Supervision in building construction — A matter of concern

by
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troduction :

There has been a tremendous owth in the building construction tivity during the past three de-des, as there is a basic need to ovide food and shelter to the owing population. In our country, shortfall of houses is already sting and is on the increase due rise in population. The govern-nt is encouraging concerned agen-s to construct more and more ses in urban as well as rural ar-s and the trend is towards multi-oreyed constructions. Achievement the construction industry during post-independence era is com-ndable, but it is equally painful see how fast some of the build-gs, especially multi-storeyed, are owing signs of deterioration and r strength and durability becomes tter of concern.

Causes of such deterioration have en been analysed by engineers d contractors as environmental nditions and quality of materials, e latent factor which has been erlooked during course of the di-gnostic analysis is the effect of or supervision by the field engi-ers, during construction. Poor ality of construction accelerates e attack by environmental factors. y deficiency due to negligence of gineer or contractor will lead to ality-suspect construction in terms strength, durability and service-ility.

Through this paper, it is intended draw attention of site engineers the problem of quality construc-n and the effect of defective con-ctions being completed, and con-straints and suggestions for improv-ing supervision during construction.

Quality :

Advancement in the construction practices and technology invariably entail stringent requirements on the quality of construction. In general terminology, quality means conform-ing to established requirements. Reg-ulations concerning construction work and its quality requirement are specified in corresponding codes. To improve the quality of construction, it is imperative :

- To continuously raise the techni-cal level of design document.
- To introduce advanced tech-niques in construction.
- To improve or make better the quality of materials, components and parts of construction.
- To deliver materials, parts and components in good condition, and to store them rationally at the construction sites.
- To follow scientific organisa-tion of construction work.
- To upgrade and enhance the skill of workers and engineering personnel.
- To provide moral incentives for improved workmanship.
- To streamline a system of qual-ity control including laboratory services.
- To devise and adopt field tests which are easy to conduct at construction site.

Durability :

Durability of a building cannot be conceived independently of the durability of component materials. A satisfactory performance of the con-stituent materials to resist environ-mental effects throughout the de-signed life with normal maintenance and routine repairs, represents a du-rable building i.e. durability of con-crete structure depends upon the du-rability of concrete poured. Normal-ly, masonry and concrete structures built with adequate care and exper-tise are expected to give maintenance-free service for several years. But where the construction quality is poor and faulty from the beginning, it starts showing signs of deteriora-tion in a couple of years only, ask-ing for maintenance of high order. In developing countries like ours, there is lack of sophisticated con-struction facilities which, when coupled with poor supervision, leads to defective and poor quality const-ructions. Specified and co-ordinated maintenance efforts are also lacking, which further tells upon the durabil-ity of buildings, which start showing signs of distress earlier than the ex-pected time. A strict supervision and quality control at the time of con-struction and during routine mainte-nance can help in enhancing the durability and life of buildings.

Factors responsible for quality :

A number of factors are respon-sible for quality construction. A few which are common and need more care are :

(i) *Poor specifications :*

Poor specifications lead to poor quality whereas incomplete speci-fications lead to ambiguity in con-struction. A specifications writer should be able to produce a clear and concise language leaving noth-ing to be taken for granted which will lead to ease in adoption and complete the construction without involving any claims and extra costs. Ambiguity, verbosity and rep-etitions should be avoided in specifi-cations, as it gives cause for doubts about the intentions of parties con-

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cerned. Detailed specifications also help during inspection by clinets at various stages of construction.

(ii) ***Poor design and detailing :***

A major shortcoming noticed with design is the failure on the part of the designer to make use of authoritative design guidelines. The attention paid to details is not sufficient which may lead to difficulty in adoption and translation at site by the field staff. Use of standard details could bring out clarity and lead to improvement. Non-standard details may be thought out in 3-dimensional form and be illustrated clearly. It should not be left to the man at site to find difficulties and even sometimes impossibility of execution as intended by the designer, at site.

(iii) ***Quality of materials :***

Use of poor quality materials results in poor quality of construction in any building. Quality of constituents must conform to the prescribed specifications and properties. The principal properties to be considered in specifications of materials are :

(a) Physical properties, such as strength, durability and hardness;

(b) Chemical composition;

(c) Electric, thermal and acoustic properties;

(d) Appearance including colour, texture, pattern and fineness;

(e) Procedure and requirements to be met in inspection, tests and analysis;

(f) Protection needed during handling and storage etc.

