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Implementation of Site Quality Management System for a Building Construction Project

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Abstract - Construction industry plays an important role in the development of any country. The development of construction industry depends on the quality of construction projects. Quality is one of the critical factors in the success of construction projects. Improvement in the quality of construction projects is linked with quality management in the project life cycle. Although quality management at every stage of project life cycle is important but the quality management at the execution (construction) stage contributes significantly on final quality outcome of construction projects. This project mainly focuses the importance and factors that affects the quality management in the execution (construction) phase. The project also includes visiting of some construction companies and conducts the questionnaire survey, then analyse the difficulties (major factors) and the cost variance due to quality defect in quality management and suggests some proactive measures for the improvement of quality in the execution phase of construction projects.

Keywords - Construction, management, Quality, Questionnaires

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INTRODUCTION

Quality itself is an explanatory factor in the success of construction projects. Quality of construction projects can be considered as the accomplishment of gratification, (satisfaction) of the project participants. The construction industry in India has been struggling with quality issues for many years. A remarkable amount of the budget is spent each year on infrastructure and other development projects. Within the standard business for the attainment of construction contract, contractors who are keen to win offer, can attain contracts by submitting them at low prices, but at the danger of not being able to produce construction work which meets the standards and specification. Likewise, consultants may be under oppression to reduce the initial cost of construction and construction supervision so that contractors are not able to produce the required quality. Absence of quality in construction is exhibited in poor or non-sustainable workmanship, and risky structures. Since the quality outgrowth of the projects is not as stated by to required standards, defective construction takes place.

Significance: Like other industries are establishing the TQM (Total Quality Management) system but in the construction industry we cannot establish even QMS (Quality Management System). The cause behind is 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.

In those common works are affected by some major factors like quality of material, quality of manpower, construction detailing, concrete work, etc. in this thesis is very much helpful to find out the major factors and give result with cost of poor quality. This theory is more helpful for creating cost oriented quality awareness to low level construction companies.

LITERATURE REVIEW

P.P.Mane, J The best quality, time and cost are the important aspects of successful construction project which fulfils the main goal of construction industry. The quality management has to provide the environment within which related tools, techniques and procedures can be deployed effectively leading to operational success for a construction project. The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the construction project.

METHODOLOGY

This work focuses on the study of "Quality Management in construction projects" which is the need of the hour by which we can achieve control over the general defects that are seen in

construction sites. There is not much time nor resources to misuse. Reworks and delays are not acceptable. As in the manufacturing industries, the construction industry should target on process quality.

It involves better employee relations with greater customer satisfaction and improved operational performance in the project. This study highlights the study of the factors leading to quality in construction and how to overcome the quality defect on site.

Behnam Neyestani **:** Quality management system (QMS) provides generic guidance and requirements forestablishing an appropriate quality management procedure, in order to lower cost, increase productivity, customer's satisfaction, and market share in the organizations since the last two decade. In construction industry, it can assist the companies to achieve successfully their objectives, and ensure that all phases of construction project consistently meet client's requirements (need). The main aim of this article was to evaluate the impact of QMS implementation on main factors of construction projects in Metro Manila, Philippines. For this intention, the study was conducted an in-depth literature review from different books, journals, and websites, in order to understand profoundly quality management system

DATA COLLECTION

Project: Residential building.

Location: Badalapur

Project by: Sunmax Associates

Purpose of the project: Residential purpose.

Total built-up area: 1197 sq. ft.

Defects found in the building later;

1. Swelling or loose plaster in ceiling

Symptoms:

- Surface with water/rust staining, water leakage
- Patterned Cracking
- Bulging, falling of concrete patches with reinforcement exposed
- Falling off of plaster/tiles

Causes:

Defective concrete as a result of ageing is commonly found in old buildings. Persistent water leakage may affect the steel reinforcement. Weak concrete caused by the use of salty water in concrete mix, or overloading are common causes in spelling.

2. Water seepage from external walls, windows, roof or ceiling

Symptoms:

- Water staining
- Peeling off of paint or wall paper
- Water dripping Growth of fungus
- Defective concrete, Plaster or tiles
- Rust staining

Causes:

External Water Seepage could be due to a variety of reasons including cracks on external wall, honey comb concrete, defective water proofing membrane at roof, defective external water and drainage pipes etc.

