

GENERAL QUALITY ASSURANCE STRATEGY IN MASS CONSTRUCTION OF RESIDENTIAL BUILDINGS IN DEVELOPING COUNTRIES

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Abstract

The comprehensive Topic of Total Quality Management (TQM) has been put forward since the 6th decade in industrial countries. The serious attention to it in developing countries goes back to recent years. Unfortunately serious attention is not paid to quality issues in building industry. Therefore, the construction of buildings is highly vulnerable against natural events while having low effective lifetime. Wide-range destruction of the residential buildings in the earthquake of Bam (in IRAN) is a clear proof for this claim. In this paper we tried to present the corresponding effects between quality issues and other aspects of a building project (such as costs) and proposed general solutions to improve quality indices in construction industry.

Keywords: quality assurance, comprehensive quality management, reparability, cost, lifetime

1. INTRODUCTION

Industrial countries have paid much attention to topics of quality and quality control in recent years. Quality is more watchful nowadays and can be measured more accurately in building works. Quality has covered nowadays all areas in design and construction, and quality control is not merely limited to construction stage. Quality can be defined as an assembly of production or service properties giving ability to the product so that it can satisfy specific needs. The needs may include economic need, achieving factors and easy maintenance, reliability and According to different needs in different time periods we can summarize progress process of quality improvement methods in post-decades of 2nd World War as shown in table 1. [1]

Characteristics\Time	4th decade	5th decade	8th decade	9th decade
Strategy	problem detection	control	coordination	strategic reception
Quality Viewpoint	solving problem	elimination problem	preventing problem creation	converting the problem into competition chance
Emphasis	product uniformity	improving product quality	improving production chain	regarding market and customer's needs
Methods and Techniques to do work	measuring and supervision	process control by statistical methods and sampling	planning and analysis of systems	education, planning and mobilization of organization
Quality experts' roles	supervision and categorizing product	failure detection in production process	measuring quality of systems design	aiming, education and training
Quality control responsible	supervision division	production and designing engineering division	all organizational units	all personnel
Direction and View	quality supervision	quality control	quality management	quality creation
Doer	human being	hardware	software	----

Table1:Evolution of quality improvement methods in different industries

Considering the above process it is figured out that as time has lasted, the quality has turned into as an inseparable part of different industries.

2. RELATION OF QUALITY AND CONSTRUCTION COSTS

The most important obstacle on the way to approach favorable quality in constructing residential buildings may be obliging the constructors to expend higher primary costs. Some of the most important primary expenses are as follows: [2]

1. expense of utilizing high grade and more expensive materials
2. expense of employing more professional manpower
3. expense of manpower education
4. expense of inspection, supervision and quality control in construction processes
5. expense of using advanced construction methods and technologies compared to traditional methods
6. expense of research and investigation about methods, materials and building standards

The following thrifths are gained against expending the above costs:

1. Durability of residential buildings and higher effective lifetime of buildings that leads to national economical thrifths.
2. Decrease of vulnerability against natural damages such as earthquake.
3. Decrease in service and maintenance expenses of buildings
4. Decrease in repair, retrofit or renewal expenses of some specific parts of the buildings .[3]

If the expenses of the first group are defined as short-time expenses and those of the second group as long-time expenses, the correlation between quality index and the project economy will be as shown in figure 1. [2]

In order to quantify the curve which has been shown in figure 1, different economical and social conditions should be considered. In other words the effective lifetime of buildings must be defined numerically or indices such as construction costs using durable materials must be given compared to case in which usual materials are used.

