

# QUALITY MANAGEMENT ON CONSTRUCTION SITE

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**Abstract** - Construction Industry are bound toward implementing quality system on site. Quality help in deciding the success traits and failure traits of the organization. Proper team work and support will always lead the company to accomplish its goals and objectives. The purpose of this paper is to look on to major critical factor which decline the quality on site and also to know the view points from engineers and Project Managers about what are the best practices we can apply to get superior quality work with proper safety and at minimum risk. The result of this paper is conducted through Relative importance index method and percentage method. The aim of these paper is to deliver the best quality work which fulfill customer satisfaction.

**Key Words:** Construction industry, Quality, Critical factors, Customer Satisfaction, Team work.

## 1. INTRODUCTION

Construction industry deals with number of key parties for its business and trade. The key role of construction industry is to deliver project with superior quality work and under economical cost and minimum time. The company success or failure depends on the quality work, where there are some of internal and external principal the company deal with. The main objective of quality management system is to minimize the risk, reduced defect and promote safety. Doing this it will help us to get more work and handling of major project in hand.

Quality management system is a key tool to achieve the goal of customer satisfaction. Quality management system is an instrument which helps us to minimize risk by following various elements such as coordination among key personal, regular meeting and audit, availability of construction drawing, availability of resources on site, testing of material before use, proper workmanship, mix design of concrete and use of software.

In today scenario, construction industries are facing too much difficulty due to modernize world. Technology availability is too much but people are unaware about its functionality and also cost of purchase is large.

To assure betterment in QMS, it is important that higher authority should have high level of management commitment toward the quality of construction projects. Applying quality management on site gives us the potential to work with full enthusiasm, discipline, to create work friendly environment and to achieve customer satisfaction



Fig -1: 3 Tier for achieving Quality



Fig -2: Project manager roles and responsibilities

### 1.1 Objectives

1. To analyses and identify the major factor affecting quality on construction site.
2. To take the view point from different technical personal that what are the obstacles we face for quality implementation and how best we can implement quality on site.

## 2. LITERATURE REVIEW

According to Behnam Neyestani (2017) This research is based on construction project in Metro Manila. During the research several author book, journal and literature paper were studied to study the factor regarding quality management on construction projects. For this survey questionnaire survey was used in which all the factor affecting the QMS on site were listed and was send to thirty-seven managers. For analysis of collected data descriptive statistic method was used. The results declare that the most critical factor was find to be customer satisfaction while less critical factor was found to be quality implementation on site. For any Project to be success, quality with cost and time is to be taken in account which fulfills the needs and requirement of client. Quality Management System is an efficient tool to score and check the quality as well as the project manager and civil engineer should use it for smooth running of the project.

According to Pravin Mane, Jalinder Patil (2015) Construction project are vulnerable to quality on site. The main aim of construction project is to complete the project within stipulated time and cost with proper quality. The author of the paper has collected data by doing questionnaire survey and taking interview of various personnel which include builder, project management consultant, etc. The result was analysis by weighted average method. Through analysis of the data collected we found quality can be get better if every activity we check through checklist. Studies also found that proper workmanship of the activities should be achieved and all the activities ongoing on site should be checked on regular basis. Also, customer satisfaction and fulfillment of its requirement is the major factor which each contractor as well as builder should take care of it. Similarly testing report of each material should be tested in laboratory rather doing it on site for exact result.

As per Dr. Daw Alwerfalli (2016) Construction industry need to work and operate with better management skill, better operation skill with proper planning of material and resources. All industry needs better technique to run the project with all safety and quality aspects. The purpose of this paper is making of list of QMS element which helps to accomplish project requirement. Some of the elements include Proper training should be given to beginners, Resources management, Material testing, Activities Inspection, Material inventory, Material Delivery, purchasing of materials, Planning and Controlling, etc. Time management and cost in budget is main hurdle to face on site. Quality management system on site is a requirement to meets project need and to balance the factor which are affecting that ruin quality and produce cost and time barrier. Regular audit and meeting should be held to decide in advance the future goals and objective so if any problem occurs, corrective measure can be taken.

