An In house journal of Construction Industry Development Council

NIRMAN UDYOG

Oct., 2010 Vol-3, No. 2

- Quality in Construction
- CIDC News • CCI








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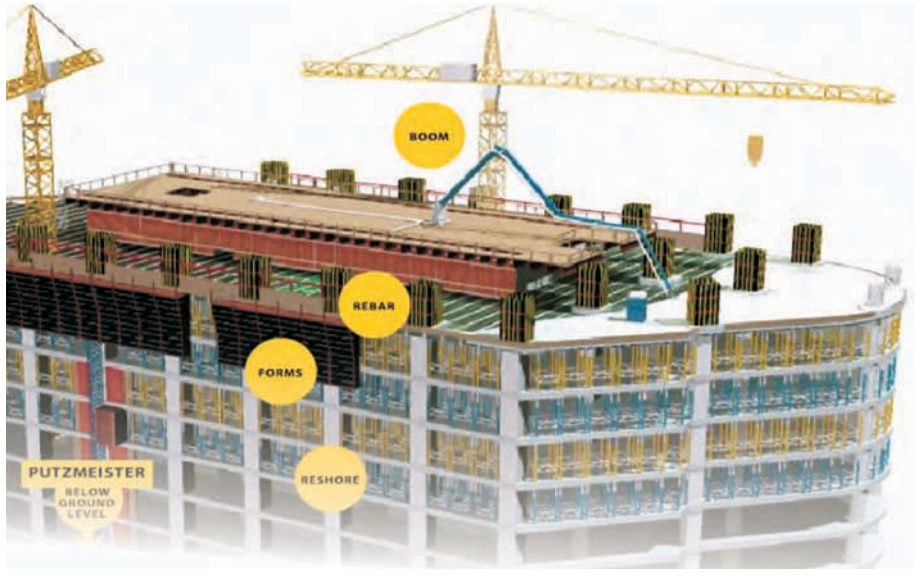
Table of Contents

Nirman UDYOG



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The journal is published for private circulation amongst the members of the society and other stakeholders and interested persons for the purpose of dissemination of information and generating discussions.

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5th National Proficiency Evaluation Test (NPET)

February 19, 2011

Conducted By

The National Proficiency Evaluation Board

(Constituted by Construction Industry Development Council)

Notice is hereby given for the fifth National Proficiency Evaluation Test (NPET) to be conducted on 19th February, 2011 at various centers across the nation for evaluating the proficiencies of candidates desirous to join Indian Construction Industry.

National Proficiency Evaluation Test (NPET) is the independent assessment of proficiencies of young Engineering Graduates, Diploma holders and Supervisors. It also evaluates those with Bachelor / Master's in Management and Architecture.

The National Proficiency Evaluation Board, constituted by CIDC is conducting NPET. Under the test, candidates proficiency is graded based on academic achievements, work experience (for experienced professionals), written examination, interview and group discussions for all the above categories. The Board functions independently under the Chair of Dr. S. A. Reddi, Former Dy. Managing Director, Gammon India Limited and comprises of eminent project specialists, multi disciplinary engineers, administrators, academicians, top managers etc and complete list of board members is hosted on CIDC website.

Testing under NPET is based on the generic needs of the employer organizations and upgraded from time to time. Upon conclusion of the examination the result are declared and the scores attained by the candidates are provided to them. In addition, an electronic card detailing the candidate's achievements and other pertinent details are issued to the candidates for ready reference purpose. The scores are valid for a period of 3 years from the particular date of test. Candidates with low scores can reappear in the test and upgrade their scores.

A nation wide performance list of the candidates is prepared & provided to the prospective employer organizations including CIDC members & various Construction Industry Stakeholders (list is hosted on CIDC website) and other interested organizations totalling over 300.

Examination Date : 19th February 2011

Fee Structure

Group	Examination Fee	E-Card	Total
Bachelor in Engineering	Rs. 2000/-	Rs. 500/-	Rs. 2500/-
Bachelor / Masters in Management	Rs. 2000/-	Rs. 500/-	Rs. 2500/-
Architects	Rs. 2000/-	Rs. 500/-	Rs. 2500/-
Diploma in Engineering	Rs. 2000/-	Rs. 500/-	Rs. 2500/-
Supervisory Trades	Rs. 1000/-	Rs. 500/-	Rs. 1500/-

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Email: npet.cidc@gmail.com , URL: http://www.cidc.in

Message from the Chairman

CIDC's new corporate office "Vishwakarma Pratham" is under construction at Faridabad. The site is a showcase of best practices in the industry and is serving as an active training centre for CIDC's vocational students from across India. Instead of employing contract labour and contractors, construction is being carried out by the trainees under the supervision of CIDC's engineers and staff. 681 trainees to date have received their final leg of training on this site and have then been placed in the industry. The support received by CIDC from all in the construction industry in making this new facility a reality, is indeed heartening and encouraging. I convey my sincere thanks to all the sponsors of the project.

Shortage of training facilities in construction trades (at the vocational level) is creating all sorts of problems ranging from inferior quality to poor speed of execution of works. It is a difficult task to bridge this gap. CIDC, however, has taken the lead in this direction and is successfully running several training programs for construction supervisors, technicians, workers, etc at several locations. CIDC has been successfully motivating the younger generation of the nation to take up construction as a career and help bridge this gap. Placement meets are being organized on regular basis and candidates trained by CIDC are getting excellent job offers. I urge the industry to offer all support to CIDC in making this endeavour a greater success in time to come.

Chander Verma

Message from the Director General

This issue of Nirman Udyog focuses on quality in Construction Industry and several good articles have been published. As the Indian Construction Industry is largely unorganized the general quality of construction is not so satisfactory. However, there has been a sea-change in which the Construction Industry during the recent past. Projects have grown in size and large infrastructure projects are being executed. This has lead to the growth and development of the Industry in a very big way. New materials (such as RMC) and processes (such as pre-stressing) have been introduced in the Construction Industry leading to modernization of the Industry. However construction remains a site process and hence needs strict supervision with regards to quality. Other issues such as good housekeeping and proper planning also influence the quality of construction substantially. These areas I believe that are being neglected today.

With regards to quality CIDC has been working for quality inspection (as Independent Quality Assurance Consultant) for various projects of Govt. of Madhya Pradesh, Punjab and Gujarat. CIDC is also working for quality grading and certification of building projects in the Private sector. Further CIDC offers short duration training program for quality inspection. A three month courses for Laboratory Technician is being conducted by CIDC.

I am proud to bring to your notice that the new facility of CIDC at Faridabad has started functioning which will serve as the Corporate Office of CIDC. The facility has been constructed on a one acre plot allotted by HUDA, Govt. of Haryana. The total area of the fully constructed facility will be of about 70,000 sft having excellent facility for conducting various activities of CIDC. The support received by CIDC for the construction of this ambitious facility has been excellent and very encouraging. From this new facility CIDC will expand its activity in both scope and size.

CIDC has also established an excellent training facility (at vocational level) at Ramshapur, UP (Dist. Sultanpur) for the conduct of several short duration (three months) training programs for the rural youth who seek employment in the Construction Industry. This will provide excellent employment opportunity to the rural population and also serve the Industry by providing skilled supervisors/technicians/workers.

Dr. P.R. Swarup

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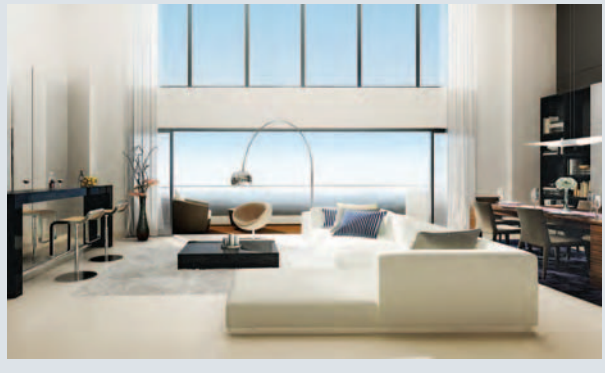

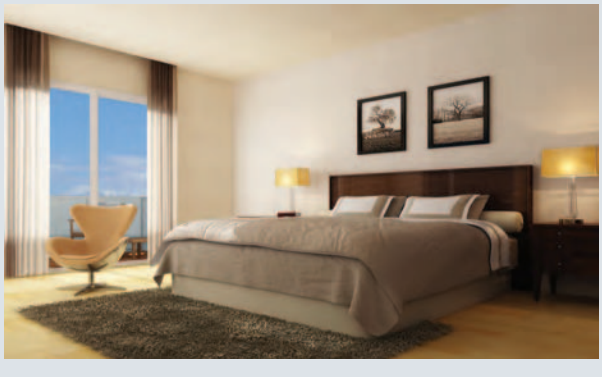

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CIDC VISHWAKARMA AWARDS 2011

Invitation of Nominations





The Construction Industry Development Council (CIDC) Vishwakarma Awards are inspired by the spirit of construction and creation patronized by Lord Vishwakarma the ruling deity of the Construction practices in India.

CIDC Vishwakarma Awards are meant to motivate individuals' and organizations' contribution in construction domain and to promote replicable best practices in the Indian Construction Industry.

Each year, this event is celebrated on 7th March which is also the foundation day of CIDC. CIDC is mandated to work relentlessly towards promoting best practices in the Indian Construction Industry and help it achieve a global stature.

