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Quality Control and Monitoring

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***Abstract*: In construction project the cost of construction ranges from 60 to 70% of total cost. The main aim of this project is to determine the current material management practice and impact of this on building construction projects. Construction industry plays an important role in the development of our country. The development of this industry depends totally on material quality and its management. The purpose of this project complies of developing checklists for quality controlling. Checklists are prepared to reduce the mistakes caused daily in our project works. Checklists are used to continue a proper construction work daily. This project focuses on quality control for reducing time and cost of the project activities. Gathering of every data needed for quality control is done using checklist and appropriate method is used to check that the construction work is according to checklist or not. Quality control involves the minimum standards of material and tasks which insures the performance of work according to desired standards.**

***Keywords*: Checklist, Quality control, Quality assurance.**

1. Introduction

Quality is the critical factors now a days in the success of construction projects. Every year how much amount is spent on infrastructure and development of construction project. The quality outcomes of the projects are not according to specified standards, poor construction takes place. Extra investments are required for removing these defects and maintenance of work. Construction project goes through different phases of the work. The main phases of a construction project is quality control and monitoring.

The construction industry has been heavily affected by the economic crisis. Product differentiation and cost reduction through improved qualities could be the way out. However, applying quality control to the construction industry is a challenging task since construction projects are highly customized, constituting the application of statistical process control principles extremely difficult. This paper presents the constituting elements of a real-time quality assessment tool for the residential housing sector. It has been designed to be used primarily for internal company purposes. In particular, utilizing the tool for assessing, in real- time, the quality of the projects currently in-progress and comparing the quality of completed projects and consequently drawing conclusions about the company's quality progress.

The main reason for construction material to be so leading in a construction project is that the cost for material handling may range from 60-80 % of total construction cost. Therefore, ineffective material management can cause unavoidable loss for a construction project. Material management can be considered as a prime uncertainty in a construction project. Materials management functions which include planning and material take off, vendor evaluation and selection, purchasing, expenditure, shipping, material receiving, warehousing and inventory and material distribution. As material management is interrelated to other processes and stages of the construction project and is dependent over various other factors it has high uncertainty. Especially the nature of construction project being fragment basis with unstructured communication and no clear responsibility between the parties, increase the challenge of implementing effective material management. Although material management problems highly affect the construction professionals all over the world, they are more critical for construction professional.

A. Importance of quality control tool

Checklists are a great tool used to optimize how you organize your construction project in a number of ways. To effectively manage a construction project, it is important that you progress the activities and tasks efficiently and on time. Use a checklist if you want a great tool to ensure that you won't forget anything whilst ensuring every process and task you carry out again and again, are completed perfectly every time, then use a checklist. Checklists can make a significant difference for your construction site and they can even be used to help reduce cost of your project. Quality of work increases and your business can be more efficient and productivity increases.

- Tasks that you need to complete in a specific order.
- Activities that are of a series of steps, each of which is equally important
- Implementing Standard Operating Procedures (SOP)
- Carrying out an inspection & Health and Safety procedures
- Looking for the cause of a defect and checking the cause
- Analyzing and verifying operations
- Collecting data you need to analyze in the future

B. Benefits of construction checklist

Having a construction checklist allows your project to follow and respect a timeline. If you include a timetable in all your phases and the steps to be executed, everyone's work is guided

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by the set deadlines, by which definite construction activities are expected to be finished. Laying out responsibilities and expectations in a construction checklist promotes healthy work ethics and reinforces a healthy work environment.

If all stakeholders involved in your project clearly know and are accountable for their responsibilities, disputes and misunderstandings become fewer. Using an updatable construction checklist that specifies work methods and materials for certain tasks automate workflows. This, in turn, allows individual workers more focus to execute their tasks in a timely and efficient manner. This ultimately results to a seamless construction project development. Utilising a construction checklist that allows transparent collaboration and communication, makes it easier to deliver a complex construction project. This makes for clear transactions between entities needing to work together and allows for integrated project delivery or similar outcomes.