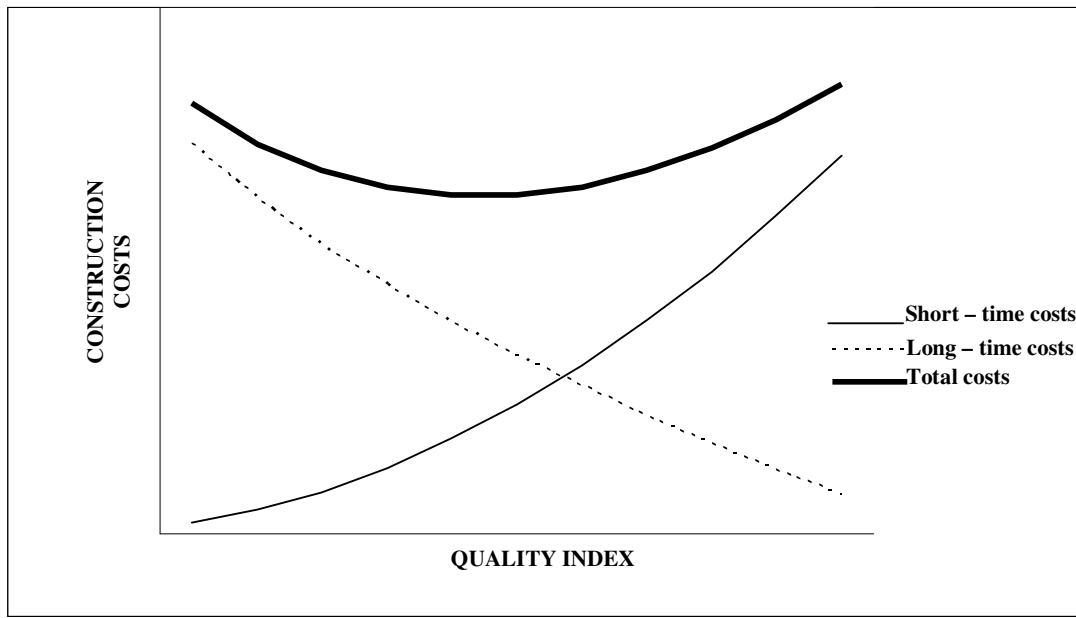


Fig.1: Correlation between quality index and construction costs

3. RELATION BETWEEN QUALITY AND REPAIRABILITY

Any structure may confront natural and accidental damages in its lifetime. At first stage the probability of creation of damages should be known. That is, the amount of probability that structural members would work according to predefined characteristics and work properly according to predefined lifetime (effective life) ought to be known. Then considering the project specifications and what is determined in technical and economical possibility study, it will be regarded whether they are acceptable with that amount of probability or not. It is obvious that in a case that the probability is less than the determined amount, the capability should be increased, where it requires expending costs. In addition to expending initial costs in order to achieve to reliance, the customer or consumer should know that:

- A building requires repair some often
- How much the expense of the repair will be
- What expenses would be expended in normal conditions and for maintenance if the system is expected to work according to the desired specifications and characteristics in repair intervals. [3]

As different members of a building have different lifetimes and primary costs, in order to achieve to favorable reliability for each of these members and all of them in a whole, the sum of parameters creating primary costs should be compared to expenses of directing costs, maintenance, repairs and retrofit and optimum limits should be drawn out considering the whole .

It is clear that maintenance is prior to repair whereas both of them require expending costs. Repairability is the capability of a system to accept repair works to turn it back to specific and defined conditions by the use of specific and determined facilities.

The relation of repair/maintenance and quality in time can be shown by figure-2. [4]

It can be resulted by the mentioned figure that small repair in short time can lead to economical thrifths in addition to preventing quality indices drop under the minimum values.

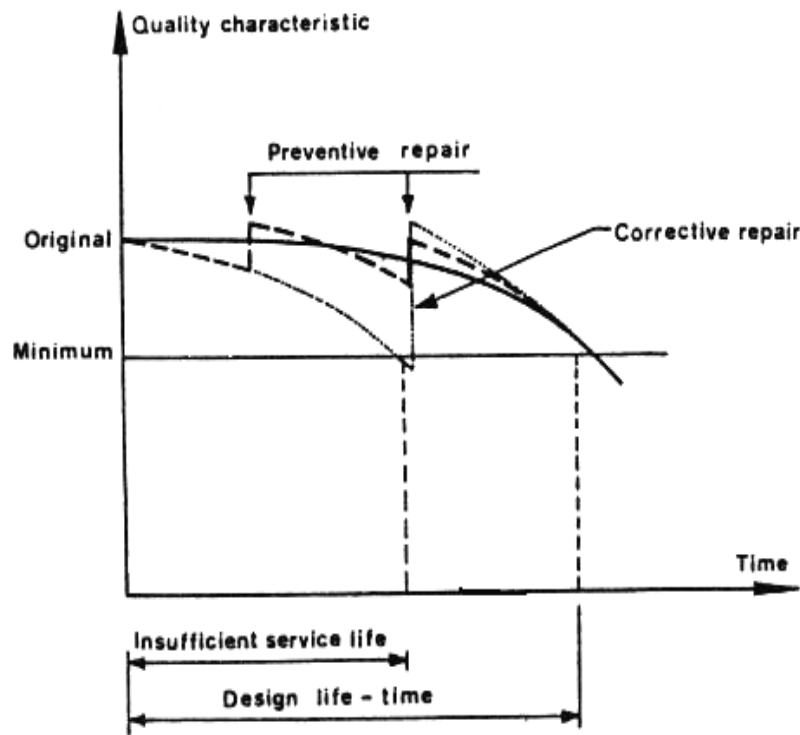


Fig.2: Correlation between quality and reparability indices along the time

4. RESEARCH METHODOLOGY AND RESULTS

In order to assess and evaluate the quality control status of construction of residential buildings, the field study and statistical method have been performed. The statistical society subjected to the study includes 55 under construction or constructed buildings in Tehran province area (IRAN), which has some problems or faults during the construction or exploration (operation) period.

It is notified that the above mentioned faults are the problems relevant to the exploration and don't include the majority of structural problems.

To evaluate each building, two types of question-form have been provided. One of the forms should be completed by inspector engineer and be confirmed by the owner of the building and the others should be completed separately by the supervision engineer.

For statistical analysis of the mentioned forms, SPSS-2(common statistical software) has been used.

39 buildings from the sum of the 55 have reinforced concrete and the remaining of 16 buildings has steel structure. This matter illustrates the extent of construction of reinforced concrete structure and in the other hand shows the faults caused by these kinds of buildings in IRAN.