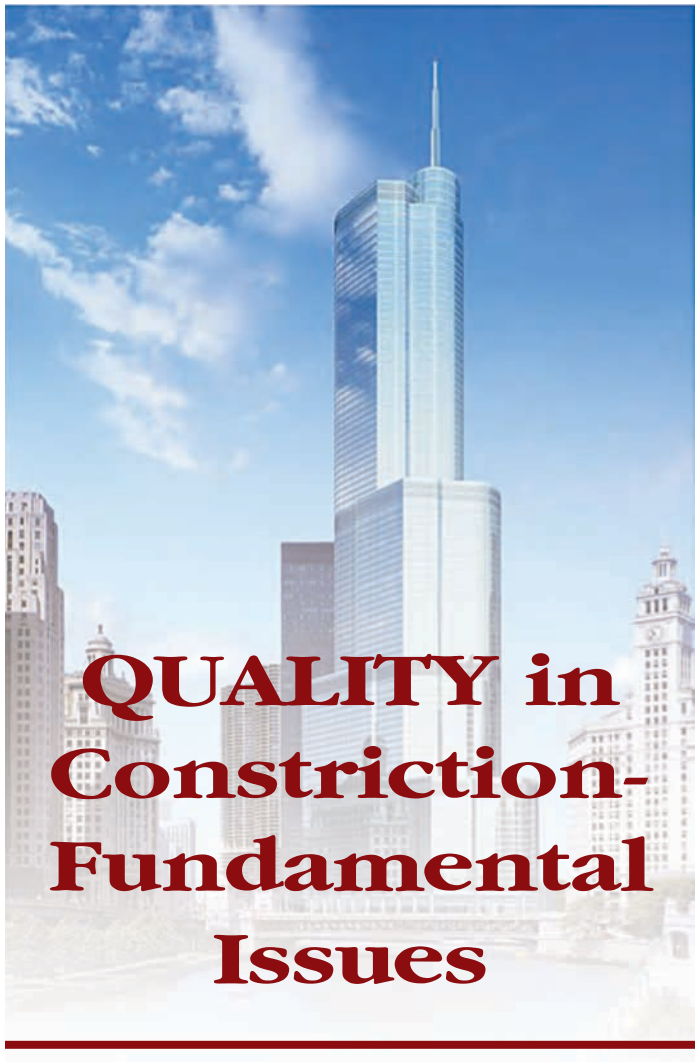
To make the process all inclusive and broad based, CIDC Vishwakarma Awards are being given to all representative categories that comprise the entire spectrum of the Indian Construction Industry from artisans to industry doyens, students and professionally managed companies.

The uniqueness of the CIDC Vishwakarma Awards is reflected in its recognition of contributions made by individuals such as grass root construction workers, artisans, marginalized sections such as women workers, prison inmates (CIDC is conducting programs for rehabilitation of prison inmates in Madhya Pradesh) to the growth and development of Indian Construction Industry.

The Awards cover the entire spectrum of Indian Construction Industry. All stakeholders both from public and private sector including NGOs are encouraged to participate in the process and send their nominations subject to a maximum of one nomination per category as per the categories mentioned below Please visit our website: www.cidc.in to download the detailed guidelines. ■

Award Categories:

1	Achievement Award for Social Responsibility (2 Nos.)	Code A
2	Achievement Award for Industry Doyen (2 Nos.)	Code B
3	Achievement Award for Public Officer (2 Nos. in each State)	Code C
4	Achievement Award for Academician/Technologist/Scientist/Innovator (8 Nos)	Code D
5	Best Professionally Managed Company (2 Nos. in each Category)	Code E
	-Category - I (Turnover > Rs. 1000 Cr)	Code E1
	- Category - II (Turnover > Rs.500 -1000 Cr)	Code E2
	- Category – III (Turnover Rs. 500 to Rs.100 Cr)	Code E3
	- Category – IV (Turnover < Rs.100 Cr)	Code E4
	- Category – V Entrepreneur	Code E5
6	Achievement Award for Best Project (11 Awards – one in each category) Roads & Highways; Bridges; Dams; Power; Railways; Oil & Gas; Mining; Transmission; Urban Infrastructure; Social Infrastructure; Health Infrastructure; Buildings (Residential/Commercial);	Code F
7	Artisans (25 Nos.)	Code G1 -25
8	Achievement Award for best news coverage of Construction Industry	Code H
	Best Journalist	Code H1
	Best News Channel	Code H2
	Best News Magazine	Code H3
	Best Newspaper	Code H4



QUALITY in Constriction- Fundamental Issues

K D Arcot

K D Arcot

The Concept of Quality:

The fundamental concept of quality in construction encompasses the following:

- Establish and maintain quality in construction.
- Creating an awareness of importance and benefits of quality in construction.
- Compliance of codes and specifications leading to total quality in construction.

The Meaning of Project Quality:

Project quality is defined as:

The totality of features and characteristics of a product or services that bear on its ability to satisfy stated needs or implied needs of a customer.

The Purpose and Significance of Quality Management:

Quality Management runs through every stage of the project from conceptual design to detailed engineering and construction and commissioning activities at site. Quality Management is the corner stone of any endeavor which results in cost & time saving and executed to national and international standards keeping in mind local environmental and social considerations.

The Quality Assurance System:

Quality system is the organization structure to ensure quality control in line with International standards like ISO 9000: 2000, ISO 14000 and related standards with checks and counter checks built in.

Quality in Construction:

Quality in construction can be subdivided into following three parts:

- Quality during pre-construction phase.
- Quality during construction phase.
- Quality during post-construction phase.

A quality assurance system encompassing all the above three phases, results in Total Quality in Construction.

Quality during pre-construction phase:

Quality during pre-construction phase has its impact during construction activities during pre-construction phase relate to generation of quality documents which can be further classified as follows:

- Conceptual Plans.
- Process Design.
- Detailed Engineering.
- Construction Drawings.
- Procurement Specifications.
- Construction Specifications.

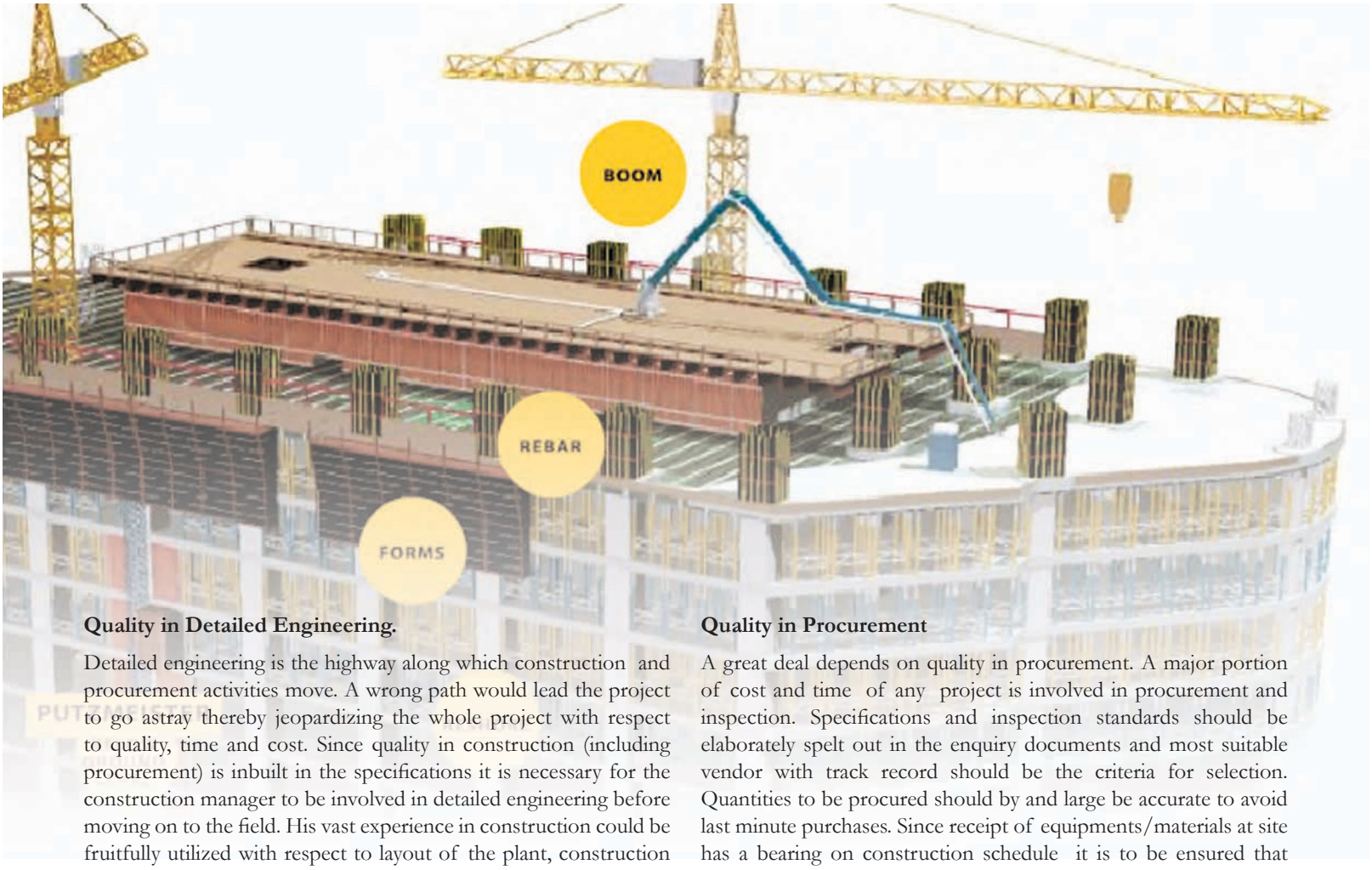
Quality in Conceptual Plan.