According to David Arditi, Husnu Murat Gunaydin (1999) The research was conducted between two personnel. The one is beginner level professional and another was an experience professional. The main aim of this research is to know the perception between two personnel. Delphi process and questionnaire survey method were used to analysis the differences between beginner and experience professional. During the research it was found the similarities in their perception regarding the factor were seventy-four percentages whereas their disagreement regarding the factor was twenty-six percentages. The factor was listed of all the three phase of design stage, construction stage and operation stage. The finding states that colleges and university should cover all important topics which contain all the necessary information regarding building project such construction

bidding process, calculating life cycle costing of building, detailed specification of project, types of skills the manager should have and training process.

According to Frank Voehl, Hal Wiggin (2012) This paper talk about the problem they are facing in construction industry. They are facing huge effect of productivity and quality on their site and are finding better opportunities and solution to solve it. They conducted many interviews and survey to analysis their data. If better quality work and high productivity is not delivered it will generate increased in project cost and if the project not satisfied the client need unfortunately it will lead to huge amount of construction waste. This paper defined the leading factor that harms the quality and productivity of project.

According to K N Jha, K C Iyer (2006) A survey was conducted to know the impact of quality on construction project. The study found fifty-five factors that affect the sites. This factor was divided into two groups, success factor and failure factor. To understand the major critical factor the above factor is again subdivided into critical success factor and other is critical failure factor. The factor which includes in critical success were tracking and getting feedback from participants, interaction and coordination among project staff, High authority support, Pm competence and Client competence. The factor which includes in critical failure were improper working environment, weather conditions, disputes, lack of knowledge about software and tough competition during bidding process. Out of all these factors the major influencing factor that affect the quality are High authority support, interaction and coordination among project staff and Pm competence. During ancient times, these factors were not in account. But with the rise in technology, change in people mindset and labour tendency the productivity is affecting.

According to H. Mallawaarachchi, S. Senaratne (2016) Construction project are known for creating balance with budget, completion time and superior quality. But with increased in time span, we can get better quality work and at less cost. Alternatively, we can get speedy work and superior quality but at higher cost. For client quality is the second priority but there first priority is to have a successful completion of project. Construction stage and commissioning stage are two most important stage in which project can affect by its maintenance, operation and reliability. If proper quality work is maintained it will create a better impact on project which intern into smooth running of project. The aim of this literature paper is to show the importance of quality on construction project. For successful requirement of project, it is required to well defined scope of work, completing project within time frame, decision making, Available of documents within time and to have proper operation and maintenance.

According to D. Ashok Kumar 2014, For development of any country, construction industry plays a very vital role. Proper maintenance of quality at every stage of project is important but at execution stage it proves very significant. In this research a questionnaire survey was conducted to know the major factor affecting quality and also to know the incur cost release due to quality defects and also to know the available idea and improvements which can better the quality of project. This paper includes all activities execution factors such as ceiling plastering, wall plastering, block work, slab work, beam work and column work which helps us to know the major factor which causes the defect and which help us to lessen the wastage of construction materials, incurring cost, wastage of time, etc.

### 3. DATA COLLECTION

#### 3.1 Sample Size

$$\text{Sample Size} = (Z^2 * P * (1-P)) / C^2$$

Where, Z = Z Score Which Is Determined Based on Confidence Level.

P = Population proportion

C = Margin of error

$$\begin{aligned} \text{Sample Size (SS)} &= ((1.96)^2 * 0.5 * (1-0.5)) / (0.05)^2 \\ &= 384.16 \end{aligned}$$

$$\begin{aligned} \text{New Sample Size} &= \text{SS} / (1 + [(SS-1) / \text{Population}]) \\ &= 384.16 / (1 + [(384.16-1) / 80]) \\ &= 66 \end{aligned}$$

#### 3.2 Questionnaire Survey

The questionnaire was prepared together the insight view from different respondent about the quality management system they follow on site. The questionnaire was distributed to 80 professional which include site engineer, project manager, senior engineer. Out of 80 questionnaires distributed, 66 professionals have responded.