(iv) ***Climatic conditions :***

The time at which construction of building is done is also very important for achieving good quality. Rainy season is not advisable for construction activity, especially when the work is open to the rain. Very hot or very cold climate is not recommended for R.C.C. work and if it is unavoidable, due precaution must be taken to avoid deterioration of quality due to their effect. Hence the selection of time for construction should be carried out depending upon the climatic conditions of the area to ensure good workmanship and quality of construction.

(v) ***Contractor's experience and calibre :***

Quality of construction depends upon the type of contractor who is entrusted the job. A company or a contractor of good experience and calibre will make use of modern equipments, latest techniques of construction, well qualified and experienced staff, whereas a substandard contractor would try to use outdated methods of construction and equipment, with semi-skilled staff and labour. A reputed firm or contractor makes it a point of prestige to give best possible output and quality of work so that he could earn repeated works and benefit in the long term.

(vi) ***Qualities of contract system :***

A contract is an instrument for the execution of a project with predefined conditions which are binding on both the parties. Incomplete description of various items and other conditions leads to ambiguity during execution and finally affects the quality. A contract should possess the following information :

(a) Clarity of scope of work vide schedules of work, specifications and drawings etc.

(b) Coherence between drawings and specifications.

(c) Compatibility between contract specifications and local standard of workmanship.

(d) Clarity of acceptance criteria and the tolerance level.

(e) Automatic devaluation and rejection clauses for works beyond acceptable range.

(f) Involvement of optimum number of executive/supervisory staff from both the client's and contractor's sides.

(vii) ***Supervision :***

Supervision is the most important factor in controlling the quality at site. Poor supervision could lead to poor quality of construction inspite of all efforts to ensure use of proper and specified materials, as has been reported in most of cases surveyed during past. Poor quality can be avoided by timely action of the site supervisor and the engineer-in-charge. Though the contractor or construction agency is mainly responsible for the final quality of construction, the site supervisor and the engineer-in-charge cannot be exonerated from their duty of stopping the contractor who is executing poor quality construction. Though reputed construction agencies are conscious of maintaining good quality, it cannot be achieved in the absence of proper supervision, both on the side of the contractor and the engineer-in-charge, the chances of poor construction increase with poor supervision and inadequate controls by the technical staff and so supervision can be said to be the prime factor involved in ensuring quality constructions.

The likely impact of supervision and quality control on the maintenance costs of a building has been graphically presented in Fig. 1 (see opp. page). Poor supervision leads to poor quality construction, higher maintenance cost and reduced life of the building.

Causes of poor supervision :

Construction supervision is a job of a qualified engineer and must be done by an engineer who is qualified and experienced and conscious of his duties. Poor supervision may cause various defects in buildings at later stage, which become difficult to rectify. A few of the main causes of poor supervision and suggestions for improvement are summarised further :

Lack of experience and technical confidence :

The young engineers have either little or no experience of site supervision. They do not have enough patience to properly inspect the construction and tend to trust the contractor and accept the job done by him in good faith. Some of them lack confidence to challenge the contractor due to their limited knowledge and lack of experience of field problems. They hesitate to take spot decisions needed at site which hampers the progress.

Additional administrative duties :

In most of the cases, a Civil Engineer is burdened with additional administrative duties and so he cannot give his full time and attention to the site problems. A good organisation prefers to appoint an Administrative Officer separately to deal with legal matters and labour problems and free the technical staff for technical jobs.

Field training :

During education, there is no provision of giving any technical field training to the engineers, though it is very much needed. A proper field training may produce better site engineers needed for quality constructions with programmed progress.

Sense of responsibility :

The technical staff engaged by the contractor do not have self-consciousness. A better workmanship can be achieved on a construction project if the technical staff engaged have a sense of responsibility while executing various activities at site.

Field test facility :

Non-availability of field test laboratories at a construction site defy the site engineer to confirm the quality of materials brought at construction site. It is essential to have a small laboratory at site, equipped with various sophisticated test apparatus and trained staff, to ensure that the final products possess the design properties.

Hiding defects :

It is a common practice of field staff to hide the defects without repairing or treating them, through plastering or other cosmetic finishes to the structure and the concrete surfaces. Durability of such a construction remains doubtful and will mainly depend on maintenance. A site-engineer should be aware of such consequences and ensure that all the defects are properly repaired and well treated before the final finishing is carried out, and the project is taken over from the contractor.

Construction management :

A poor management leads to poor supervision. Efficient organisation and team concept should be preferably planned and implemented making all involved responsible for the duties assigned individually and collectively. There should be proper planning and coordination among various sections working, for the successful completion of the project. Materials and machineries required at various stages should be arranged well in advance.