A project is to be initiated only after deep study of the end use of the project/product and the same meets with market quality / international standards and is financially viable. This is achieved by economic study of input/output costs and satisfy that required Return on Investment.

Any rethinking /change mid course will have disastrous consequences on the project as a whole.

Quality in Process Design.

Process design is the fountain head of any project and hence quality in selection of the right process technology is to be ensured. A world wide search is to be made to identify the right technology owner with proven track record and availability of their process engineers during pre commissioning/commissioning phase. Availability of process equipments either indigenously or from international markets to be ensured.



Quality in Detailed Engineering.

Detailed engineering is the highway along which construction and procurement activities move. A wrong path would lead the project to go astray thereby jeopardizing the whole project with respect to quality, time and cost. Since quality in construction (including procurement) is inbuilt in the specifications it is necessary for the construction manager to be involved in detailed engineering before moving on to the field. His vast experience in construction could be fruitfully utilized with respect to layout of the plant, construction methodology quality aspects, schedule, safety etc.

Quality in Construction Drawings

Drawings issued for construction should be clear unambiguous and match the specifications. These should be released sequentially and well before the proposed activity at site. Frequent revision in drawings would lead to rework and delay in construction.

Quality in Procurement

A great deal depends on quality in procurement. A major portion of cost and time of any project is involved in procurement and inspection. Specifications and inspection standards should be elaborately spelt out in the enquiry documents and most suitable vendor with track record should be the criteria for selection. Quantities to be procured should by and large be accurate to avoid last minute purchases. Since receipt of equipments/materials at site has a bearing on construction schedule it is to be ensured that purchase orders are released well in time keeping delivery period in mind.

Quality in Construction – Various Aspects:

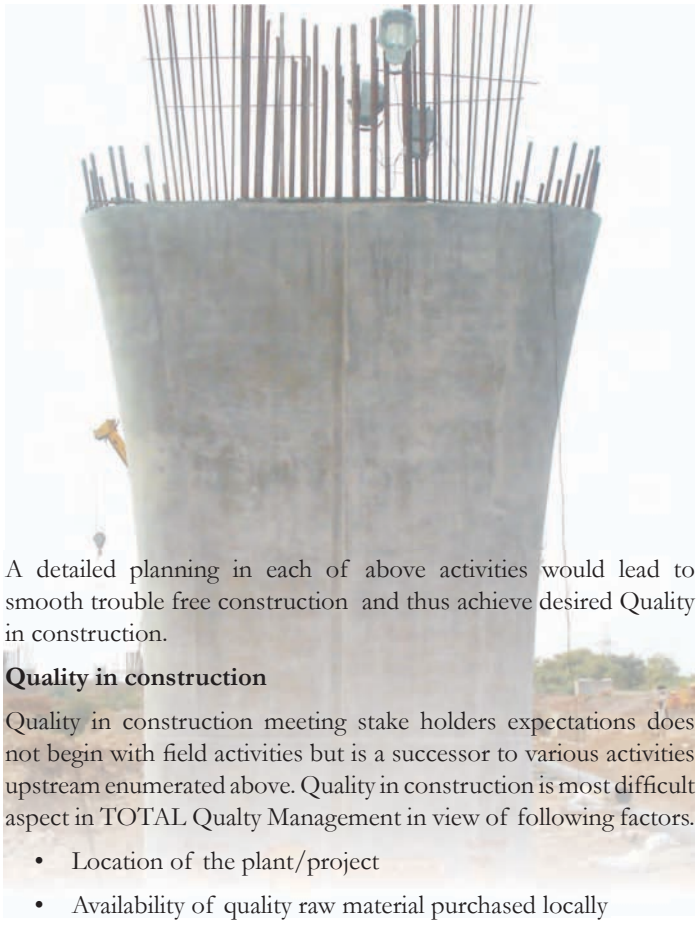
Every aspect of construction should have an inbuilt quality assurance plan. Various aspects of construction can broadly classified as follows

- Quality in Planning
- Quality in Construction
- Quality in Warehousing
- Quality in Safety

Quality in Planning

Planning is an important ingredient for proper construction. Planning can be further sub categorized into the following:

- Planning for sequential construction
- Planning for issue of drawings to meet above requirement
- Planning for deployment of manpower
- Planning for receipt of equipments
- Planning for receipt of other materials
- Planning for positioning of subcontractors
- Planning for construction equipments tools tackles and infrastructure



A detailed planning in each of above activities would lead to smooth trouble free construction and thus achieve desired Quality in construction.

Quality in construction

Quality in construction meeting stake holders expectations does not begin with field activities but is a successor to various activities upstream enumerated above. Quality in construction is most difficult aspect in TOTAL Qualty Management in view of following factors.

- Location of the plant/project
- Availability of quality raw material purchased locally
- Time constraints
- Availability of trained manpower
- Vagaries of weather/sub soil conditions
- Sub contractors falling short of expectations
- Machinery breakdown
- Unsafe working conditions etc.

Not withstanding above constraints Quality in Construction has to be maintained at all costs.

The process is all the more complicated considering the fact that construction on the whole involves activities of all disciplines of work viz Civil, Structural, Mechanical, Piping, Tankages, Electrical, Instrumentation, Insulation Fire proofing, Fire protection, Air-conditioning of plant and non-plant buildings, Cathodic protection and development of required infrastructure.

Each of above disciplines call for different inspection standards, tests, tools, skilled inspectors etc.

Besides grass root inspection required for each and every discipline mentioned above there must be a Quality Assurance Plan in position. This will act as a watch dog process plan and ensure that all important parameters are checked at each and every stage of construction and well documented.

Quality in warehousing:

This is an area very often neglected leading to disastrous consequences during final system checking or during commissioning of the project. Purpose of quality in ware housing is to ensure that all materials are received with proper inspection and release notes, physically inspect incoming materials to ensure that no transit damages have occurred, properly documented with relevant identification and stored at pre-determined locations. Issues are against proper requisitions. Care should be taken to ensure that wrong materials are not issued. Above precautions if implemented will help traceability of wrong materials installed at wrong locations in a plant.

Quality in Safety

Construction activity is prone to accidents . An accident at site demoralizes work force and hampers progress of work.

A separate safety team should be a part of construction supervision force and strictly enforce safety rules. A safety manual should be circulated to all and ensure that proper personnel safety gear are compulsorily used by all. Safety precautions during work should be observed by all and management should provide proper infrastructure such as proper lighting , house keeping and periodical training. Every new comer to the site should be inducted only after he/she has gone through a safety training course.

Quality Assurance Plan:

A Quality Assurance Plan typically consists of the following:

- An organization structure.
- Method statement of inspection activities for each discipline.
- Required specifications.
- Codes to be referred.
- Inspection standards.
- Inspection tools
- Approved list of testing laboratories.
- Frequency of inspections/tests.
- Acceptable standards.
- Documentation procedures.
- Resolution of non conformance products/services.

Organisation Structure:

An organization structure with regards to quality assurance should be laid down for the project. The quality assurance team shall be a well knit and compact, comprising of experienced engineers in each discipline under over all command of Head of Quality Department (HOD). The HOD will function independent of any other officer of the project and will administratively report to Project Manager. He shall have powers to stop any ongoing work which is not of acceptable standards or remove/ disqualify any workman who consistently fail to achieve quality standards. He shall be assisted by a team of Sr. Quality Managers (SQM.) of each discipline. Each Sr Manager will be assisted by a team of field inspectors.

Method Statement of Inspection Activities:

It will be the responsibility of Sr Quality Managers to develop a method statement of inspection activities pertaining to his discipline. Method Statement shall broadly cover nature of work, required specifications, codes and standards to be followed, inspection tools required including codes and I S Standards, training of inspectors as well as conducting training to contractors inspection engineers.

He shall develop a quality assurance plan covering all activities of the discipline. Generate periodical report for the HOD and identify Non Conformance product or services for a resolution by HOD. The overall stress of these method statements is to ensure that works are done First Time Right by contractors personnel. Quality Assurance Plan is only a tool to achieve this.

Quality of Specifications:

Specifications of works or materials should meet the end requirements of the project. This should generally be in line with relevant national or international codes, standard engineering practice & easily understood by all. Works to be executed as per these specifications should be susceptible to inspection checks. Correct specifications therefore play a large part in ensuring quality in construction.

Quality in Inspection:

To ensure quality, construction works are constantly subjected to stage inspection. Inspection criteria, minimum quality acceptable standards, availability of relevant codes and tools or specialized inspection agencies should be ensured when specifying product or service requirements. A standard Inspection Test Plan should be developed for each discipline of work by the Sr. Inspectors. The format should indicate type of inspection, frequency of inspection, responsibility of inspectors.

Important Hold Points should be identified in this plan as also extent of documentation required.

Inspection tools and approved laboratories

Quality of construction activities depends upon quality of stage inspection which in turn depends on quality of inspection tools and experienced inspectors handling these tools. All inspection instruments should be calibrated and periodical refresher training imparted to inspectors in handling these inspection gadgets. Where field test are not possible, the same should be conducted in approved laboratories.

