

Cost and Quality Management in Buildings

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Abstract - Construction Industry is the largest industry in the world. The cost and quality control in execution of structure should be an integral part of it. With the development of new and innovative technologies there utilization may provide better results. Quality control is not possible without involvement of all decision makers, supervisors and workers. At every level, knowledge, commitment and quality consciousness is important. Necessary trainings should be provided from time to time at every level. Good quality reduces the cost of redoing and improves stability, durability, reliability and legibility of the structure. On the other hand delays in decision making delay the project completion time and add additional cost. Some of the important aspects related to quality control are being discussed in this article.

Key Words: Quality control¹, Prefabrication², innovative technologies³, Wastes control⁴

1. INTRODUCTION

Shelter is one of the primary necessities for human beings. In spite of all efforts of the state to check population growth, the gap between the demand and availability of houses is on the increase. The present rate of house construction is about 2.6 million per year in India, if it be planned to provide a house for each family by the year 2025, at least 6 million houses are required to be constructed every year. The resources being limited, there is a need to adopt advanced scientific knowledge and new methods and systems which have proved to be cost effective. Apart from initial cost of construction, the life and safety of structures as well as maintenance cost are also important parameters. It is possible to achieve satisfactory behavior to these parameters through quality control of materials and workmanship. There is a misconception that the quality work is always costly, whereas through proper controls it may be possible to avoid wastage and reduce the cost with better quality. The waste material could also be reused after recycling or without recycling as the case may be. It all will depend upon the management skill of the individual responsible for project execution. S Keelery (2022) published the data of eight major city of India shown in the Fig. 1 cumulative numbers of demand and supply for housing from 2016 to 2020. In view of above, it is essential to pace-up fast the construction activities using innovative technology of building infra structure development.

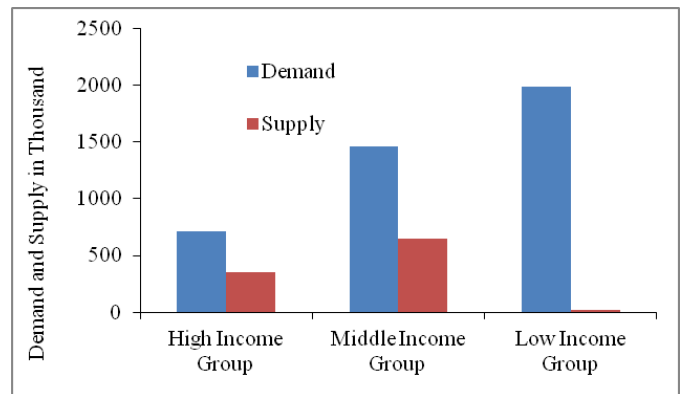


Fig. 1 Cumulative numbers of demand and supply for housing in eight major cities of India from 2016 to 2020 (Sandhya Keelery, 2022)

2. COST CONTROL MEASURES

The general impression is that saving in building means adopting poor specifications and accepting poor workmanship. When we talk of low cost building, a reflection in mind appears that it will be due to (a) Use of poor mortars (b) Keeping low ceiling height (c) unfinished or semi-finished walls (d) use of low strength bricks (e) Use of secondary / local species of timber (f) lower thickness of walls (g) elimination of parapet walls and rain water pipes (h) No water proofing or heat insulation of roof etc.

This concept could be true with the traditional constructions, but with advancement in construction methodology and development of new materials it is possible to save in cost without sacrificing the quality. It is only possible if one is abreast with the latest developments related to building technologies. The aim should be to optimize materials and control quality, use new and alternate materials, as a modern concept (Fig.2)

A few of the useful suggestions for cost reduction are:

i) Adoption of New/Latest Technologies

A number of new technologies for study and cost effective construction are easy to adopt and can be used in the present day construction projects, such as:

a) Use of Prefabrication - In building construction centering/shuttering (form work) come as a hurdle in the

progress of work and thus delays completion and also costs nearly 20% of the RCC members. To save on this cost prefabricated components like lintels, lintels come sunshade, Flore and roof can be used without any difficulty. Some of the salient features of prefab. building components are:

- Cost effective and economical
- Better quality control
- Optimal use of scarce materials (cement and steel)
- Easy casting operations
- Un-interrupted progress of construction work leading to saving in time of completion.