Labour organisation :

A major factor in enhancing the productivity and workmanship is the principle of executing construction work stage by stage. The construction process should be divided into homogenous operations which are to be performed by teams of workers of appropriate group and skill. Introduction of efficient working methods and procedures, maximum job mechanisation, efficient utilisation of working time of staff, training and raising the skill of workers. Developing wage standards, enhancing value of hygiene and aesthetics in labour helps in raising the standard of workmanship.

Periodical Checking :

It is observed that senior executives mostly depend on their subordinates and visit the construction site very rarely. But a periodical checking by senior executives alongwith designer and architect make the site engineer more conscious about the quality of work. These visits should be advisory & problem-solving and any modifications or changes must be confirmed in writing to avoid any sort of doubts and ambiguities.

Human Relations :

In any construction project the management of personnel and human relations is a very important factor as it is totally a labour intensive activity. All the infrastructural facilities like housing, electricity, water supply and sanitation, education, etc. must be made available to departmental as well as contractor's staff at the project site. On a construction project the quality of work depends on the manpower, their efficiency, productivity and proper decision making in varying circumstances. If

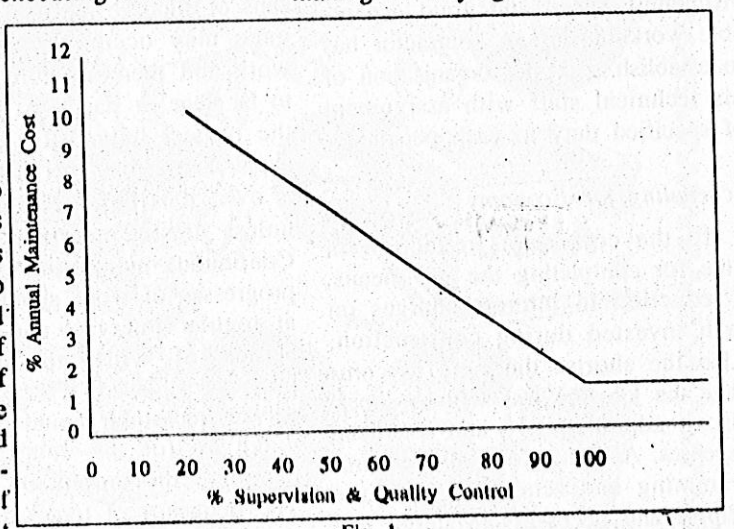

Fig. 1
Relation Between Quality Control and Annual Maintenance Cost

the families of the employees are cared for and the life is easier and trouble-free, the employees will work more efficiently producing better progress with quality.

Some more aspects of supervision:

Role of Contractor :

Construction is a combination of organisations, engineering, science, studied guesses and calculated risks. From their very nature, construction operations are required to be performed at site of the project, which is a dynamic, restless, compelling business. The full scope of the job assumed by a contractor has a two-fold objective. Firstly, he must give the owner a service that is satisfactory and on time, secondly he must earn a profit to himself.

The construction of a project involves thousands of details and complex inter relationships among owners, architect, engineers, contractors, manufacturers, dealers and others. The contractor assumes responsibility for delivering the properly completed construction at a specified time and cost. In doing so, he accepts legal, financial and managerial obligations. Technological advances are resulting in more complex facilities. Hence, there is increasing necessity for skillful coordination of all construction activities to attain maximum efficiency, speed and good acceptable workmanship. A contractor has to establish a proper organisation of his technical staff with assignment of specified duty to each personnel.

Scheduling for Economy :

To the contractor, reduction in time for completing the job means, a reduction in interest charges on cash invested during construction. Also the shorter the time to complete the job, the less will be supervisory, administrative and overhead expenses. And therefore advance programming and scheduling is quite helpful and necessary. Material and labour components are almost fixed and so profit can be managed from skillful, indigenous utilisation of time element. Construction scheduling consists essentially in arranging the several operations involved in the construction of a project in the sequence to accomplish completion in minimum time. To assure completion with the contract time limit, and to attempt to reduce time required for doing the job, it is necessary to programme each unit of the project within itself and to properly relate each to all others.

Progress Schedule :

The first thing to be done before start of a project is to make a time schedule of the proposed operations and set up a tentative plan for, and construction procedures of doing the work. These days large number of projects are being undertaken with investment so high that adherence to time schedule has become imperative; PERT/CPM have limited use to Indian conditions as site engineers find it difficult to update these charts and consequently control is lost. Moreover, our system does not permit site engineers to freely reflect the actual progress of work accurately to the top management and as a result most of civil engineering projects overshoot their schedule.