Definition of Quality

The totality of features and characteristics of a product or services that bear on its ability to satisfy stated needs or implied needs of a customer

Non conformance products and services. (NCRs)

Purpose of quality assurance plans and inspection test plans are meant for preventing non conformance situations. In the unlikely event of noticing non conformance product or services these will have to be addressed with great care keeping in view the time factor cost factor and serious nature of defects. A separate procedure is to be drawn and incorporated in method statement. Resolution of NCR's will involve the designer, the owner, the contractor and Sr. Quality Manager, the project manager and construction manager .

Conclusion:

This paper has taken you through all the lanes and by-lanes of Quality in Construction. This is a tremendous important task which can only be achieved by active participation of all concerned. ■

Mr. K D Arcot, BE, FIE, is former GM, M/s Engineers India Ltd.

Quality Certification – Need of the Hour

Ujwal Kunte

The last decade has witnessed an upsurge in the demand for realty products across India and specifically in IT designated cities. This has resulted in rapid growth of the construction industry and a proliferation of projects catering to all sections of public and business interests. Globalization is bringing in new techniques and exposing our country to international standards and practices. However maintaining quality of construction without affecting speed and economy remains the biggest challenge to all the constructors. Crashed project schedules and fiercely competitive price wars often result in dilution of quality considerations. The unorganized nature of industry and lack of trained manpower make it further difficult for promoters to achieve the quality goals they set for the project.

The problem is compounded in the housing industry where buyer is not able to judge quality and all products look alike at the time of purchase. He relies on reputation of builder and aesthetics of the construction to make a choice. Terms such as high quality standards have become more of marketing clichés than a reflection of actual quality of work. Quality remains a subjective parameter based on individual judgment.

Even professionally managed construction companies find it difficult to bring accountability towards quality amongst their own staff and the subcontractors even after mobilizing all the necessary resources.

The construction industry has always lagged behind other sectors in adoption of quality systems and benchmarking models. Lack of performance standards and lack of objectivity in judging quality has been one of the major reasons for poor standard of construction apart from other reasons like unattainable project schedules and lack of trained manpower. Therefore a strong need is felt for a quality certification system in the construction industry.

Some of the reasons for poor quality are as follows :-

- Poor pre-tender development consideration for planning, design and co-ordination, contracts strategy.
- Absence of detailed contract specifications and acceptable quality of work is not defined properly.
- Shortage of good contractors and skilled labour.
- No penalty clause for poor quality.
- Detailed project plan with milestones is absent.
- Delays in schedule of RCC puts pressure on finishing items.
- In labour contracts the responsibility for timely completion of work rests entirely with clients (builders) engineer.
- Labour contractors do not have qualified supervisory staff often rely on clients staff for supervision.
- Safety, Environment etc.
- Work done by labor comes for inspection directly to the clients (builders) engineer without any intermediate checks. Clients engineer has little time for detailed inspection and under pressure of time ,quality problems get overlooked.

Quality Audit-A perfect management tool to control quality of construction

In view of the above situation periodic third party quality inspections will be useful for maintaining quality. Conventional audit reports can only identify nonconformities and suggest remedial measures. Quality measured on a numerical scale in form of score card could bring accountability towards quality. Promoters/clients of building projects can use these score cards for:-

- Keeping a check on the quality of construction by linking bonuses and penalties to payment made to contractors based on quality out put given by them.
- Making contractors and their own staff more accountable towards quality of construction.
- Comparing the quality of construction of different buildings, projects over a period of time.
- Performance Appraisal of their supervisory staff.

Bench marking quality of buildings

Bench marking construction quality can be complex as no of parameters involved is very large and just good quality raw materials and correct process may not necessarily result in good finished product and visa versa. A benchmarking system for quality of construction has been developed by CQRA which can accommodate very large no of parameters and yet make the scale sensitive to each parameter as per requirement. This bench marking process takes in to account the resources mobilized, the processes employed and the finished product quality . Each of these parameters is broken down into very minute small parts, data on which is easy to capture in checklists in objective forms.

A quality protocol is prepared for every trade under the scope of audit, which describes in detail the practices to be followed and quality standards to be achieved .This quality protocol agreed with the client serves as basis for audit. Detailed, objective type checklists are prepared covering all possible nonconformities. The nonconformities are classified as mild, moderate, severe and very severe based on there impact on overall quality. The data is collected in objective formats covering resource mobilization, processes followed and finished product quality. This is done by making regular unannounced visits by audit supervisors while the work is in progress. The collected data is fed in to specially developed computer software which generates a quality score card on a scale of 0 to 10. Quality score cards are generated for each trade in civil construction monthly and stage-wise along with nonconformity reports.

The stage wise reports give feedback to the client on level of quality standards achieved on site with help of simple 0 to 10 score cards.

A non compliance report indicates points where marks were lost on quality. A special goal setting software helps the clients to set objective quality goals for next audit by identifying the nonconformities to be eliminated. Audit can also be used to give an independent performance appraisal report of engineers and contractors on quality. This report can be generated based on responsibilities assigned to the concerned staff.

Need for quality certification

Quality certification will be extension of third party audit to assure the end buyer about quality of construction. Since quality varies from project to project based on the contractor's capability and competence of site staff, the certification is awarded to projects and not to construction companies. The certificate is awarded based on performance of the client in terms of scores achieved in these audits. The quality rating can be upgraded or downgraded based on the actual performance during the course of construction.

A quality certification will not only bring accountability towards quality but by professionally recognizing good work, it will shift the focus of the industry towards quality. It will also assure the end users (clients) and the financers about reliability of construction and quality of finished product .

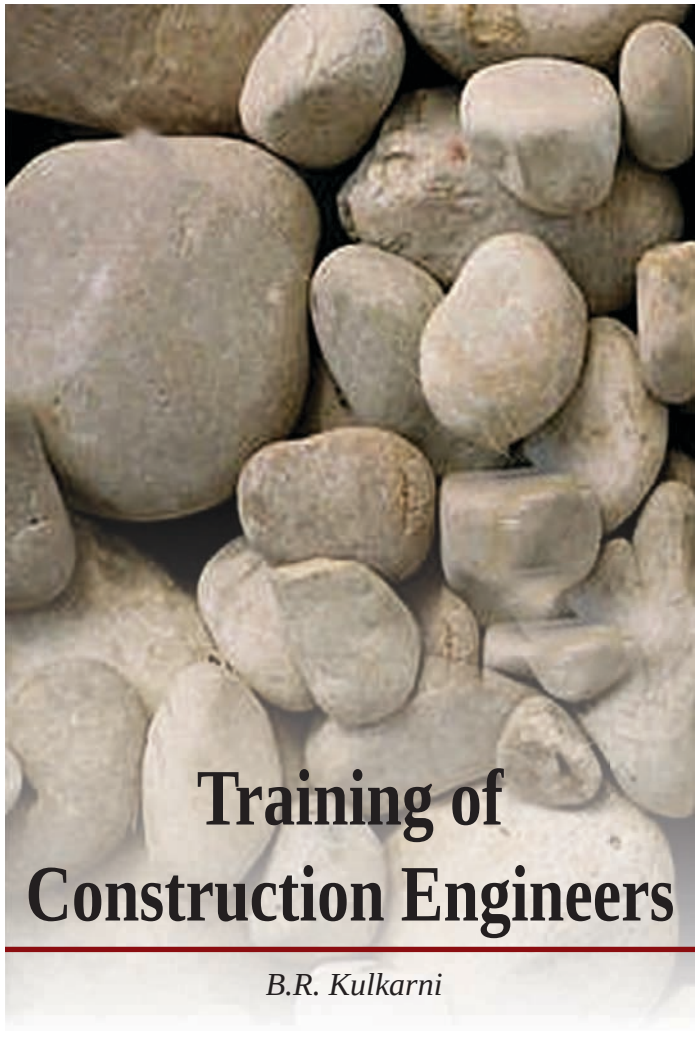
Quality certification in construction industry is poised to bring about a paradigm shift in the way industry looks on quality. Competition amongst promoters to deliver better quality product will help the end users to secure a reliable and trouble free home.

The certification will also help the developer to market his product and can fetch him a premium.

The quality certification aims to achieve following :-

- Objective evaluation of quality.
- Recognition of excellence and hence encourage better quality construction.
- Assist in marketing thereby helping builders and consumers.
- Bring the Indian construction projects at par with international standards.
- Thus, in times to come, Quality Certification of buildings will become a norm, for the Construction Industry.

Mr. Ujwal Kunte is Managing Director Durocrete Construction Quality Rating Agency, P. Ltd (CQRA), Pune



Training of Construction Engineers

B.R. Kulkarni

Current issues:

As we are aware quality is the most elusive word in the Construction Industry. We often deploy the contractors/sub-contractors to get the work done in a professional manner. Buyers want quality & the contractors promise that the same will delivered. Yet, in general, the perception is that quality is denied in construction works. Lack of adequate skill & poor workmanship are the most frequent causes for this. Material selection is the next most common cause. Finally, inadequate or superficial design is responsible for a significant portion of the quality compromises.