3. Structural cracks in walls

Symptoms:

- Cracks that penetrate through finishes into the concrete or bricks
- Long, continuous cracks across width of wall
- Diagonal cracks at corners of windows or door
- Cracks with rust staining

Causes:

Structural cracks may be caused by many factors e.g. Excessive movement of the building structure, unwanted ground settlement, serious overloading, weakness caused by corrosion/deterioration of materials, or damage by accidents, or poor design/construction etc. Detailed investigation must be carried out to identify the causes which nust be removed or rectified before the cracks are repaired

DATA ANALYSIS

Impact index:

Factors causing defect overrun were identified during literature review and interviews with client, engineer, contractors and consultants. These factors were then ranked according to their impact with an equation developed as impact Index. It is defined as the ratio of sum of product of frequency of getting the same score (here, low, medium or high) to the no of total number of responses. Impact Index is helpful in determining the impact of factors causing defect It is used to rank the factors. In this report factors are ranked according to impact index. Impact Index (I.I) is given by

Impact Index = (∑F r x r/N) ;

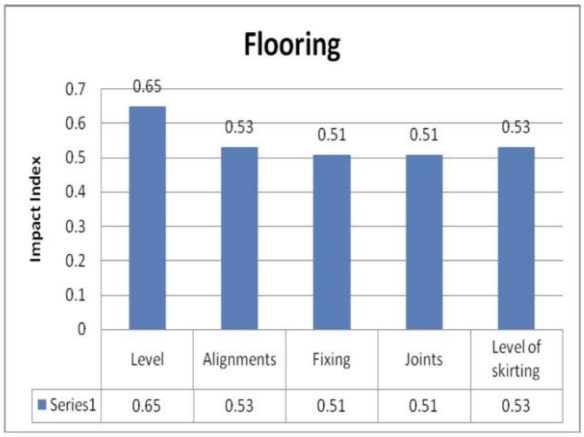
Where, r= severity score ; Low=1, medium=2, high= 3

F= frequency of factors getting score r.

N= total no of respondents

Table 1: Impact index of factors affecting Flooring

FACTOR ID	FACTOR DESCRIPTION	IMPACT INDEX
A-1	Levels	0.65
A-2	Alignments	0.53
A-3	Fixing	0.51
A-4	Joints	0.51
A-5	Level of skirting	0.63

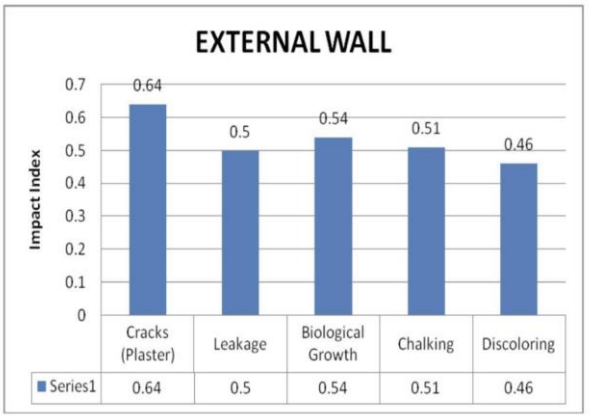


Graph 1: Impact index of factors affecting Flooring

Here all the factors affecting Quality of flooring are determined so as to analyse the impact index of level, alignments, fixing, joints, level of skirting.

Table 2: Impact index of factors affecting External Wall

FACTOR ID	FACTOR DESCRIPTION	IMPACT INDEX
B-1	Cracks	0.64
B-2	Leakage	0.5
B-3	Biological growth	0.54
B-4	Chalking	0.51
B-5	Discoloring	0.46



Graph 2: Impact index of factors affecting External Wall

So a five step process for managing the construction defects is suggested and they are as follows :

- Awareness
- Investigation
- Discovery
- Evaluation
- Treatment or remedy

Study of two projects from Mumbai – Content analysis technique for quality management

To substantiate the questionnaire survey, a case study was conducted, the quality documents of two projects were studied. Both the projects were of a single client but different contractors located in Bangalore. Using Content analysis technique all the inputs, mechanisms, and output were tabulated. The quality details were analyzed and tabulated .The tabulations were done under the quality clauses of ISO 9001. The analysis was carried out based on the inputs, mechanisms, control measures and the output.

Project 1 is located in Bangalore. The whole work was contracted to a single contractor. The quality plans were set up separately for that specific project. The tabulations were done under the quality clauses of ISO 9001. The analysis was carried out based on the inputs, mechanisms, control measures and the output. The information from the referred quality documents were arranged according to functional hierarchy.

Project 2 is also located in Bangalore. The whole work was contracted to a single contractor and then subcontracted. Even in this case the quality plans were set up separately for that specific project. Delphi Technique was adopted to make suggestions on how to overcome the issues faced during quality implementation. The experts had a minimum 25

years' experience in construction and were quality policy makers for their respective firms. The experts were not the respondents of the questionnaire.

