- 1) ATT done by spraying machine.
- 2) Provide Gum boot, Goggle, mask and hand gloves to the labor.
- 3) ATT do on the approved surface where no more excavation is required.
- 4) Chemical store at safe place.

4. Soling-

Critical Observation

- 1) Improper Placing of stone.
- 2) Level of soling

Preventive solution-

- 1) All the stone vertically place, and minimum gaps are kept between them.
- 2) Fix small stone chips fill in the gaps of stone.
- 3) To maintain level use required size of stone then hand packing to be done.

5. PCC-

Critical Observation

- 1) Level of pcc not maintained, observed gaps between pcc and footing shuttering.
- 2) Honeycomb observed on sides
- 3) Breaking of pcc due to incorrect orientation and size.
- 4) Segregation of concrete

Preventive solution-

- 1) Surface level of pcc to be maintain, mark top level by auto level.
- 2) Proper compaction to be done.
- 3) Clean shuttering ply then apply oil.
- 4) Tender drawings need to study properly.
- 5) Mark coordinates by total station.
- 6) Check all marked points by reference point.
- 7) Add water in the concrete as per mix design.
- 8) At the time of concrete pouring height should be less than 1m.

6. RCC Work-

Critical Observation

- 1) Problems facing due to supports.
- 2) Frequently changing of concrete team
- 3) Labor standing on supports/ shuttering at the time of casting.
- 4) Defect in vibrator observed during casting work.
- 5) Compaction not done properly.
- 6) Passing of slurry, Gaps and joints of shuttering not filled properly.
- 7) After de-shuttering surface of concrete is rough/ not form finished.
- 8) Pouring of concrete not done properly
- 9) Chipping of excess concrete beyond levels.
- 10) Failure of 7 days cube
- 11) Cracks on the top surface of column
- 12) Silt content, aggregate oversize observed.
- 13) Corrosion of steel and placing on ground was observed.
- 14) Breakdown of machineries observed.

Preventive solution-

- 1) Proper Concrete team need to deploy at site. Do not change labor team frequently.
- 2) Instead of concrete team do not pour concrete by carpenter & fitter.
- 3) Support of shuttering to be done properly (velar, tie rod, props, clamps, chavi use properly)
- 4) Casting should be done after inspection of shuttering and reinforcement by engineer in charge.
- 5) Proper staging work need to be done for the pouring of concrete.
- 6) Check working condition of vibrator before casting work.
- 7) Uniform vibrating need to done during pouring of concrete.
- 8) Use Rubber hammer during concrete pouring work.
- 9) Use foam sheet for the filling of gaps.
- 10) Before casting all gaps to be filled properly.
- 11) Use shuttering ply after cleaning and oiling.
- 12) Layer wise pouring of concrete to be done.
- 13) Level mark of concrete pouring to be done on shuttering.
- 14) Keep top surface rough for second lift bonding.
- 15) Sufficient gunny bags to be provide for curing. Follow methods of curing as per IS standards.
- 16) Laboratory testing to be done strictly.
- 17) Use good quality of material.

7. Block Masonry- Critical Observation

- 1) Hacking work not done on the concrete surface.
- 2) Thickness of Block joint is more.
- 3) Raking of joints not done.
- 4) Line and level not maintained.
- 5) Gaps between beam bottom and masonry.
- 6) Safety precaution during block cutting.
- 7) Curing not done properly.

Preventive solution

- 1) Sufficient hacking as per standards to be done on concrete surface.
- 2) Thickness of joint is not more than 10 mm for mortar and 2 to 3mm for chemical.
- 3) Raking of joints to be done.
- 4) First layer of block work checked with beam top / bottom edge, offset & plumb.
- 5) Gaps between beam bottom and masonry to be filled properly by mortar.

- 6) Safety precaution need to be taken, Safety guard provided for the cutter.
- 7) Prepare curing schedule

CONCLUSIONS AND RECOMMENDATIONS

The aim of the present research on the quality control is to find out the shortcoming of quality management practices of on-going residential projects progress through the research. Thus findings of this study will enable to improve the quality of product, work, and service, while strengthen the quality management system, and raise the overall level of quality management. Following is the summary of conclusions based on the observations made on different construction activities.