**Table -1:** Respondent data through questionnaire

| Sr No. | Questions   | Very Strong | Strong | Moderate | Less | Very Less | Total |
|--------|---|-------------|--------|----------|------|-----------|-------|
| 1      | Change in design  | 18          | 12     | 18       | 5    | 13        | 66    |
| 2      | Filling of checklist  | 18          | 21     | 13       | 6    | 8         | 66    |
| 3      | Mix design of concrete  | 27          | 12     | 19       | 4    | 4         | 66    |
| 4      | Sequence of construction drawing on site                                      | 23          | 13     | 24       | 3    | 3         | 66    |
| 5      | Material testing on site  | 27          | 15     | 15       | 6    | 3         | 66    |
| 6      | Shortage of manpower on site  | 15          | 20     | 14       | 9    | 8         | 66    |
| 7      | Machineries breakdown   | 12          | 20     | 16       | 9    | 9         | 66    |
| 8      | Lack of supervision   | 26          | 10     | 9        | 15   | 6         | 66    |
| 9      | Unavailability of material on site  | 16          | 13     | 22       | 8    | 7         | 66    |
| 10     | Weather condition   | 13          | 14     | 29       | 8    | 2         | 66    |
| 11     | Labor disputes  | 11          | 12     | 19       | 15   | 9         | 66    |
| 12     | Uncertainties such as rising of ground water level, leakage in pipeline, etc. | 13          | 13     | 19       | 13   | 8         | 66    |
| 13     | Detailed specification of activities  | 17          | 20     | 21       | 7    | 1         | 66    |
| 14     | Shortage of technical staff   | 16          | 16     | 13       | 12   | 9         | 66    |
| 15     | Error in measurement, data collection, quantity and estimation                | 17          | 14     | 14       | 12   | 9         | 66    |
| 16     | High profit margin of contractor  | 16          | 8      | 29       | 9    | 4         | 66    |
| 17     | Lack of knowledge about software  | 11          | 13     | 20       | 14   | 8         | 66    |
| 18     | Giving less wages to labor  | 10          | 14     | 23       | 9    | 10        | 66    |
| 19     | Loading and unloading of material on site                                     | 12          | 17     | 21       | 11   | 5         | 66    |
| 20     | Curing  | 27          | 18     | 11       | 4    | 6         | 66    |
| 21     | Project duration  | 12          | 20     | 22       | 10   | 2         | 66    |

|    |   |    |    |    |    |   |    |
|----|---|----|----|----|----|---|----|
| 22 | Coordination with purchase and account department | 16 | 15 | 17 | 13 | 5 | 66 |
| 23 | Maintaining daily schedule and documentation      | 22 | 20 | 16 | 4  | 4 | 66 |
| 24 | Communication from top to bottom level            | 26 | 18 | 11 | 8  | 3 | 66 |

### 3.3 Interview Survey

During the interview survey, the interviewers were asked three questions about quality. These include:

1. How to implement quality on site?
2. What are the obstacles in the implementation of quality management on site?
3. What you need to achieve best quality on site?

The responses of all the three above questions are shown below. The interviewers include project coordinator, site engineer, senior engineer and project engineer.

**Table -2:** Response data on how to implement quality on site?

| Sr.No. | Name                  | Designation         | Response  |
|--------|-----------------------|---------------------|---|
| 1      | Aliasgar Challawala   | Site Engineer       | Work should be check at every 2 hours. (Any type of work).  |
| 2      | Mohammad Hasam        | Project Coordinator | Ensuring accurate and useful information is an important part of maintaining quality performance. Other aspects of quality control include document control (including changes during the construction process), procurement, field inspection and testing and final checkout of the facility.  |
| 3      | Ali Shakir            | Site Engineer       | First you have proper labour management to maintain the quality of material, maintenance of equipment, work efficiency, team work and a proper head to make them work.  |
| 4      | Darshan Jain          | Senior Engineer     | By proper knowledge of all related test and working experiment with proper techniques.  |
| 5      | Murtuza Chakaliyawala | Project Engineer    | <p>To make norms and rules for quality control and implement all the quality standards which are applicable during execution for construction of any types of structure.</p> <p>Quality of workmanship and best material utilization should be monitored by civil engineer from start of foundation to final finishes of activities of building.</p> <p>Quality control can be implemented through various test of materials and execution procedure. For e.g.:</p> <ul style="list-style-type: none"> <li>• Pouring concrete, we can do slump test.</li> </ul> |

|  |  |  |  |
|--|--|--|--|
|  |  |  | <ul style="list-style-type: none"> <li>For cement quality we check the date of manufacturing.</li> </ul> |
|--|--|--|--|