C. Purpose of checklist

Construction checklists are a huge tool in implementing safety measures and procedures. They are especially useful for employees to comply with safety and health standards to prevent injuries, accidents, and deaths in the construction workplace Construction checklists are also a great utility for spotting potential risks in the construction site. Construction checklists are also great tools for regular check-ups of equipment and gears. You can use a construction checklist for new workforce employee orientation requirements of your construction project. Having this construction checklist allows you to have an overview of your new employees, their competencies, and their jobs and responsibilities, and their progress on your orientation guide. This makes it easy for you to accordingly delegate tasks according to their capacities and track their progress. You can make a construction checklist for all the raw materials you need alongside their source or supplier.

This construction list allows you to determine what items, equipment, and tools you need for all phases of your project, including what you already have and what you still need to order. You can then have a separate construction checklist of all your suppliers This can include your existing ones and those suppliers you think have the potential to provide you with other needs.

You can create a construction checklist around your project time frame with time tables outlining expected output on particular dates. Include specific dates so you can design efficient processes as you aim for your desired goals and results. You can also include a construction checklist summarizing all the processes that need to be carried out to complete your building project. This checklist would be very useful for outlining the specifics of your project phases, from planning, development, and evaluation. To make the best out of it, in terms of efficiency, you can include another construction checklist that is only focused on updating processes that have been already implemented.

D. Problem statement

Quality of material plays an important role in construction field. Due to poor material in construction the life of construction gets reduce. If bad quality of material is used in the building the building gets collapse. Safety risk is more when the material of construction is poor. Poor material increases the time and cost of the project as well as maintenance cost.

E. Objectives of the project

- To prepare quality standards of the material to be identified.
- To study quality of the material with the help of checklist.
- To minimize the impact of poor-quality material.
- To establish the desired quality standards.

2. Literature Survey

N. Istape, (2013) From the above paper we can see that the NC Indices are fluctuating rapidly in the beginning of month. As the work progresses the percentage of NC Index has fallen in 7 cases and which is below 10%. This indicates number of conform has increased and as a result the improvement of quality is observed. Similar data over a period of six months can show substantial improvement in quality of work as NC Index would fall below 10%. From the total numbers of NC INDICES, we can verify whether quality of work is really improved or still rectification is required to be done. This reflects the improvement of quality of workmanship at the site which can easily be assessed and understood by the clients. Thus, keeping in view, the above detail study of various items on a project site, the progressive improvement graphs showing tendency to increase in number of NC INDICES less than 10% will be worked out to confirm the system mentioned in this paper being implemented successfully and this will be done in subsequent project work on this topic.

D. Ashokkumar (2014), The result of this thesis will expose the main factors which affect the construction quality and also increase in cost of construction due to quality defect. This study will create the quality management awareness to all level construction companies especially small-scale companies. From this thesis we get the major factors and issues which affects the construction quality and that create a chance for find out the remedial measure. This thesis is useful for minimize the material wastage, workmanship wastage, time wastage and indirect cost. Then increase the customer satisfaction and company reputation.

R. Lakshmi (2015), This paper suggests that, the purpose of this thesis is to evaluate the use of Quality Function Deployment (QFD) as a management tool to benefit project managers. The United States building construction of Engineers is one of the largest construction management organizations in the world, annually performing over 3.5 billion dollars' worth of work. The project manager has primary responsibility within the construction, to ensure the design both fulfils user requirements and prepared correctly, and that quality control/assurance procedures are correctly administered. QFD was developed and to improve quality and lower costs in

industrial and business-related fields, by assuring all of building construction operational decisions are driven by owner needs. It uses a set of matrices to relate owner wants and needs with project specifications and requirements.

Behnam Neyestani (2017), This study identified that is very essential to apply all seven QC tools for troubleshooting issues within production processes in the organizations. Doubtlessly, all of the aforementioned quality tools should be considered and used by management for identifying and solving quality problems during producing the products and services. Thus the production processes can be affected and improved by multiple factors of these statistical QC tools. Also, Mirko et al. (2009) designed and developed an effective layout for using these QC in the organizations based on the performance of them, in order to apply appropriately these quality tools for solving quality problems and quality.