Until recently, the project managers/ project heads used to impart training to the junior staff at site through exchange of experience and knowledge. This was a regular feature at construction sites and learning was an integral part of project execution. Over a period of time the junior staff evolves into a seasoned professional. With the IT revolution in the Indian economy there is an acute shortage of Civil/Construction engineers as most of the students are opting for IT related courses. As a matter of fact most of the new engineering colleges are not having civil engineering courses. The problem got further compounded due the fact that new projects were large in magnitude and totally of different nature.

Until recently, the project managers/ project heads used to impart training to the junior staff at site through exchange of experience and knowledge

Consequently there is no training mechanism for civil/ construction engineers whereby the engineers can enhance their skills under the guidance of experienced professionals. Also due to change in nature of construction projects due to the stress by the Government to build the physical infrastructure of the nation in a big way, skill development has taken a strong beating in the construction industry. The boom in the IT industry has also lead to acute shortage of qualified professionals for construction industry.

Major Issues Faced by Construction Industry with Regards to Quality:

- Lack of skilled manpower viz carpenters, masons, fitters, plumbers, bar-benders etc.
- Very limited no. of established laboratories for testing of construction materials.
- Lack of awareness with regards to quality.
- Non-demanding nature of the civil/construction engineers / managers for quality.
- Customers are lured by the contractors on the basis of the aesthetics and basic quality of construction is not satisfied.

Training of civil/construction engineers should be established in a proper manner. The following issues must be addressed:

- Training needs at the recruitment level should be properly identified.
- Stress must be laid to impart basic communication skills so as to facilitate effective communication at different levels & stages of the works.

Conclusion:

It is a universal truth that human resource appreciates & the machines/machinery depreciates. The appreciation can be achieved through simple but rigorous training to the construction professional. It is important that construction engineers use the latest technology & tools to improve the quality of the construction works at all the stages of the projects to achieve the best quality product at the end. ■

Mr. B.R. Kulkarni is Assistant Vice President (Quality), M/s Tata Housing Limited

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Project Implementation & Total Quality Management
In Indian Construction Industry

Prof. M. Subramaniam

This Article is an over view of the Past, Present & Future on the subject , in order that the Indian Construction Industry adopts it as its MOTTO.

Project Implementation is a three legged race along with Project Management & Construction Management, a totally structured systemised activity & focussed effort; whereas Total Quality Management (TQM) is a process & philosophy integrated into the project implemention system. Herein the earlier concept was limited to Quality In Workmanship as a primary Construction Management requirement.

Two Case Studies of Mega Projects Carried out between 1996 – 1998 are provided with the reasons & the background for their secessfull completion without Cost & Time overruns.

The Present Scenario & need to learn from the problems faced at the Common wealth Games Project 2010, as also been put forth.

"The Roll Call Of Honour"

India has countless structures; where their pristine glory/beauty; as it was at the time they were constructed has stood preserved.

The Grand Annaicut:

Across the river Cauvery there exists a stone dam built by "Emperor Karikala Chola which is around two thousand years old.

The Brihadeeswara Temple:

The Brihadeeswara Temple at Tanjavur built with 160,000 Tn. of stone at Tanjore; by "Raja Raja-1" is around 1000 years old. The main Temple Tower is about 240 Ft. high wherein, the total Construction, with inter-locking stone assembly, has no mortar joint in between.

Gangai Konda Cholapuram Temple

Gangai Konda Cholapuram Temple:

The Gangai Konda Cholapuram Temple; was built with 150,000 Tn. of Stone by his son Rajendra Chola & herein the main Temple Tower here rises to a hight of around 220 Ft.

Both the Temple Towers referred in (b) & (c) above have been built to absolute line, level, geometry & have withstood 6 subsequent earth quakes without being affected in any manner of tilt or dislocation whatsoever.

The Tajmahal:

The "Jewel In The Crown – Tajmahal"; is a heritage of the Mughal period & has been globally recognized as one of the EIGHT WONDERS OF THE WORLD. It is now around 400 years old; but it has stood very well preserved & has continued to further exhibit its intrinsic perfection and excellence in concept and workmanship.

Jamnagar Mega Refinery Cum Petro Chemical Complex

CASE STUDY I

A 27 Mn ton green field refinery & petrochemical complex at a cost of US$10Bn was commissioned in June 1998 and went into full production; in a global record time of 32 Months vis-à-vis global norm; for such an enterprise at 54 months & Reliance industries own targeted schedule of 39 months. The Project Cost Savings at International Norms was 50% & at Envisaged Estimate was 16%.

Jamnagar Complex went through two AGNI PARIKSHA'S; the 150 kms cyclone of 9th June 1998 & Bhuj Earth quake, Richter scale 7.9 of 26th January 2001; & successfully overcame both of them.

Reliance Jamnagar successfully carried out the massive mobilisation & deployment of 100,000 workmen; 5000 staff; including 250 expatriates; along with provision of their accomodation with all other facilities. The equipment & materials were brought in by full ship loads & unloaded at marine terminals specifically created at Jamnagar for same. A total of around 1000 Reliance personnel were posted at U.O.P (process Consultant) & Bechtel (EPCM Contractor) at USA / UK resepectively; to coordinate/absorb the transfer of technology & know how; as also carry out the complete Project engineering & procurement. The Construction commence started once 80% of the Engineering had been completed; & 80% of the material & equipment had arrived at site.

Tall Towers: At refineries & petrochemical complexes; normally erection sequence of these towers; left gaps in pipe racks etc thereby hindering their activity continuation & consequent delayed Project completion. Considerable time was further involved in

The Grand Annaicut

assembly/welding/ stress relieving etc since the towers used to be delivered in parts to site. At Jamnagar the towers were received from the manufacturers in one piece & thereafter 3000 T heavy lift cranes lifted them above the pipe racks and put them in their respective positions. The towers/equipment/material cargoes in full ship loads; were received at Ro-Ro; Lo-Lo facilities; which were specifically created at Sikka/Jamnagar. The overall time saved on the project by adopting this innovative method was around 6 months.

PIPE RACKS

- Refineries and petrochemicals are constantly exposed to fire hazard; therefore heavy precast concrete pipe racks weighing up to 350 Tons were cast/transported and erected at sight into ready made foundations; thereby cutting down envisaged construction time by around 6 months.

PIPING

- This is the most critical element in a refinery cum petrochemical complex since a joint exists at every 1.6 – 1.8 meters of pipe length. Normally 40% is fabricated in shop and 60% welded after erection at site. However at Jamnagar 80% was fabricated and thereafter 20% balance done at site in a complete reversal of process. Further with heavy lift crane capacity & their reach the specifically fabricated pipe lengths up to 24 m were lifted with specific tools/tackle and placed on pipe racks vis-à-vis 6 m normal practice; thereby cutting down the planned construction time by 6 months.

For the first time in the world; round the clock activity was planned & carried out continuously on all fronts; unlike earlier projects wherein erection; concreting; staging; reinforcement placement were phased out & scheduled during certain restricted timings.

If football/basket ball/cricket could be played at night in flood light; why not CONSTRUCTION? Was the challenge Reliance confronted and successfully overcame. The consequent success achieved by this methodology cut down the total construction time by 6 months in sum & substance.

All the available sub contractors in India/abroad were got together; & each allotted the work load; they could undertake the 250 contractors out of which 220 were from India worked together as one team & completed the complex 7 months ahead of originally planned schedule of 39 months.

A massive deployment of Construction equipment costing US $ 1.5 Bn was got organized at Jamnagar; which consisted of 600 cranes, 40 batching plants & other supporting Construction equipments to suit every construction activity required at site.

A commissioning/start up/operations team of experts was positioned at site well in advance of the mechanical completion so that it could proceed ahead without any further delay whatsoever.

A separate/independent QA/QC group reporting directly to the Resident Director; played advise/consent role at all stages of construction complete; without fear or favour. Thereby ensuring global standards of quality excellence on the project.

Environment/Ecology & Harmony with Nature

The overall site drainage ensured that rain water run off flowed into water reservoirs specifically put up inside the plant. The sewage from township/plant as also industrial sullage from plants were tertiary treated and utilized for the green belt and horticulture in the plant/ township. Around three million usufruct trees such as Chikkos; Mango etc formed the green belt towards sustainable development preservation/conservation of environment & ecology around the plant.

Reliance Jamnagar carried out global sourcing & vendor development for all requirements as bulk procurements which were delivered at site in full ship loads; thereby achieving savings in cost & time of around 40%. The prudential Treasury management carried out on Indian / Foreign funds enabled considerable income accrual as other income; which provided added savings to project cost.

Jamnagar Megaport

CASE STUDY II

The US $ 1.5 Bn & 60 Mn ton per annum capacity which is the largest port in India was constructed in 24 months flat from concept to finish. The principle features of the port are; it can double up its capacity at minimum & marginal additional costs; it has two interconnected SBM's; two submarine pipelines rising up & on to; trestle bridge of 4.5 kms & shore approach of 1.4 kms and four berths with oil load/unload facilities. The owners Engineer for Project was Bechtel; the EPCM Contractor Saipem; & overall Project management was carried out by Reliance directly.

The complete marine facilities have built in safeguards for all Natural Hazards of; wind, wave, tide configurations; seismic factor & cyclone factor; based on the model studies carried out by Delft Hydraulic Netherland

The Construction methodology adopted for trestles foundations was; steel shell casings 2.2 m dia driven to refusal & cut off at sea bed level; drilling through steel shell casing up to 3 m into basalt

rock as anchorage; inserting 2 m dia shell pipe; grouting of pipe/ shell casing; & placing of precast pile cap on top.

