Cost and Quality Management in Buildings—Some Innovative Measures

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Introduction

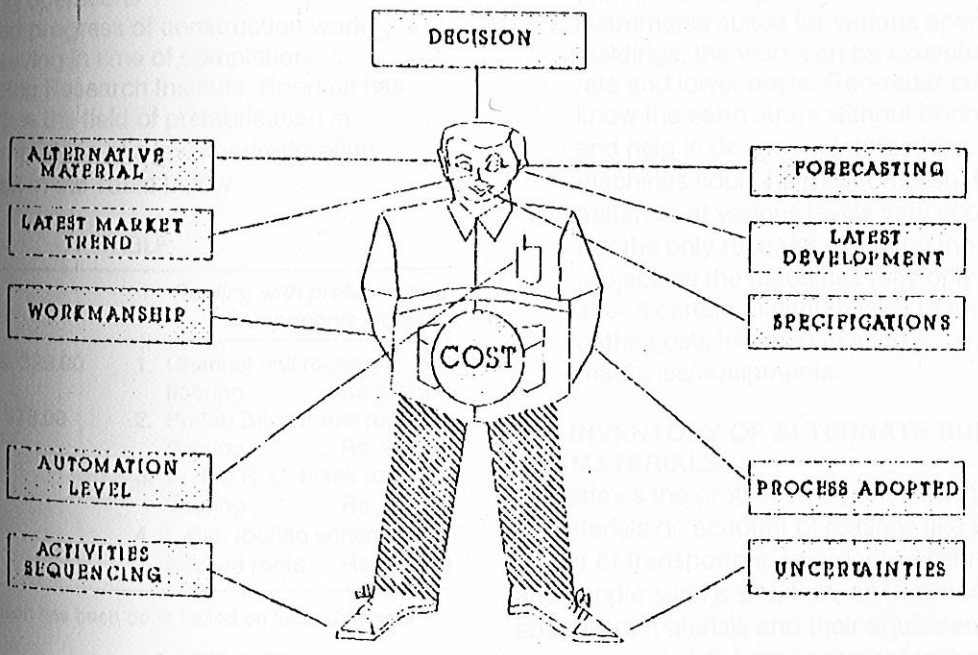
Shelter is one of the primary necessities for human beings. Inspite of all efforts of the state to check population growth, the gap between the demand and availablity of houses is on the increase. The present rate of house construction is 2.6 million per year and if it be planned to provide a house for each family by the year 2001, atleast 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 structure as well as maintenance cost are also important parameters. It is possible to achieve satisfactory behaviour in these parameters through quality control of materials and workmanship. There is a misconcept that quality work is always costly whereas through proper controls it may be possible to avoid wastages and reduce the cost with better quality. But it all will depend upon the management skills of the individual responsible for projects execution.

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) low ceiling height (c) unfinished walls (d) low strength bricks (e) use of secondary/local species of timber (f) lower thickness walls (g) elimination of parapets and rain water pipes and (h) no water proofing treatment to roofs, etc.

This concept could be true with the traditional constructions, but with advancement in construction methodology and development of new materials it is



FACTORS AFFECTING PROJECT COST
Fig. 1

possible to save in cost without sacrificing the quality. It is only possible if one is abreast with the latest developments related to buildings. The aim should be to optimise materials and control quality, use new and alternate materials, as a modern concept (Fig. 1)

A few of the useful suggestions for cost reduction are:

(i) ADOPTION OF NEW/LATEST TECHNOLOGIES

A number of new technologies for speedy 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, centring and shuttering comes as a hurdle in the progress of work and thus delays completion and also costs nearly 20% of the R.C.C. members. To save on this cost, prefab, components like Linetels, Lintel-cum-chhajas, floors and roofs can be used without any difficulty. Some of the salient features of prefab building components are:

- Cost effective and economical
- Better quality control
- Manual handling without involving machines
- Optimal use of scarce materials (cement and steel)
- Easy casting operations
- Uninterupted progress of construction work leading to saving in time of completion.

Central Building Research Institute, Roorkee has done lot of work in the field of prefabrication in buildings. A comparison of a few flooring/roofing schemes is given in the Table below.

TABLE

Traditional Slab Cost/M²	*Roofing with prefabricated Components Cost/m²*
1. R.C.C. Slab Rs. 329.00	1. Channel unit roofing/ flooring Rs. 227.00
2 R. B. Slab Rs. 378.00	2. Prefab Brick Panel roofing/ flooring Rs. 235.00
	3. Prefab R. C. Plank roofing/ flooring Rs. 280.00
	4. L-Pan roofing scheme for pitched roofs Rs. 206.00

Note: The comparison has been done based on labour/material rates in this area.

From the above table it is clear that a saving in roofing/flooring around 20% is feaslble without compromising in quality and saving of around 30% may be possible in other prefab items like lintels, lintel-cum chhajas, shelving units etc. Stone masonry blocks is another prefabrication technique for walling which is most suitable and economical for hilly regions where bricks need to be transported from far off places.

(b) Use of local materials:

The traditional materials getting nearly exhausted their costs have gone abnormally high and need has been felt to develop 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. Stone-masonry blocks 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 complicated machines, and open avenues for local employment generation.

(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 be helpful after a certain minimum level of project, in view of the costs involved in such machines/equipments.

ii) INVENTORY OF ALTERNATE BUILDING MATERIALS

Sometimes the problem may arise due to short supply of materials on account of reasons like strike of quarry labour or transporters. In order to ensure progress and handle such a situation, an inventory of alternate sources of materials and their equivalent substitutes may prove useful. A management technique called Value Analysis or Value Engineering evolved during the 2nd World War may be quite helpful. The material could be substituted wholly or partially, such

Activated Lime Pozzolana Mixture (ALPM) could replace cement fully or in some small proportion 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 consideration.