Table 3: Content Analysis of Project 1

Unit of Analysis	General	Management Responsibility	Resource Allocation	Product Realization
Input	Quality policies and Objectives , PQP	Authorities, Objectives and communication	Training Plan and procedures, Awareness among employees, Competencies, Employment programmes	Planning and schedule records Quality designs and Customer requirements documents.
Mechanism/ Representative	Quality Manager, Steering committee, Process in charge	Cash flow technique, Senior Manager , Management Representative at site, Deputy General Managers	HR policies, Recruitment, Quality Manager, Planning Engineer	Schedule, Design of Experiments, Laboratory manual, QA/QC Engineer.
Control	Process mapping model, Minutes of Meeting, Control of records and document	Agenda and Minutes of Meeting of management review meeting	Skill sets, Evaluation records, Incentives, Variable pay	Monthly/Weekly quality statements, MIS, Test, certificates, Control and monitoring checklists
Output	Master list of quality records, Formats and controlled documents	Detailed Procedure, Work Programme, Standard Operating procedures and external audit.	Employee's records of training, qualification and skill records	Project Completion report, maintenance report, Delivery confirmation, Project manager's report, relevant checklists

Table 4: Content Analysis Table of Project 2

Unit of Analysis	General	Management Responsibility	Resource Allocation	Product Realization
Input	Quality policies and Objectives, PQP	Authorities, Objectives and communication	Training Plan and procedures, Awareness among employees, Competencies, Employment programmes	Planning and schedule records Quality designs and Customer requirements documents
Mechanism/ Representative	Quality Manager, Steering committee, Process in charge	Cash flow technique, Senior Manager, Management Representative at site, Deputy General Managers	HR policies, Recruitment, Quality Manager, Planning Engineer	Schedule, Design of Experiments, Laboratory manual, QA/AC Engineer
Control	Process mapping model, Minutes of Meeting, Control of records and documents	Agenda and Minutes of Meeting of management review meeting	Skill sets, Evaluation records, Incentives, Variable pay	Monthly/Weekly quality statements, MIS, Test certificates, Control and monitoring checklists
Output	Master list of quality records, Formats and controlled documents	Detailed Procedure, Work Programme, Standard Operating procedures and external audit	Employee's records of training, qualification and skill records	Project Completion report, maintenance report, Delivery confirmation, Project manager's report, relevant checklists

CONCLUSION

Quality Management System generally manages product and process quality and this enables an organization to consistently meet the needs and wants of their customer through Voice of board. The literature study stated that the implementation of QMS can be an effective technique to achieve the objectives of projects successfully through process approach, towards the optimization of project performance, and problem solving. As this study was aimed at finding out the defects of quality management and factors affecting it , considering them all the questions of questionnaire were designed.

After having a view on all the literatures over implementation of various Quality Management, it can conclude that:

- Management commitment to quality improvement is very important in each phase of the building process and the implementation of QMS can be an effective technique to achieve the objectives of projects successfully through process approach, towards the optimization of project performance, and problem solving.
- The impact of QMS is customer's satisfaction more than any other vital criteria in construction projects, because process approach of QMS is considered and prioritized according to customer's requirements and satisfaction, as its input and output in the organizations.
- According to the case studies that have been carried out considering the quality parameters, we can see the various construction defects like swelling or loose plaster in ceilings and walls, water seepage from roofs, structural cracks in walls.
- Examining from the sites, the major factors that are mostly affecting the quality of construction in execution phase are limitation of finance, labour, wages, communication, weather, building plan, time, rules and regulations, construction details and so on.
- The whole construction industry is project oriented; so improved quality performance must be project-related and must include manufacturer, subcontractors, main contractor, vendors, professional designers, project managers and above all, the owner must be involved in the process. Partnering arrangements between these parties will enhance total quality.
- Engineering, architecture and construction management students who eventually become the industry's future leaders must be instructed in the basics of quality

management. Education and training in TQM theory and practice at all levels (management as well as operative levels) and in all phases (design, construction, and operation phases) are essential to enhance competitiveness.

- The questionnaire survey done through the on-going construction sites stated that Use of Mobile technology will help to elimination of quality defects that occur on site due to improper management. We see that the percentile agreement over defect elimination factors are as Material order planning as 15%, Regularity in quality checks as 25%, Labour management as 10%, Mobile technology as 35% and Site management as 15%.

- According to the count of survey we see that 35% of the total respondent said Mobile technology will be useful to reduce the Quality defects in Quality Management of Construction industry. Thus to enrich the poor Quality Management of construction industry a mobile application is designed and developed to support the project study

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