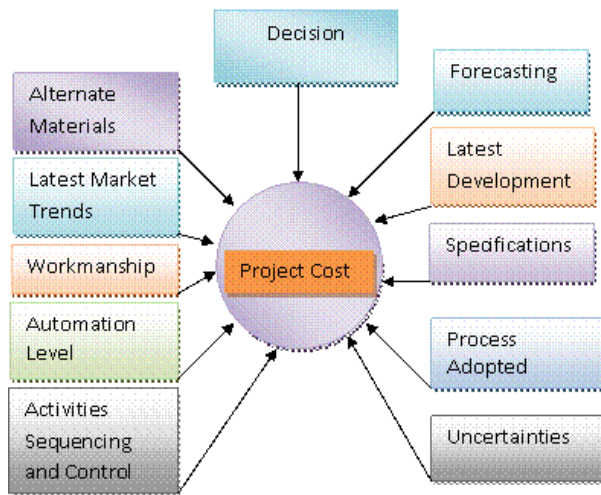


Fig. 2 Factors affecting project cost

- b) Use of Local Materials – the traditional materials getting nearly exhausted and their cost have gone abnormally high. The need has been felt to developed alternate materials and use locally available secondary materials for the sake of economy. Much work has been done to upgrade the locally available materials to make them suitable for use in the building construction, so as to avoid lead time and cost involved in transporting materials from outside. A Stone-Masonry block is one such technology which makes use of locally available materials. Similarly L-Pan roofing system can replace CGI/AC sheet, with better performance. These can be used without involving any completed machines, and open avenues for local employment generations.
- c) Use of Machines, Equipments and Instruments – With the development of machines and instruments suited for various operations in buildings, the work can be executed at a faster rate and lower costs. Geo-radar can help to know the earth strata without boring

operation and help in designing foundations. Lifting machines could help accomplish the shifting of materials at various levels very economically. But the only restraint would be the size of project, as the machines may only helpful after a certain minimum level of project, in view of the cost involved in such machines and equipments.

ii) Inventory of Alternate Building Materials

Sometimes the problems may arise due to short supply of materials on account of reasons like strike of quarry labors or transporters. In order to ensure progress and handle such a situation, an inventory of alternate sources of materials and their equivalent substitute may prove useful. A management technique part Value Analysis or Value Engineering involved during the Second World War may be quite helpful. The materials could be substituted wholly or partly, such as Activated Lime Pozzolana Mixture (ALPM) could replace cement fully or in some small proportion in depending upon the end use and properties expected from the materials.

iii) Selection of Specifications

A judicious selection of specifications can help in cost economy. The selection of specifications should be such which could help economise without affecting life or safety of the structure. While drawing specifications the following points need considerations.

- (a) Availability of materials required both qualitatively and quantitywise
- (b) Cost of materials
- (c) availability of alternate/substitute materials
- (d) Site location
- (e) Local resources and its availability
- (f) Importance of structures
- (g) Zonal considerations like earthquake, wind velocity, rainfall, altitude, vicinity to sea etc.
- (h) Local considerations like type of soil and water table and conditions which the structure withstand
- (i) Knowledge about latest technology, its reliability and acceptability
- (j) Working conditions
- (k) Availability of machines and equipments

The above mentioned parameters will help in deciding above type of foundation and other majors necessary for safety of structures

iv) Check on wastes

In order to avoid wastes the controls at work site are essential, but in addition the points like shortage of materials, shelf life, and rotation of stokes can also be helpful in avoiding the wastage during storage and stacking. The saving up to 5% is possible only through avoiding wastages in any project.

v) Behavioral Aspects

Internal environment of any setup is important for the progress of the project. A healthy atmosphere leads to better progress and efforts should be made to solve the problems of staff and provide amenities like healthcare, education and accommodation with proper sanitation and drinking water.

vi) In-time Decision

The works normally get delay due to decisions in the project, and any delay adds to the costs. The decision may be immediately taken at site and in case it is not possible it should be conveyed to the site staff at the earliest possible. To avoid such situations the architecture design/structure and other details should be finalized before the start of the work as far as possible, or at least well in advanced before the particular stage of application approaches.

vii) Common Walls Opening and Projections

Any reduction in wall length and number of openings for specified area will help in reduction of cost per unit area. Common walls for buildings in rows will help achieve this. Similarly the doors and windows are costlier in comparison to the equivalent wall area, and any reduction in opening will also save the cost of lintels over them and thus finally help in economizing.