The briefly conclusions resulted by these statistical studies are as follow:

4-1- The carried out studies demonstrate that the majority of the problems during the exploration period of buildings are as followings:

- Non-existence or low quality of acoustic or thermal insulations, 49.09 %
- Non-Existence of suitable bracing or connection between view panels and main structural elements, 23.63 %
- Low-quality of vapor tight segments and occurrence of leakage or moisture, 16.36 %
- Other defaults, 10.92 %

4-2- It has been clarified that additional expenses result from building defects such as repair, destruction and redoing works that are about 5 to 14 percent of the total construction costs. These expenses include only the items which emerge in construction stage and do not include long-time repair and reconstruction expenses.

4-3- 59% of these defects and faults are related to construction stage, 39% related to design and calculations and 2% related other items.

It is considered that more than half of the faults and problems are created in construction stage.

4-4- In this research the most important reasons for existence of defects and faults and low quality level in construction stage are categorized as following:

- Lack of watchfulness, supervision and quality control, 56.36%
- Lack of information, 7.27%
- Problems resulted from existing defects or inappropriateness between used materials, 9.1%
- Incompetence of manpower, 10.91%
- Lack or weakness in technical knowledge, 16.36% (As shown in figure-3)

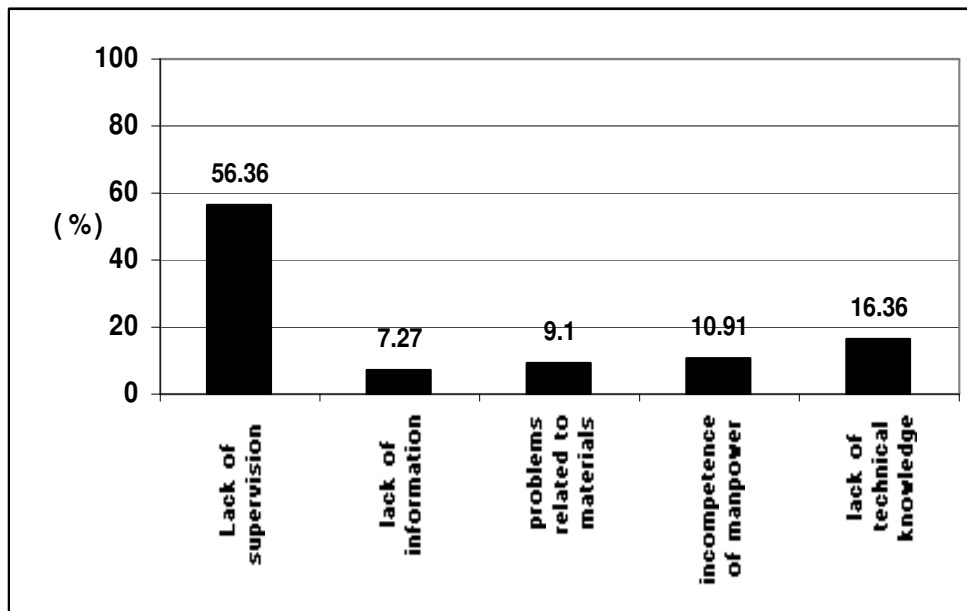


Fig.3: Distinction diagram for defect creation reasons in construction Phase.

The above values show the importance of supervision and effective quality control systems in order to achieve proper quality level.

In constructing any building unit a comprehensive program for quality control ought to be prepared and presented (similar to what is customary in time scheduling). The program should include details of utilized standards and specifications, methods and testing equipment, comprehensive program for sampling, employment and education of required manpower. [5], [3].

5. CONCLUSIONS AND RECOMMENDATIONS

Classification of constructed buildings on basis of construction quality and exerting obligations to use these results could increase purchasers' knowledge or could help the owners know conditions of their residential buildings. Results of this classification can be used as following to increase construction quality level of residential buildings: [6], [7]

5-1-Exerting policy of encouragement/punishment on constructors according to quality of constructed units by them

5-2-Exerting required specifications on insurance companies to make obligatory building insurances against defects or damages for specific time according to category of building quality

For instance, assigning different insurance tariff for buildings based on different construction quality grade (the lower the quality of construction the higher the constructor or owner must pay as insurance to insurance companies). It will encourage constructors to build residential units of high quality.

5-3-Determining guarantee period for buildings: [8]

Although in many countries, buildings have guarantee period and post-sales services like other productions, unfortunately in some of the developing countries still there aren't distinct rules or specifications about guarantee periods after constructing residential buildings. In case of determining guarantee period and defining corresponding responsibilities and duties between constructor and the owner in this period, the constructor will automatically direct to improve construction quality in order to prevent creation of faults and defects in operation period (the repair and reconstruction expenses of which the constructor will undergo).

Hence, building members should be categorized based on importance and their effective life, and specific guarantee period should be assigned to each member. For instance guarantee period for coating and plastering is proposed 3 to 5 years and for electrical and mechanical installation (according to the case) as 5 to 7 years. The constructor is responsible in this period to eliminate defects and do reconstruction by his own if the defects and faults don't go back to improper maintenance of the owner. [9], [10]

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