The 60 m span & 300 ton weight trestle bridges; Jetty berth platforms etc; were prefabricated in UAE & brought to site in 450 barge loads; sequentially; to suit the planned schedule & erected in place. While in the inter tidal zone shore pull method was adopted with 180 T winch; in the off shore area it was carried out by heavy lift floating cranes specifically mobilized for same.

The special marine equipments deployed on the job were; floating heavy lift cranage of one each respectively in 2400 T, 1200 T, 1500 T capacities; three jack up platforms each with a 250 T crane; 2 number 250 T work barges; 2 numbers grouting welding barges; 8 numbers tugs & differential global positioning systems.

Both the case studies indicate the success & results arising out of the **Project Implementation & Total Quality Management** Policy adopted front end on these Projects.

The refinery output on a regular & sustained basis has been achieved at 120% of its rated capacity.

The financial model, debt equity raising etc was carried out innovatively by Reliance through Project Finance & Non Recourse mode.

Consequent to all of which after commission the Jamnagar Refinery cum Petrochemical Complex has become a CASH COW proposition for Reliance

Accrued Knowledge

The Accrued Knowledge can be broadly classified into two categories; as Pre & Post Independence Era respectively. Their History & experiences can also be sub classified as The Good, The Bad, & The Ugly.

Pre Independence – The Good

The Dams at; Krishna Raja Sagar, Mettur on Cauvery; Thekadi on Periyar, and their downstream irrigation systems are now global bench marks for river valley developments. These were carried out in complete harmony with Environment, Ecology and Nature. The Ganga barrage & downstream upper, lower Ganga cannals have shown how irrigation potential can be fully utilized for benefit of the country in spite of the odds faced then. These systems having been in operation for more than 100 years; however their performance has continued to be exemplary on a sustainable basis.

Post Independence – The Good

Bhakra Nangal, Tungabadra, Nagarjuna Sagar on Krishna, Hirakud on Mahanadi are the Dams & irrigations systems constructed completely with Indian know how & expertise; which have stood the test of time for the last 50 years.

Present Events The Good

The Konkan railway line; Delhi Metro; NHAI Golden quadrilateral, North South Highways, Port Airport links are examples of the high level of Indian expertise & innovative concepts that have contributed to INFRASTRUCTURE DEVELOPMENT AT INTERNATIONAL STANDARDS; in spite/despite the fiscal deficit budgetary constraints of the Govt of India.

The Bad Indian Public Sector Major Projects Analysis Projects

Time	13	10	13	8
Delays	2 Yrs	2 Yrs to 3 Yrs	3 Yrs to 5 Yrs	Beyond 5 Yrs

Cost	2	9	15	17	6
Overruns	Nil	50%	50% to 100%	100% to 200%	Above 200%

Overrun (2005) - Time 15%, Cost 25%
Overrun (2010) - Time 50%, Cost 50%

49 (Upto 2004)

The Common Wealth Games Project presently expected to ultimately cost around Rs. 35,000 Cr. commissioned by 30th September represents The Ugly Face of Project Implementation Scenario of India in 2010. The Project has suffered many revisions in cost & postponements regarding completion & commissioning.

Conclusion

The Govt. of India, had earlier achieved excellence in Project Implementation & Total Quality Management at the Delhi Metro, therefore the Common Wealth Games Project 2010 experience could be treated as a Knowledge Gain for non repeat in Future.

Project Implementation & Total Quality Management would need Corporate Leadership with a "No-Nonsense Approach" combined with a strong determination to persevere & succeed.

The Public Sector has provided two sterling role models in this context: Mr. Sridharan at Konkan Railway & Delhi – Metro Projects: & Mr. Khanna at the Kudermukh Project. Whereas in the Private Sector we have the examples of; Dhirubai, Mukesh, Anil Ambani at Jamnagar and Mr. Ratan Tata at Tata Motors & Tata Steel. ■

Prof. M. Subramaniam is Alumnus of the College of Engineering at Annamalai University & IIM (A) & has held Top Management positions in two of India's largest multinational Corporates)

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QUALITY CONTROL IN STRUCTURAL DESIGN AND DETAILING

Sukhbir Singh Mann

INTRODUCTION

Quality control has been extensively implemented in the construction sector for constructing safe, strong and sound structures. The back bone of all successful structures is the excellent design and detailing by the designers taking care in advance, the probable problems, difficulties and obstacles which could hamper the progress and quality of the project during construction stage.

The role of designers either Architects, Engineers or other Consultants in the planning stage itself lays the foundation of the success of the project. The Cost over run, Time over run or Quality decay during construction can be efficiently minimized by taking certain decisions during the conception, planning and design stage of the Project. An efficient quality control and quality assurance during the initial stage of the project enhances the project implementation efficiency resulting in a sound structure.

Civil Engineering Project Types :

- Building Structures : Residential, Commercial, Industrial Institutional, Recreational & Entertainment, Sports Facilities and Medical facilities.
- Highway and Transportation Related Structures: Highways, Pavements, Bridges and culverts, Flyovers, Underpass, Viaducts, Tunnels, and Maintenance Workshop Depot related to Transport.
- Railways and related Structures: Railway lines, Bridges and culverts, Flyovers, Underpass, Viaducts, Tunnels, Depot related to Railway stock.
- Hydraulic and River training Structures.
- Nuclear power Related Structures.

Consultants involved :

- Engineers: Structural Engineer, HVAC Engineer, Electrical Engineer, Plumbing Engineer and Project Management Engineer.
- Architects: Architect, Urban Designer, Town Planner and Landscape Architect.
- Other Consultants: Sound Insulation Consultant, Hospital consultant, Hotel consultants, Railways Consultant, Airport Consultant and Hydraulic Engineer.

QUALITY CONTROL

Quality control is a process by which the project products undergo through a system of checks and reviews to ensure & maintain the quality of the deliverable up to or above the given standards.

This approach places an emphasis on all such elements such as Competence, knowledge, skills, experience, qualifications, personnel integrity, confidence, organizational culture, motivation, team spirit, quality relationships, job management, defined and well managed processes, performance & integrity criteria, and identification and maintenance of records etc. etc.

Quality control emphasizes testing of products to uncover defects, and reporting to management who make the decision to allow or deny the release of deliverable.

Factors influencing quality control :

- Importance and Utility of the project
- Type of the Project and its Usage
- Market value, Market Demand and Competition
- Supply Conditions
- Production and availability of Material
- Weather Conditions
- Transportation
- Maintenance
- Constructability

Factors affecting quality control

- Management
- Skilled Manpower
- Time for planning and design
- Workability and utility
- Artisans availability
- Material and Man power supply
- Energy efficient systems
- Cost economy
- Revisions, changes and Alterations
- Repetitions

Different project stages for quality control

- Conceptual & Planning stage
- Preliminary Stage
- Tender Stage
- Detailed Design stage
- Execution stage
- Completion

Quality control assessment criterion

To evaluate the quality of the product and manpower, major criterion and their measurements can be defined as under:

- Training : The number of hours of learning design / Drawings / Software by an individual
- Completeness : All deliverables must be defined properly & checked at delivery.
- Coordination : Among the co-staff, with Juniors and Seniors.
- Correctness: The Product's quality is measured by its Correctness.
- Compliance: The Nos. of hours/days spent on production and the output measured at each stage .
- Commitment: Of time and product related documents delivery
- Consistency : For the skilled man powers. The manpower must not change for a project.
- Software system : Use and Test the software on mutual compatibility basis and thru manual checks
- Software system dependence: Dependency on Software and cross check its results

QUALITY ASSUARANCE

Quality assurance is a process to improve and stabilize production, and associated processes, to avoid, or minimize, issues that led to the defects in the first place.

It is carried out to assess the capabilities of the consultancy companies with whom they conduct business by ensuring that a quality system audit is conducted by a qualified quality assurance professional. Quality assurance and quality tools add value wherever they are applied. The key to unlocking this value is to determine what level of investment is needed in quality assurance for your consultancy business.

Owners should also ensure that jobsite quality audits are periodically conducted to ensure that quality is indeed being managed and that unnecessary risk is not accumulated that could jeopardize the project delivery and company reputation.

Quality Assurance System

Quality assurance is a thought process as well as a system about controlling, applying systematic methods, assuring quality, applying due-diligence, risk management, keeping defects from your customer, mistake-proofing, continuous improvement, and so on.

It is a worthwhile investment to periodically utilize a qualified quality professional to impart the knowledge and to assist the company in developing and maintaining the quality system and "quality toolbox".

Quality assurance assessments relieve the quality assurance reviewer from the responsibilities of determining the acceptability of deliverable content from an end-user or technical point of view. Instead, the quality assurance reviewer is restricted to verifying the presence or absence of specified items within, or associated with, the deliverable

Quality Assurance Program (QAP)

Quality assurance can be explained as below:

Plan: Documented processes via quality procedures & quality plans.

Do: Work systematically by following your procedures

Check: Verify with quality audits & by documenting nonconformance.

Act: Act upon the results by implementing & conducting Management Reviews.