Khidir Sanusi, Izwan Rashid, Syuhaida Ismail and Nor MawatiMohd Shariff (2017), As a conclusion, this study has successfully identified and met the objectives that were previously stated. Results from the analysed data have proved that customized Safety Behaviour Checklist (SBC) able to modify construction workers safety behaviour and improve their safety performance although requiring some times. In addition, the at-risk behaviour of construction workers during installation of scrubber have been identified successfully through the activity list as well as Hazard Identification assessment record from Organization X itself. This study supports the idea of Geller (2000) which emphasized that developing a practical behavioral checklist that is acceptable to all potential users require a right implementation as it will instill a sense of team ownership, as well as self efficiancy and personal control. Based on the outcomes of this study, it is believed that customized SBC is able to modify construction workers safety behaviour during installation of scrubbers at the site and indirectly able to reduce the potential risks of accidents as well as save unnecessary costs caused by the accidents.

Heena Sharma, (2017), Study has been conducted to implement quality control tools and techniques in manufacturing industry. The main goal of this study is identifying the defect and suggest a better solution to improve the production line performance on implementation of Quality control tools in manufacturing process in order to minimize the rejection and rework. Quality tools i.e., Pareto chart and Cause and effect diagram are used to identify and evaluate different defects and causes for these defects responsible for rejection /rework of materials at different stages (In process, Final Stage). Quality Control Tools could improve process performance by reducing product variability and improves production efficiency by decreasing scrap and rework.

Trunal K. Patil, (2017), From all above papers we can conclude that are there are the Product Cost, Product Quality, Production Time & This all problem easily eliminates by using seven quality tools. Quality Tools such as Check sheet, Flow Diagram is the best option for collection of data & find out location of problem. Quality tools Such as Pareto chart is the best option for to shows impact of each problem. Quality tools such as Cause & Effect diagram is the best way to find out cause of the problem & their effect to organization. Control chart is the quality tool use for check whether process is an control or not, thus we can say that from above study Quality tools is the best tools that more effectively reduce the losses, problem, cost of the product, production of time & improve the overall productivity of organization.

Patel Vatsal, Jayeshkumar Pitroda, (2017), In the present case study, analysis on the work site was done with the previous knowledge of the material management, and new methodologies were implemented at work site, based on the current construction scenario. Following aspects were taken into consideration, the original site layout was redesigned, then the proper management was bought in and a completely new concept was derived. Understanding of the problems that occur at the worksite due to, inventory, purchasing and on how materials are being handled at the work site were taken into consideration. Importance on how materials are properly procured at the site was also taken into consideration and new appropriate technological implications were introduced like RFID, PDA, which helped us in a proper scheduling and financial control for proper scheduling and based on the materials importance, and on how they have to be released, ABC analysis. From the above concepts, new theories which help us in proper material management at worksite were identified and prime importance was given to them.

Ofila Irhamna, Rahmat Nurcahyo (2018), Quality Control Circle and Performance on Construction Industry" reported by, suggest that, Quality is a key element that cannot be ignored in the competition and is one of the critical issues for the success of the company, including in the construction industry. On the other hand, if the quality management policy is not implemented or limited participation will both negatively affect the management of the project and competitiveness of the firms. This will also decrease the survival potential of construction firms within the industry. Achievement of performance can be better if the implementation of integrated quality management is supported by the company. Quality Control Circles (QCC) have been found to be a simple and productive technique of Total Quality Management (TQM) and proposed implementable in construction industry. This paper aims to influence of quality control circle implementation on company performance in construction industry.

Karen Grimmer (2020), These checklists are designed to assist researchers to conduct their studies appropriately and then to report them comprehensively. The checklists also provide reviewers with a simple and efficient way of reviewing content and reporting in papers that they have agreed to review for a scientific journal. The checklists also offer supports for educators when teaching students about research when encouraging them to critically appraise articles in clinical areas. Whilst the checklists are not intended for critical appraisal per se, they offer a simple way for (especially novice) researchers to determine if a paper reports everything it should, in the expected manner. Students and young researchers who become familiar with the checklists in the EQUATOR Network are well placed to conduct better quality research themselves because they understand the important elements that make research

publishable. Using a checklist in the early design phase of a study is a sensible approach for any researcher (no matter how experienced). It is common, in the midst of everything that is required when undertaking a study, to overlook important details (such as justifying sample size, or recruitment methods, or describing interventions appropriately) when designing a study.

3. Methodology of the Work

The different phases of his project of the work are shown in the following flowchart. The chart describes the strategy of this study step by step.

From the literature survey it had been observed that there are many problems regarding quality in construction industry. We have to check all the qualities of material while giving the order or on the construction site itself. Various tests are there to check the quality of material on site. We should always check the quality of material before using it in the construction work. The quality of material plays an important role in construction.