3. QUALITY CONTROLS MEASURES

For assured performance of a structure quality is of utmost importance. For quality assurance following question need to be answered –

- i) Are materials ok?
- ii) Does proper coordination exists amongst working agencies and different activities?
- iii) Are the process being adopted correct?
- iv) Is the work accomplished satisfactory?

A flow diagram showing controls is given below in Fig 3:

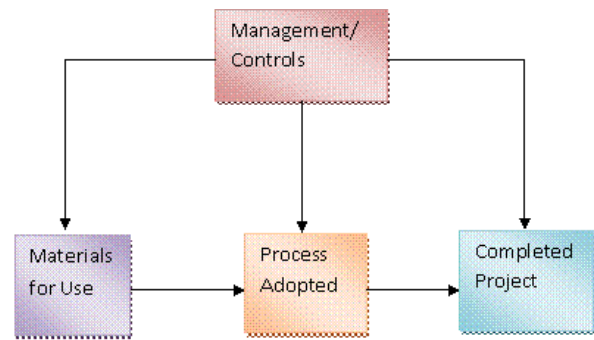


Fig. 3 Flow diagram showing controls

3.1 Materials quality assurance

For quality assurance of materials, proper sampling and testing is needed. The question arises; why not check all instead of sampling? The answers are simple:

- i) The cost of 100% inspection is prohibitive.
- ii) Many of the tests go up to destruction.
- iii) 100% inspection does not mean 100% quality assurance as it involves inspection fatigue.
- iv) Sampling procedure involves rejection/acceptance of lot, but it has been observed to have desirable effect on the supplier to provide quality product.

In view of the above, sampling is quite use full unless there is some very special case. A sampling plan could be one of the following types:

(a) Only one sample

It is useful when the quantity of lot is small and chances of oversight are less. The lot will be accepted or rejected based on results of sample.

(b) Double sampling

Sometimes good quality lot is rejected as a result of single sample, which may turn out to be poor. To avoid this double sampling system could be adopted. In this method three ranges of (i) acceptable (ii) no decision sample (iii) rejection are fixed. In this method firstly one sample is tested and lot is accepted/rejected depending upon where the results lie. In case the results lie in no decision range another sample is taken and average of two sample test will decided about acceptability/rejection of lot.

(c) Sequential Sampling

It is extension of double sampling and is useful for bulk supply of materials. In this system sampling is continued till average of results fall in no decision range.

3.2 Adoption of Standards

The quality management is not only concerned with achieving quality and ensuring the same within minimum costs. Before adopting any standard the following costs of quality need to be considered.

(a) Cost of Appraisal

These are costs of inspection, sampling, testing, and equipment maintenance etc. which are necessary for ensuring the quality of work.

(b) Cost of prevention

There are costs to check the bad quality occurring at site. These include costs of activity planning, its implementation and monitoring to avoid any bad quality, and wrong sampling.

(c) Cost of failure

These are costs on account of rejections, rework, spoilage and attending complaints and providing service etc.

Before finalizing the norm and standard, these costs should be properly assessed and the standards fix in view of the cost of quality.

3.3 Quality circle

It is a device to motivate workers and suggests method for ensuring a better quality works. It is collective effort for a 3 to 15 volunteers from amongst workers and supervisors, which meet regularly at intervals to identify, analyze and search solutions to work related problems and ways to implement them. Every department could have its quality circle; however, it needs support from top management and administration for its effective implementation.

3.4 Human Resources Development

There is always a resistance to change which can easily be won over by continued training. Training should be done to arrange/organized training program in latest and advanced technology as a regular program. A visit to other work using improved technique may also help in switching over to advanced method of construction. Quality management is a total organization activity. Quality consciousness should be inculcated among the workers. Enough training facilities in advanced systems do not exist at present and for the national development a sound national manpower planning and its implementation is desirable.

4 Conclusion

Costs and quality both are important for any construction project. The quality need not be sacrificed for sake of cost economy but measures taken to ensure quality without

increasing the cost. No doubt the improved technology by its implementation can help in achieving this end.

REFERENCES

- [1] Sandhya Keelery, 2022, "Demand and supply for housing in major cities of India 2016-2020" <https://www.statista.com/statistics/1211868>
- [2] Chary, S. N. 1988, "Production and Operation Management", TMH, New Delhi.
- [3] "Precast Stone Block Masonary", CBRI building Research Note No. 7.
- [4] Verma, Narendra, 1974, "Prefab Brick Panels for Low Cost Rural Houses" Jnl. Of The Institute of Town Planners, India September.

BIOGRAPHIES



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