However, systematic methods (quality procedures) have little value if they are not properly managed by a quality system that includes :

- **Document Control :** To ensure employees have the correct procedures and the procedures are properly maintained.
- **Audits :** To verify quality procedures are being followed.
- **Non-conformance Tracking :** To monitor and track quality issues to ensure that defects are kept from your customer.
- Coactive action and preventative action:

  To correct flawed processes (i.e. quality procedures) when detected via audits and non-conformance tracking to prevent defects from reoccurring.
- **Management Review:** Reviewing quality system data (performance and quality metrics) to determine if the quality system is working and if it is not, taking the appropriate action to improve the system.

  The most critical element of all is to ensure that job specific quality plans are developed for each different job to ensure that quality is being managed.

Consultancy Quality Assurance Program

The concept of quality assurance in the consultancy industry is being developed, to address the many cost overruns, project delays, and other cost of quality issues that have become the norm on recent projects.

Due to a lack of a standard quality assurance program that meets the needs of the consultancy industry, a back-to-basics and streamlined quality assurance program has to be developed.

The goal is to develop a system that captures the essence of quality assurance, including

- Assuring quality.
- Adding value.
- Utilizing a risk-based approach (to minimize the cost of a quality system).
- Reducing the cost of quality (and increasing profit).
- Providing the tools required to successfully:
  - Get the job done right at the first time.
  - To find & correct defects before your customer finds them.
  - Prevent defects from re-occurring.

Quality Assurance Manual (QAM)

QAM should state your companies overall vision with a quality policy, describing the major areas of your consultancy business that will be controlled systematically via quality procedures, and be signed-off by senior management.

QAM in general are designed to "say what you do" and then "do what you say", which means, if you don't do it, don't say it!

Quality Procedures (QP)

Quality procedures are written to define each key process using a risk-based approach to minimize complexity, to further add value,

to make the system user-friendly, and to keep defects away from your customer.

Quality Checklists and Forms (QCF)

Quality checklists and forms are developed with mistake-proofing techniques in order to allow a consultancy company to begin building quality into the process. Using these techniques will allow you to provide a better quality product to your customer and be a more profitable company at the same time.

Overcoming obstacles in QAP

Implementing a consultancy quality assurance program is not always easy. There can be many obstacles along the way, but being aware of some of them ahead of time can make you better prepared to overcome them. Here are a few:

- Changing the company culture to learn how to work systematically.
- Gaining executive buy-in and commitment.
- Overcoming the "let's just get it built" mentality.
- Overcoming the mentality of where "it's only wrong if we get caught".
- Getting everyone in the company involved (quality is everyone's responsibility).
- Training project managers how to manage quality.
- Getting the Clients to recognize the criticality of quality in addition to safety and lowest bid.
- Achieving more accountability in the management of government contracts.

STRUCTURAL DESIGN AND DETAILING:

For successful completion of any structure as listed in Para 1.0 above, the strength, safety and soundness can only be ensured thru efficient structural design, with the involvement of structural Engineer. Quality control and quality assurance can be applied & achieved, once the process and system of art of structural engineering is well understood.

Skilled manpower:

Design engineers - Graduate or Post Graduate Engineers

- Quantity Surveyors and Estimators-Graduate or PG engineers
- Draftsmen - ITI or VTC trained Technicians
- Typist- General computer operator All with or without sufficient exposure and experience

Softwares

- Structural Engineering Software : Staad Pro , Strap, Etabs GT strudl , RISA, Strudd, Strusoft etc. etc...
- Structural Detailing Software : AutoCAD, Z Cad, Revit, Tekla etc.etc…

Points to be considered during project design stages

- Conceptualization–new methods, materials, innovative designs,
- Rationalization of design
- Systematizing - work methods to ensure that the job is "done right at the first time".
- Standardizing - best practices to maximize productivity
- Procedural zing-To ensure and manage Quality and timely delivery commitment at each level and to keep defects from customers
- Economy - To reduce the cost of quality to increase profits
- Insurances -To protect the business from liability risk and to become a Smarter company.

Documentation type and their marking system

Documents produced for the elaboration of the project are the following :-

- Project Master Plan documents
- Project Management documents:
- Functional specifications document
- Project cost Realization documents
- Non-Numerical Data:

For all these documents produced, a record of, who produced it, to whom it was delivered and who is the responsible for approval of these documents, has to be maintained. In the future if there are changes and revisions that also to be recorded during project History. The details and accuracy of calculation at different stages should be maintained and a soft copy should be preserved for all such documents.

Drawing types and their marking system

Various types of drawings types include but are not limited to :-

- Master Plan showing division of sectors/Blocks/buildings etc.
- General notes covering materials type and specifications, code references, abbreviations and symbols, genetical details, repetitive details to be used in the drawings,
- Foundation and Sub structure details,
- Superstructure Details of all vertical and horizontal systems,
- Blow up details of all important and special Connections

The contents of the drawings are detailed in order and refined at every next stage. A Drawing title box should have project name, list of key consultants, stage of project, block, sector / building type ,drawing number, drawing Title/Purpose/Level date of preparation and revisions details.

Revisions (R) and Versions (V)

- Revision number is used for minor modifications or for an improvement of area, plan, detail or connection
- Version number is used if there are major modifications or additions of new area/sector or functionalities

The revision and versions should contain area, details of correction/ revision, date, and the name of the contributor.

General design process of building structures

- Preparation of structural schemes, conceptual plans and relevant details
- Getting approval from the Client/Architects / Competent Authority
- Preparation of tender drawings, details, specifications, contract documents etc.

- Preparation of Detailed drawings and analysis & design file
  -Designs Input on Analysis. The input file containing
  -Member dimensions
  - Member properties
  - Support conditions
  - Member specifications
  - Applied loads
- Analysis Output File:
  - Checks to be made on :
  - Total reactions of applied Vertical loads and of applied Horizontal loads
  - Bending Moments and shear Forces on key members
  - Deflection of the members
  - Design Output thru computer analysis
- Optimization of member sizes
- Member Strength requirements
- Provisions of Size and strength

PRODUCT DELIVERY

The product delivery depends heavily on two primary concepts:

- Deliverable Class Standards
- Targeted Reviews & Assessments

The delivery of the final products of the project can be done after review of deliverables at two levels:

- Technical (PEER) and
- End-user (customer)

Each reviewer reviews deliverables based on their area of expertise; this targeted approach allows reviewers to work with low effort and high quality, since they're evaluating topics that are directly related to their domains of expertise. Each deliverable review is based on a Deliverable Class Standard, which defines the scope, structure and content of the deliverable, as well as the items upon which each class of reviewer is to focus.

CONCLUSION

The value of quality assurance and quality tools has been demonstrated for many years. The consultancy industry can clearly benefit from mastering these skills. By utilizing quality assurance and quality tools, in the correct proportion, these benefits can be realized with significant return on investment for all parties.

The processes and techniques described above can be efficiently utilized to insure the production of high-quality deliverable documents, design and drawings while minimizing the overheads generated by quality assurance activities to ensure safe, strong and sound structures for the community. ■

Mr. Sukhbir Singh Mann is Executive Director, M/s Mahendra Raj Consultants Pvt. Ltd.

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ISO 9001 in Construction Industry Wasted Opportunity?

Anil Jauhri

INTRODUCTION

ISO 9001 on Quality Management Systems, which was first published in 1987, has revolutionised the world of quality. It has yielded enormous benefits to organizations and over 30 years after its publications, continues to grow worldwide across various sectors – manufacturing or service, large or small scale. No wonder that the construction industry has also taken to it with many a builder flaunting the ISO 9001 certified tag. But has it raised the quality levels in construction sector? Is the common man buying a flat and investing his hard earned money any happier?

The ISO 9001 certification in India is facing a crisis of credibility. The National Accreditation Board for Certification Bodies (NABCB) of the Quality Council of India, which is the national accreditation body and part of the international system has cracked a whip since April, 2007 and suspended or withdrawn accreditations of nearly 10 certification bodies in India. One of the sectors where the quality of certification has been found wanting is Construction.

The paper discusses the issues dogging ISO 9001 certification in the Construction sector depriving the industry from deriving the full benefits of such a wonderful international standard.

WHAT IS ISO 9000

ISO 9000 is a family of standards for quality management systems developed and published by the International Organization for Standardization (ISO). The only standard in the family which is amenable to certification and therefore the most popular one as well is ISO 9001:2008 which sets out the requirements an organization should meet. Its a generic standard applicable across all sectors of industry – whether manufacturing or service – and all sizes of organization and prescribes good management practices for delivering quality consistently.

It is based on the following principles of quality management:

- Customer focussed organization
- Leadership
- Involvement of people
- Process approach
- Systems approach to management
- Continual improvement
- Factual approach to decision making
- Mutually beneficial supplier relationship

Although the standards originated in manufacturing, they are now employed across several types of organizations. A "product", in ISO vocabulary, can mean a physical object, process, services, or software. Therefore, it is applicable to all sectors within construction industry-design organizations, construction companies, building material manufacturers, contractors, real estate companies, developers and builders etc.

ISO 9000 CERTIFICATION

As has been stated earlier, the only certifiable standard in the family is ISO 9001 and whenever the term 'ISO 9000 certification' is used, it means certification to ISO 9001.

It should be understood that ISO does not itself certify organizations. A voluntary system of ISO 9000 certification has developed worldwide where third party certification bodies provide the certification service. In order to ensure confidence in certification and its cross border acceptance, a system of accreditation of certification bodies has also developed worldwide based on standards produced by ISO. The ISO 9000 certification bodies are expected to comply with ISO 17021 for Management Systems Certification Bodies.