**Table -3:** Response data on what are the obstacles in the implementation of quality management on site?

| Sr.No. | Name                  | Designation         | Response   |
|--------|-----------------------|---------------------|--|
| 1      | Aliasgar Challawala   | Site Engineer       | <ul style="list-style-type: none"> <li>Work completion pressure</li> <li>Improper guidance</li> </ul>  |
| 2      | Mohammad Hasam        | Project Coordinator | <ul style="list-style-type: none"> <li>Lack of trained workers</li> <li>Competitive markets</li> <li>Poor plans and specifications</li> <li>Bad attitudes</li> <li>Lack of competent of field managers</li> </ul>  |
| 3      | Ali Shakir            | Site Engineer       | <ul style="list-style-type: none"> <li>Lack of manpower, material and proper equipment.</li> <li>Quality of materials.</li> <li>Pressurized atmosphere.</li> </ul>   |
| 4      | Darshan Jain          | Senior Engineer     | <ul style="list-style-type: none"> <li>Less knowledge of execution of tests, labour errors and machineries errors.</li> </ul>  |
| 5      | Murtuza Chakaliyawala | Project Engineer    | <ul style="list-style-type: none"> <li>Few contractors have intent of making profit from this business so they supply poor quality of resources like materials, labours and equipment.</li> <li>Lack of awareness regarding quality test and test procedure during execution work.</li> <li>Communication gap from top to bottom level.</li> </ul> |

**Table -4:** Response data on what you need to achieve best quality on site?

| Sr.No. | Name                | Designation         | Response  |
|--------|---------------------|---------------------|---|
| 1      | Aliasgar Challawala | Site Engineer       | <ul style="list-style-type: none"> <li>Good vendor and labours</li> <li>Tough instruction by authorities.</li> <li>Every work should be check and correct by Incharge.</li> </ul> |
| 2      | Mohammad            | Project Coordinator | The best way to ensure client satisfaction is by incorporating a well-defined quality control process. Strict adherence to the  |

|   |                       |                  |   |
|---|-----------------------|------------------|---|
|   | Hasam                 |                  | <p>process results in improved delivery of the work, leading to lesser rework and higher profits for the firm. Below are five key points which can help to achieve best quality work on site:</p> <ul style="list-style-type: none"> <li>• Establish Standards</li> <li>• Control Work Flow</li> <li>• Implementation of Independent Audit</li> <li>• Embrace Construction Technology</li> <li>• Seeking skilled Labours</li> </ul> |
| 3 | Ali Shakir            | Site Engineer    | Well to achieve best quality work we need enough time and quality material.   |
| 4 | Darshan Jain          | Senior Engineer  | Related test of all materials and follow up all the checklists according to the activities.   |
| 5 | Murtuza Chakaliyawala | Project Engineer | <ul style="list-style-type: none"> <li>• Skilled supervisor and manpower with deep knowledge.</li> <li>• All test procedure should be implemented on regular basis.</li> <li>• Quality of construction should not be compromise to meet completion time.</li> </ul>   |

#### 4. DATA ANALYSIS

For analyzing of collected data from different method so to get the major critical factor that affect the quality on site, the method use are Relative importance index method and Percentage method.

##### 4.1 Relative Importance Index Method

**Table -5:** Data collected through Relative Importance Index Method

| Sr No. | Questions                                | Very Strong (x5) | Strong (x4) | Moderate (x3) | Less (x2) | Very Less (x1) | Total | Total Number (N) | A*N | RII   | Rank |
|--------|--|------------------|-------------|---------------|-----------|----------------|-------|------------------|-----|-------|------|
| 1      | Change in design                         | 90               | 48          | 54            | 10        | 13             | 215   | 66               | 330 | 0.652 | 18   |
| 2      | Filling of checklist                     | 90               | 84          | 39            | 12        | 8              | 233   | 66               | 330 | 0.706 | 8    |
| 3      | Mix design of concrete                   | 135              | 48          | 57            | 8         | 4              | 252   | 66               | 330 | 0.764 | 4    |
| 4      | Sequence of construction drawing on site | 115              | 52          | 72            | 6         | 3              | 248   | 66               | 330 | 0.752 | 6    |
| 5      | Material testing on site                 | 135              | 60          | 45            | 12        | 3              | 255   | 66               | 330 | 0.773 | 1    |