(a) Availability of materials required both qualitywise and quantitywise
(b) Cost of materials
(c) Availability of alternate/substitute materials
(d) Site location
(e) Local resources and its availability
(f) Importance of structure
(g) Zonal considerations like earth-quake, wind velocity, rainfall, altitude, vicinity to sea etc.
(h) Local considerations like, type of soil and water table and conditions which the structure is to withstand etc.
(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 about type of foundations and other measures necessary for safety of the structure.

(iv) CHECK ON WASTAGE

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

(v) BEHAVIOURAL ASPECTS

Internal environment of any set-up 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.

(iv) IN-TIME DECISION

The works normally get delayed due to decisions in a project, and any delay adds to the costs. The decisions 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 architectural designs/structural designs and other details should be finalized before the start of work as far as possible, or atleast well in advance before the particular stage of application approaches.

(vii) COMMON WALLS, OPENING AND PROJECTION

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 comparlsion to the equivalent wall area, and any reduction in openings will also save the cost of lintels over them and thus finally help in economising.

QUALITY CONTROL MEASURES

For assured performance of a structure quality is of

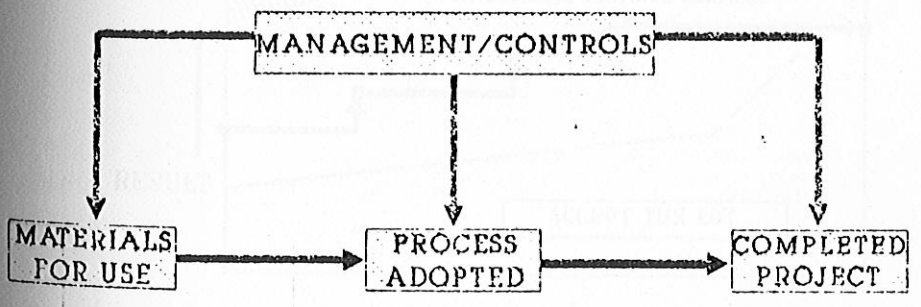


Fig. 2

utmost importance. For quality assurance following questions need to be answered

i) Are materials okay?
ii) Does proper coordination exist amongst working agencies and different activities?
iii) Are the processes being adopted correct?
iv) Is the work accomplished satisfactory?

A flow diagram showing controls is seen in figure 2.

A. 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 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 products.

In view of the above, sampling is quite useful 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 result of sample.

(b) Double sampling

Sometimes a good quality lot is rejected as a result of single sample, which may turn out to be poor. To avoid this a doublesampling system could be adopted. In this method three ranges of (i) Acceptable (ii) No decision and (ii) 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 the average of the two sample tests will decide 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. A graphical representation is given in Fig. 3.

B. Adoption of Standards

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

(a) Cost of Appraisal

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

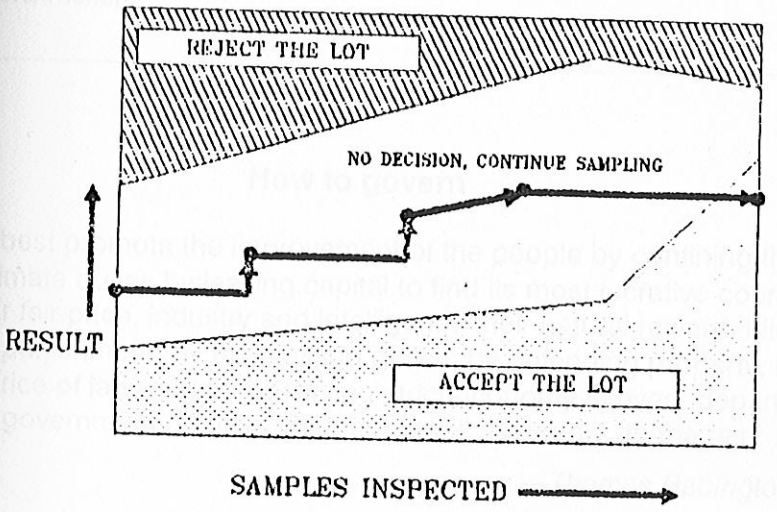


Fig. 3

(b) *Cost of Prevention*
These 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) *Costs of Failure*
These are costs on account of rejections, rework, spoilage and attending complaints and providing service etc.
Before finalising the norms and standards, these costs should be properly assessed and the standards fixed in view of the cost of quality.

C. Quality Circle
It is a device to motivate workers and suggest methods for ensuring a better quality work. It is a collective effort of a 3 to 15 volunteers from amongst workers and supervisors, which meet regularly at intervals to identify; analyse 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.

D. Human Resources Development
There is always a resistance to change which can easily be won over by continued training. Planning should be done to arrange/organise training programmes in latest and advanced techniques as a regular programme. A visit to other works using improved technique may also help in switching over to advanced methods of construction.

Quality Management is a total organisational activity. Quality conciousness 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.

Conclusion
Costs and Quality both are important for any construction project. The quality need not be sacrified for sake of cost economy but measures taken to ensure quality without increasing the costs. No doubt the improved technology by its implementation can help in achieving this end.

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How to govern

Our rulers will best promote the improvement of the people by confining themselves to their own legitimate duties by leaving capital to find its most lucrative course, commodities their fair price, industry and intelligence their natural reward, idleness and folly their natural punishment; by maintaining peace, by defending property, by diminishing the price of law, and by observing strict economy in every department of the state. Let the government do this—the people will assuredly do the rest.

—Thomas Babington Macaulay