A. Methodology of research

The research was carried out in two stages. In the first stage, a site visit checklist was designed; in the second, its applicability and effectiveness were tested. The applicability and effectiveness of the checklist were tested on one of the ongoing residential building projects. The contractors, project managers, superintendents, supervisors, and owners of project, were all asked to use the checklist. Before the first trial, they were interviewed individually to confirm that they understood the contents and objectives of the checklist. They were also asked to report items they found to be inadequate and those that they felt to be important which were not included in the checklist. Their views were considered in preparing final format of checklist. Thereafter the contractors, supervisors, and owners of the project filled out the final checklists for daily activities.

In the second stage, the percentage of factors that conform to the requirements are determined by dividing the number of "non-conforming checks (NC)" by the "total number of checks (TC)" inspected and converting the ratio to a percentage, called as NC INDEX.

$$\text{Therefore, NC INDEX} = \frac{\text{Total No. of NC's (NC)}}{\text{Total No. of checks (TC)}}$$

Summary of details for all sections for which the distribution is: a) Total no of checks (TC). b) Total no of NC'S (NC). Outcome of the above is the ratio in percentage indicating 2 factors. If the NC INDEX comes within 10% then green token is issued for that activity and if the index is above 10% then red token is issued.

B. Checklist Design

The checklist is divided into four components: Equipment's & tools, checks –before work, during work and after work. . Checklist items were designed to address important work and defects based on current site visit deficiencies It also considers frequently occurring defects, and development of the construction productivity factors based on the system and also out of the checks carried as per classifications.

Every item was lies as under:

a) Number of equipment capacity and supporting tools such as probable tray for mortar mixing line Dori.
b) Manpower operators help us with experience checking for cleaning of area for removal of foreign material water tightness repairing identified defects and damages after completion of activity.
c) Checking for leakage slopes and any other defects.
d) Checklist provide a measurement of workmanship of a constructed product and respect uses of process development of complete checklist is dependent on selecting important factors from drawing specification standard tolerances and also manufacturing standard.

As we worked on a site in Nashik at all slab levels and for footing work also, we noted all the results and the final resulted in noted below in tabulated form.

Table 1
Total no. of checks

S.No.	Description	Total Checks
1.	Excavation	07
2.	Plinth work	31
3.	Footing	19
4.	Column	17
5.	Staircase	20
5.	Slab	66
6.	Cover blocks	06
7.	Lintel	10

Table 2
Total no. of NC's

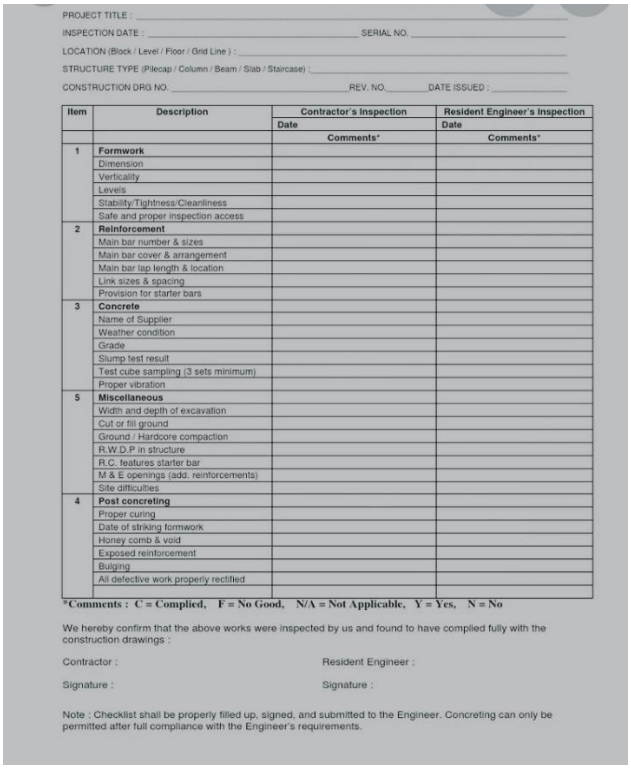
S.No.	Description	No. of Nonconformities
1.	Excavation	01
2.	Plinth work	02
3.	Footing	02
4.	Column	02
5.	Staircase	02
5.	Slab	03
6.	Cover blocks	00
7.	Lintel	00