|    |   |     |    |    |    |    |     |    |     |       |    |
|----|---|-----|----|----|----|----|-----|----|-----|-------|----|
| 6  | Shortage of manpower on site  | 75  | 80 | 42 | 18 | 8  | 223 | 66 | 330 | 0.676 | 12 |
| 7  | Machineries breakdown   | 60  | 80 | 48 | 18 | 9  | 215 | 66 | 330 | 0.652 | 18 |
| 8  | Lack of supervision   | 130 | 40 | 27 | 30 | 6  | 233 | 66 | 330 | 0.706 | 8  |
| 9  | Unavailability of material on site  | 80  | 52 | 66 | 16 | 7  | 221 | 66 | 330 | 0.670 | 13 |
| 10 | Weather condition   | 65  | 56 | 87 | 16 | 2  | 226 | 66 | 330 | 0.685 | 11 |
| 11 | Labor disputes  | 55  | 48 | 57 | 30 | 9  | 199 | 66 | 330 | 0.603 | 21 |
| 12 | Uncertainties such as rising of ground water level, leakage in pipeline, etc. | 65  | 52 | 57 | 26 | 8  | 208 | 66 | 330 | 0.630 | 19 |
| 13 | Detailed specification of activities  | 85  | 80 | 63 | 14 | 1  | 243 | 66 | 330 | 0.736 | 7  |
| 14 | Shortage of technical staff   | 80  | 64 | 39 | 24 | 9  | 216 | 66 | 330 | 0.655 | 17 |
| 15 | Error in measurement, data collection, quantity and estimation                | 85  | 56 | 42 | 24 | 9  | 216 | 66 | 330 | 0.655 | 17 |
| 16 | High profit margin of contractor  | 80  | 32 | 87 | 18 | 4  | 221 | 66 | 330 | 0.670 | 13 |
| 17 | Lack of knowledge about software  | 55  | 52 | 60 | 28 | 8  | 203 | 66 | 330 | 0.615 | 20 |
| 18 | Giving less wages to labor  | 50  | 56 | 69 | 18 | 10 | 203 | 66 | 330 | 0.615 | 20 |
| 19 | Loading and unloading of material on site                                     | 60  | 68 | 63 | 22 | 5  | 218 | 66 | 330 | 0.661 | 16 |
| 20 | Curing  | 135 | 72 | 33 | 8  | 6  | 254 | 66 | 330 | 0.770 | 2  |
| 21 | Project duration  | 60  | 80 | 66 | 20 | 2  | 228 | 66 | 330 | 0.691 | 10 |
| 22 | Coordination with purchase and account department                             | 80  | 60 | 51 | 26 | 5  | 222 | 66 | 330 | 0.673 | 15 |
| 23 | Maintaining daily schedule and documentation                                  | 110 | 80 | 48 | 8  | 4  | 250 | 66 | 330 | 0.758 | 5  |
| 24 | Communication from top to bottom level  | 130 | 72 | 33 | 16 | 3  | 254 | 66 | 330 | 0.770 | 2  |