In a large multi-facet project, reasons of slippage are many. The slippage may occur at any stage of work and therefore forecasting has to be done in stages. At the start of the project only, little efforts can avoid delays, but after half the work is over, it is difficult to curb delays unless drastic measures are taken. Continuous monitoring of physical progresses of work should be done at regular intervals and important stages of work to assess the progress achieved. If delays are observed, recasting should be done to make up for the delay, so as to complete the project on schedule. The frequency of forecasting can be decided by the management. The forecasting report must consist of observations made, assessment of work, shortcomings, expected total delay to avoid further delays.

Application of advance techniques :

Advances in automation, electronics, mechanics and other industries are being used on increasing scale in construction. This opens new possibilities for improving the quality of construction, e.g. conveyor line method incorporated for inaction in Industrial and multistorey buildings. The high level of mechanisation is certain to substantially intensify construction procedures.

Achievements in physics and chemistry are finding wide application in construction industry which is benefited by application of laser tracers, hydro-dynamic light induced effect for crushing materials, electro-osmosis for reducing w/c ratio, ultrasound for intensifying processes such as pile driving, soil cutting etc.

The use of econometrics, computers and physiochemical action provides new means of optimising production processes and enhancing the technological effectiveness in construction engineering.

Conclusion :

It can be assessed that if the persons involved with the project and especially responsible for the supervision and quality control, quit ducking their responsibility, the strength, serviceability and durability of a structure can be ensured. It is therefore essential to exercise proper supervision and quality controls to ensure expected life of the structure with trouble-free service and reduction in maintenance costs. The concept of teamwork and adhering to individual's responsibilities is the best means of achieving assured quality construction. Role of supervision and other parameters responsible for durability and quality in any project are shown in Fig. 2.

here. Other conclusions which could be drawn from the study are :

1. Strict site supervision is essential for achieving quality construction; and it depends on experience of concerned technical staff.
2. Engineering associations should introduce in-service training/refreshing programmes for field engineers to update their knowledge.
3. Selection of a proper contractor play an important role in maintaining quality and speed of the project.
4. Young engineers should learn to face challenges in construction profession.
5. Advancements in technology should be adopted in various activities of construction.
6. Scientific coordination of all construction activities and proper scheduling for monitoring the progress.

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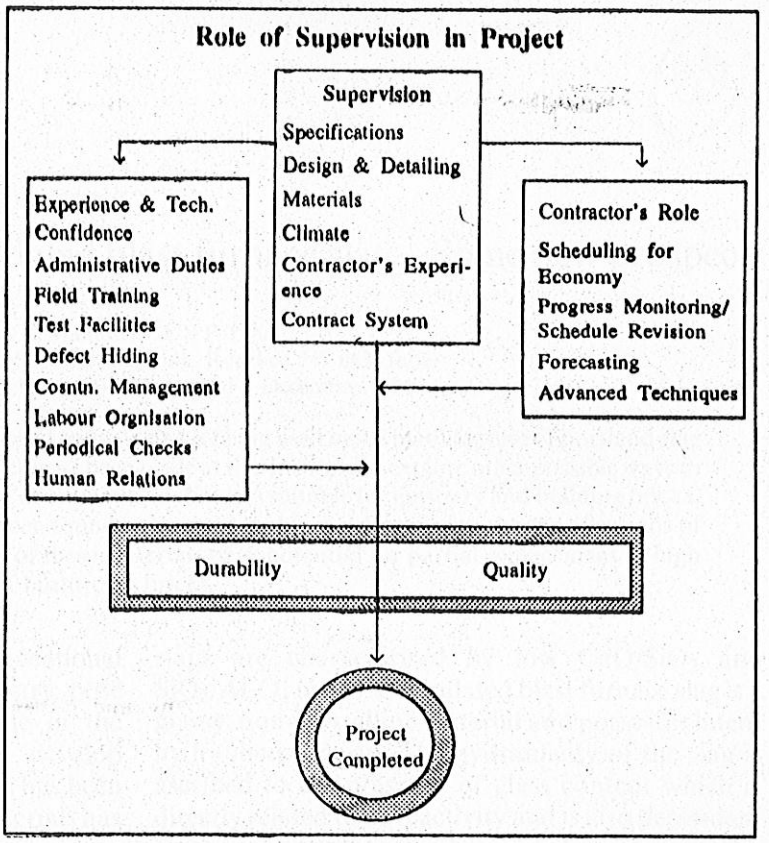

Fig. 2