Table 3
Percentage of NC Index

S.No.	Description	NC Index
1.	Excavation	14.28 %
2.	Plinth work	6.45 %
3.	Footing	10.52 %
4.	Column	11.76 %
5.	Staircase	10 %
5.	Slab	4.54 %
6.	Cover blocks	0 %
7.	Lintel	0 %

Table 4
Remark

S.No.	Description	Remark
1.	Excavation	Red Token
2.	Plinth work	Green Token
3.	Footing	Green Token
4.	Column	Red Token
5.	Staircase	Green Token
6.	Slab	Green Token
7.	Cover blocks	Green Token
8.	Lintel	Green Token



PROJECT TITLE : _____

INSPECTION DATE : _____ SERIAL NO. _____

LOCATION (Block / Level / Floor / Grid Line) : _____

STRUCTURE TYPE (Pilecap / Column / Beam / Slab / Staircase) : _____

CONSTRUCTION DRG NO. _____ REV. NO. _____ DATE ISSUED : _____

Item	Description	Contractor's Inspection	Resident Engineer's Inspection
		Date	Date
		Comments*	Comments*
1	**Formwork**		
	Dimension		
	Verticality		
	Levels		
	Stability/Tightness/Cleanliness		
	Safe and proper inspection access		
2	**Reinforcement**		
	Main bar number & sizes		
	Main bar cover & arrangement		
	Main bar lap length & location		
	Link sizes & spacing		
	Provision for starter bars		
3	**Concrete**		
	Name of Supplier		
	Weather condition		
	Grade		
	Slump test result		
	Test cube sampling (3 sets minimum)		
	Proper vibration		
5	**Miscellaneous**		
	Width and depth of excavation		
	Cut or fill ground		
	Ground / Hardcore compaction		
	R.W.D.P in structure		
	R.C. features starter bar		
	M & E openings (add. reinforcements)		
	Site difficulties		
4	**Post concreting**		
	Proper curing		
	Date of striking formwork		
	Honey comb & void		
	Exposed reinforcement		
	Bulging		
	All defective work properly rectified		

***Comments : C = Complied, F = No Good, N/A = Not Applicable, Y = Yes, N = No**

We hereby confirm that the above works were inspected by us and found to have complied fully with the construction drawings :

Contractor : Resident Engineer :

Signature : Signature :

Note : Checklist shall be properly filled up, signed, and submitted to the Engineer. Concreting can only be permitted after full compliance with the Engineer's requirements.

Fig. 1. Checklist format

4. Conclusion

This paper presented an overview on quality control and monitoring.

References

[1] B. K. Varad and S. K. Sekar, "Quality analysis and quality control in building construction," in *Journal of critical reviews*, vol. 7, no. 11, 2020.

[2] K. Grimmer, "Using a checklist to improve the quality of research reporting," in *PJAHS*, vol. 3, no. 1, 2020.

[3] P. Vatsal and J. Pitroda, "Critical literature review on impact of material management construction project delivery," in *IJCRT*, vol. 5, Issue 4 December 2017.

[4] T. K. Patil and A. Kumar, "Improving Overall Productivity by using Quality Tools," in *International Journal for Scientific Research & Development*, vol. 5, no. 3, 2017.

[5] Y. K. More, J. N. Yadav, "Quality control tools for continuous improvement of site," 2017.

[6] K. Sanusi, I. Rashid, S. Ismail and N. M. Shariff, "Customized safety behavior checklist at construction site," 2017.

[7] B. Neyestani, "Seven Basic Tools of Quality Control: The Appropriate Quality Techniques for Solving Quality Problems in the Organizations," March 2017.

[8] M. Pristavka, M. Kotorova, and R. Savov, "Quality Control in Production," 2016.

[9] A. Kumar, "Study of Quality Management in Construction Industry," in *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 3, Special Issue 1, 2014.

[10] B. Mrugalska and E. Tytyk, "Quality control methods for product reliability and safety," 2015.

[11] S. N. Istape and M. R. Apte, "Importance of development of quality checklists," in *IOSR Journal of Civil Engineering*, vol. 10, pp. 24-29, 2013.