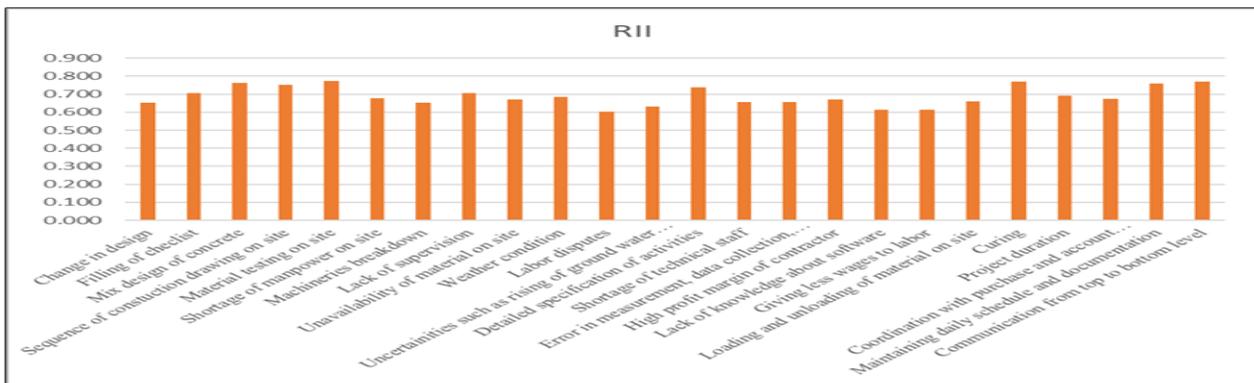


Chart -1: RII of each factor affecting Quality

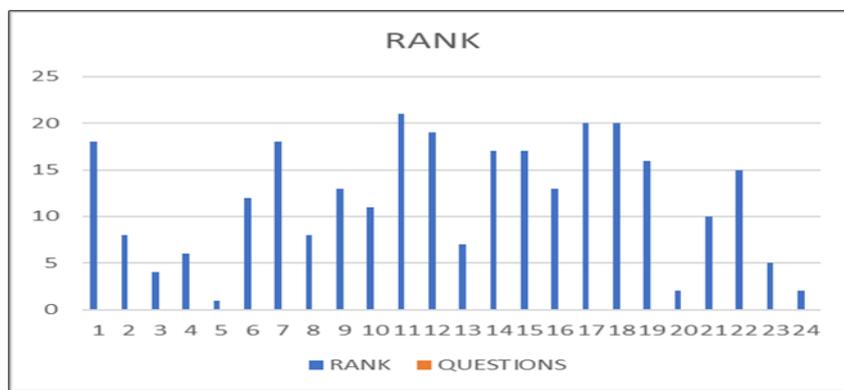


Chart -2: Rank of each factor affecting Quality

#### 4.2 Percentage Method

Table -6: Data collected through Percentage Method

| Sr No. | Questions                                | Very Strong | Strong | Moderate | Less   | Very Less | Total   |
|--------|--|-------------|--------|----------|--------|-----------|---------|
| 1      | Change in design                         | 27.273      | 18.182 | 27.273   | 7.576  | 19.697    | 100.000 |
| 2      | Filling of checklist                     | 27.273      | 31.818 | 19.697   | 9.091  | 12.121    | 100.000 |
| 3      | Mix design of concrete                   | 40.909      | 18.182 | 28.788   | 6.061  | 6.061     | 100.000 |
| 4      | Sequence of construction drawing on site | 34.848      | 19.697 | 36.364   | 4.545  | 4.545     | 100.000 |
| 5      | Material testing on site                 | 40.909      | 22.727 | 22.727   | 9.091  | 4.545     | 100.000 |
| 6      | Shortage of manpower on site             | 22.727      | 30.303 | 21.212   | 13.636 | 12.121    | 100.000 |
| 7      | Machineries                              | 18.182      | 30.303 | 24.242   | 13.636 | 13.636    | 100.000 |

|    |   |        |        |        |        |        |         |
|----|---|--------|--------|--------|--------|--------|---------|
|    | breakdown   |        |        |        |        |        |         |
| 8  | Lack of supervision   | 39.394 | 15.152 | 13.636 | 22.727 | 9.091  | 100.000 |
| 9  | Unavailability of material on site  | 24.242 | 19.697 | 33.333 | 12.121 | 10.606 | 100.000 |
| 10 | Weather condition   | 19.697 | 21.212 | 43.939 | 12.121 | 3.030  | 100.000 |
| 11 | Labor disputes  | 16.667 | 18.182 | 28.788 | 22.727 | 13.636 | 100.000 |
| 12 | Uncertainties such as rising of ground water level, leakage in pipeline, etc. | 19.697 | 19.697 | 28.788 | 19.697 | 12.121 | 100.000 |
| 13 | Detailed specification of activities  | 25.758 | 30.303 | 31.818 | 10.606 | 1.515  | 100.000 |
| 14 | Shortage of technical staff   | 24.242 | 24.242 | 19.697 | 18.182 | 13.636 | 100.000 |
| 15 | Error in measurement, data collection, quantity and estimation                | 25.758 | 21.212 | 21.212 | 18.182 | 13.636 | 100.000 |
| 16 | High profit margin of contractor  | 24.242 | 12.121 | 43.939 | 13.636 | 6.061  | 100.000 |
| 17 | Lack of knowledge about software  | 16.667 | 19.697 | 30.303 | 21.212 | 12.121 | 100.000 |
| 18 | Giving less wages to labor  | 15.152 | 21.212 | 34.848 | 13.636 | 15.152 | 100.000 |
| 19 | Loading and unloading of material on site                                     | 18.182 | 25.758 | 31.818 | 16.667 | 7.576  | 100.000 |
| 20 | Curing  | 40.909 | 27.273 | 16.667 | 6.061  | 9.091  | 100.000 |
| 21 | Project duration  | 18.182 | 30.303 | 33.333 | 15.152 | 3.030  | 100.000 |
| 22 | Coordination with purchase and account department                             | 24.242 | 22.727 | 25.758 | 19.697 | 7.576  | 100.000 |
| 23 | Maintaining daily schedule and documentation                                  | 33.333 | 30.303 | 24.242 | 6.061  | 6.061  | 100.000 |