- (1) Despite of standard guidelines and work procedures, sub-structure activities need immediate attention to improve performance of refilling, compaction and anti-termite treatment by imparting sufficient training to the workers and site supervisors for proper implementation of procedures.
- (2) In superstructure, major problem noticed associated with placing and compaction of concrete as well as poor shuttering work this leads to honeycombing of Concrete.
- (3) In masonry work, major problem is lack of skilled mason results in keeping more width of joints, improper racking and improper filling of mortar.
- (4) Poor control of Middle level Management and inadequate supervisory staff as well as lack of QC personnel is the major problem towards achievement of quality.
- (5) Another major problem noticed was coordination between store and site execution staff leads to identifying accepted/ rejected material from construction use.
- (6) There is need to make quality management more quantitative, objective and scientific, which is advantageous to constantly improving the construction quality and raise the level of construction quality management.
- (7) The review of the construction organization and workers should be strengthened, and the qualification management should be strict. The quality and technical operation of workforce should be improved through training, and the

continuing education of technical staff should be encouraged.

- (8) The systematic quality management system should be applied. The quality of each process and project can be ensured through systematic planning, control and inspection using PDCA cycle.

REFERENCES

- [1] Jogdand P., Ambekar N., Mane P. P., 2017, Quality Management System at Residential Construction – A Questionnaire Survey, International Journal of Research in Engineering, Science and Technologies (IJRESTs), Volume No. 3, Issue No. 3, ISSN 2395-6453 (Online).
- [2] Shengeza J. J., 2017, Evaluation on the Application of Quality Management System in Tanzania Building Construction Projects, American Journal of Management Science and Engineering, Vol. 2, No. 6, 2017, pp. 170-175.
- [3] Neyestani B., 2016, Effectiveness of Quality Management System on Construction Project, Munich Personal RePEc Archive, Paper No. 76754.
- [4] Mane P., Patil J., 2015, Quality Management System at Construction Projects, Research Gate (Online).
- [5] Anup W.S., Kumar A. N., Saqhi S.N.A., 2015, Study of Quality Management in Construction, International Research Journal of Engineering and Technology (IRJET), Volume No.: 02, Issue No.:02, ISSN: 2395 -0056 (Online).
- [6] Kumar A. D., 2014, Study of Quality Management in Construction Industry, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Volume No.: 3, Issue No.:1, ISSN: 2319 – 8753 (Online).
- [7] Al-Ani R., Al-Adhmawi F.I., 2011, Implementation of Quality Management Concepts in Managing Engineering Project Site, Jordan Journal of Civil Engineering, Volume No.:5, Issue No.: 1.
- [8] Keng T.C., Hamzah A., 2011, Study of Quality management in Construction Projects, Chinese Business Review, Volume No.:10, Issue No.: 7, ISSN 1537-1506.
- [9] Hoonakker P., Carayona P., Loushinec T., 2010, Barriers and Benefits of Quality Management in the Construction Industry – An Empirical Study, Total Quality Management & Business Excellence, Volume No.:21, Issue No.:9.
- [10] Hesham A., Remon F. A., Esraa A. S., 2016, Applications and Assessment of Quality Management in Construction Projects, International Journal of Innovative Research in Engineering & Management (IJIREM), Volume-3, Issue-5, ISSN: 2350-0557.
- [11] Raji Al-Ani, Firas I. Al-Adhmawi 2011, Implementation of Quality Management Concepts in Managing Engineering Project Site, Jordan Journal of Civil Engineering, Volume 5, No. 1, 2011.
- [12] D. Willar et al. 2010, Improving Quality Management System Implementation In Indonesian Construction, Proceedings of the First Makassar International Conference on Civil Engineering (MICCE2010), March 9-10, 2010, ISBN 978-602-95227-0-9.
- [13] Turgut Acikara et al. 2017, Evaluations of Construction Project Participants' Attitudes Toward Quality Management in Turkey, Creative Construction Conference 2017, CCC 2017, 19-22 June 2017, Primosten, Croatia.
- [14] Ping Lu, Xiangyang Cai et al. 2019, Quality management practices and inter-organizational project performance, International Journal of Project Management 37 (2019) 855– 869.
- [15] Gowda C H et al. 2015, Total Quality Management in Construction, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 02 Issue: 05 | Aug-2015.
- [16] Migliaccio G. C. et al. 2013, Continuous Quality Improvement Techniques for Data Collection, 10.1061/(ASCE)CO.1943-7862.0000427. © 2013 American Society of Civil Engineers.