|    |  |        |        |        |        |       |         |
|----|--|--------|--------|--------|--------|-------|---------|
| 24 | Communication from top to bottom level | 39.394 | 27.273 | 16.667 | 12.121 | 4.545 | 100.000 |
|----|--|--------|--------|--------|--------|-------|---------|

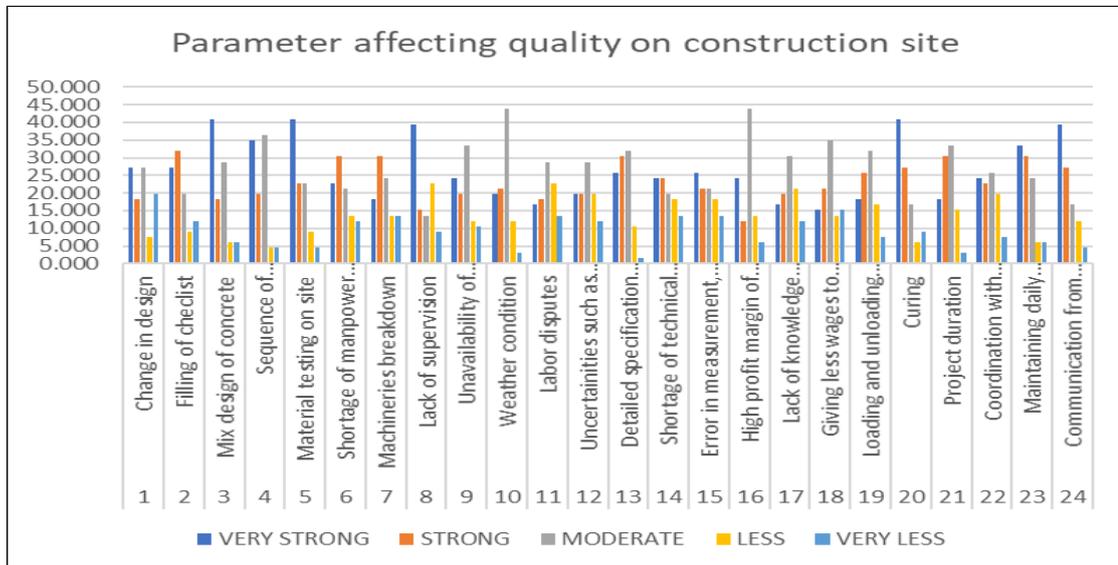


Chart -3: Percentage of each factor asked to professionals

## 5. CONCLUSIONS

Quality management is one of the important aspects for any construction projects. Quality defines the degree of excellence about the work. Construction project are big budget endeavors so naturally large stacks are involved in it. With time and cost, quality and safety criteria are important elements to govern. Achieving quality helps us to gain client and customer satisfaction, give better aesthetic to structure, less maintenance cost, longer life duration of structure, achieving fame and name in the market, strong competitor, etc.

There are various factors that affect quality on site. Out of all the factor, the five major factor affecting quality as per my analysis are Material testing on site, Curing, Communication from top to bottom level, mix design of concrete, Maintaining daily schedule and documentation. These factors should be taken into consideration so that we can-do better-quality work, maintain better coordination among company employees, provide good workmanship and avoids disputes and delays.

Nowadays, client requirement and expectation are constantly changing. So, to accomplish their goals, contractors need to identify measure and continuously improve their skills to sustain in the market.

## 6. FUTURE SCOPE

In this thesis I could find and list the major factor that detoriates the construction quality for any type of structure. In questionnaire survey, I had put up the question as per my experience on site and based on current industry scenario. Also, I have some of the expert view and suggestion what are their facing and what are step to mitigate it. The future scope of this thesis is to study and to calculate the percentage and the possible reason for the cause which give us the deep insight of the factors. Also finding some of the latest research paper and recent case studies to find the most crucial factor which the construction sites should take initiative and find possible solution of these major factors.

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