Many countries have formed accreditation bodies to accredit certification bodies, which audit organizations applying for ISO 9001 certification. The accreditation bodies have formed an association called the International Accreditation Forum (IAF) which has in turn laid down a system of peer evaluation of accreditation bodies to facilitate mutual recognition to ensure that certificates issued by accredited Certification Bodies (CB) are accepted worldwide.

The organization seeking certification is assessed based on an audit of a sample of its sites, functions, products, services and processes; a list of non conformities (NCs) is made known to the organization at the end of the audit. If there are no NCs, or the NCs are resolved to the satisfaction of the CB, an ISO 9000 certificate is granted.

An ISO certificate is not a once-and-for-all award, but must be renewed at regular interval of 3 years. There are at least annual surveillances and provisions for suspension/withdrawal of certificates in case of serious non compliances.

The National Accreditation Board for Certification Bodies (NABCB) under Quality Council of India is India's national accreditation body and signatory to the IAF mutual recognition arrangement signifying that its accreditations are equivalent worldwide and any ISO 9000 certificate carrying NABCB logo is acceptable worldwide.

ISSUES IN CERTIFICATION

Notwithstanding the excellence of ISO 9000 and popularity of its certification, there are worldwide concerns about the quality of certification.

One of the biggest concerns is the inherent conflict in the process - a certification body is evaluating an organization on one hand and is providing a service on the other for which it is expected to be paid by the client. Coupled with the competitive pressures that a certification body faces, it is reluctant to raise serious NCs lest the client goes away to another CB.

Another concern is about impartiality – the CBs are required to be impartial and one of the biggest threats is consultancy. CBs are barred from undertaking consultancy or outsourcing any certification activity to consulting organizations. However, this does not applies to individuals and the CBs are free to use consultants as auditors provided they are not used to audit organizations where they may have given consultancy. The relationships of CBs with consultants is a source of grave threat to impartiality of the CB.

Yet another serious concern is that the CBs in general would like to have multi- skilled auditors who can handle audits in any sector. The international system however requires that auditors are qualified for each sector and even sub sectors based on competence criteria defined by each CB. It could be in terms of education and work experience or knowledge and skills. However, most CBs tend to qualify auditors based on merely auditing experience so that each auditor can handle a number of sectors for reasons of cost. This leads to inferior quality of audits but this is true for all sectors. For specific sectors like construction, this becomes a critical factor.

In March, 2007, NABCB took a pioneering initiative to directly visit certified clients to check quality of certification and penalized 4 CBs at that time with suspensions. This initiative has now become part of the international system as 'validation audits'. Since then, NABCB has been very tough with CBs undertaking several validation audits besides assessments at CBs' offices and witnessing of their audits which in any case were part of the system of accreditation, and as many as 10 CBs have faced suspensions/sanctions by it.

Many CBs in India also hold accreditation from foreign accreditation bodies (ABs). One interesting development is that many of these foreign ABs are seeking NABCB's help to conduct assessments in India which gives us access to their clients as well. It has been our experience that many CBs cover their clients in complex sectors like construction under foreign accreditation giving an impression that they wish to avoid rigorous scrutiny of NABCB. This development should curb this practice as well.

Concerns undermining quality of Certification in Constructions Industry

(i) ISO 9000 requires compliance to applicable regulatory requirements-however, this aspect in general is weak and not properly audited by the CBs.

(ii) Construction companies especially builders and developers typically outsource activities like design, construction at site etc which are not properly addressed in their QMS and proper controls are not exercised. The CBs also do not audit this aspect rigorously.

(iii) The ISO 9000 certification is dependent on manpower of the organization-because ISO 9000 assumes that each employee contributes to quality and should do his job right. Therefore, audit mandays depend on the manpower, permanent or temporary. But since mandays also govern the CB's charges, most companies are advised by the consultants or CBs to declare lower manpower to cut down costs of certification leading to less effective audits.

(iv) The CBs are expected to follow a system of auditing sites – most construction companies would have a number of offices and certainly a number of sites, which need to be systematically covered under the audit of CBs. In order to cut down costs of certification, the attempt is to audit the least number of sites. Even the temporary sites need not be indicated in the certificate and the CBs are required to get information on ongoing projects before a surveillance and then plan their audits.

(v) The controls at site of construction in terms of incoming materials, workmanship, supervision of processes like concreting, curing etc are not adequately defined in the system nor properly audited. This has direct bearing on the quality of construction.

(vi) Handling of customer complaints is another concern.

CONCLUSION

There is no doubt that ISO 9000 is a immensely valuable standard which if properly implemented, brings several benefits to the organizations. However, if it is implemented for the sake of certificate, its value is not fully realized. The Indian construction sector should realize its value and look for competent resources to implement and certify it. Otherwise, they would face the embarrassment of having their certificates suspended or withdrawn as NABCB piles pressure on CBs to certify properly. ■

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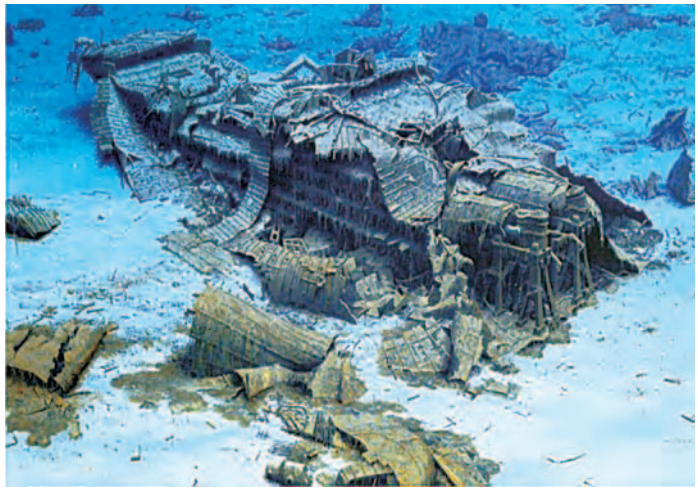
Reinforcing Bars-An Overview of Global Trend For Quality Up Gradation

by B N Sen, Sandip Talukdar & Ashish Anupam

ABSTRACT

RCC construction is one of the most common practice followed in the world for building various infrastructures. India is no exception and during the last decade, we have seen excellent growth in RCC construction in the country which is projected to continue in near future as well.

One of the most critical input for the RCC construction is reinforcement bar-popularly known as "rebar" which acts as a component to impart structural safety to the load bearing member specially for withstanding tensile load which concrete alone cannot bear. In simple words, for RCC structure, while concrete is expected to bear largely the compressive load, the rebar on the other hand, must ensure structural safety against tensile, lateral, seismic and fatigue loads to which concrete has rather a weak resistance. If rebar fails to deliver its expected performance, un warranted structural disaster / catastrophic failure can happen which arguably can be described as "man made disaster " simply for the fact that such incidences perhaps could be avoided through better practices and proper rebar selection and design. Unfortunately, rebar has never been strongly recognized /perceived by us to be an important engineering item so far unlike many advanced countries where rebar is regarded as a safety critical engineering item of the first order and therefore robust quality consciousness is built up which is still a far from realty in our country. This paper describes in brief, the effect of various quality parameters of rebar on its structural performance and the future trend of further advancement in this area.



Introduction

The usage of reinforcement concrete in construction is age old now and evolved through various technical up gradation to improve upon the safety, reliability as well as durability of structures. One of the essential features in concrete technology is its reinforcement with steel rebars. While concrete has a very good compressive strength, it does not posses any significant ductility needed to withstand various tensile/dynamic loads. It is the steel

reinforcement, which supplement this shortcoming of concrete. Therefore the role of reinforcement bar is of prime importance in order to ensure safety and durability of the structure.

Steel rebar has established itself as the most deserving means for concrete reinforcement over any other alternatives because of its high strength and ductility, bendability, weldability, matching coefficient of thermal expansion/contraction with concrete and the highest strength to cost ratio. In addition, a wide range of properties can be developed in steel by controlling its chemistry and micro structure through different treatments. Since steel can be recycled through appropriate process, it is environment friendly as well. In addition this is bio degradable to a large extent.

Specific to steel rebar, if we look into its quality code from any country, the properties specified to be guaranteed include not only chemistry but also a combination of mechanical properties like Minimum Yield Strength, Ultimate Tensile Strength, Tensile to Yield Ratio, Total Elongation, Elongation at Maximum Stress, Area of Ribs, Bend/Rebend Properties etc. Such properties are all essential features of a rebar to ensure structural safety of RCC members as well as lives of people using that structure. There is perhaps only a very limited family of other steel applications which demand such extensive property guarantee. This indicates the engineering value of a rebar.

While this crucial role of steel reinforcement to impart structural safety is widely understood, unfortunately, more often than not, the construction rebar has not been treated as an engineering item especially in countries like ours. There has been only limited focus to fully utilise the unique structural property of steel and its functional benefits in order to design and execute a construction with high standard of safety and reliability and in a cost effective way. On a brighter side, things are changing fast in the global arena and the approach to look into the construction rebars as a performance guaranteed engineering item is gaining increasing importance. In India though, this realisation and consequent urge to use appropriate quality rebar is yet to gather momentum. Faster pace of urbanization, increasing number residential, commercial and other infrastructures for larger public utility has resulted in raising the bar for structural safety of the construction and the stated requirements for rebar is getting more and more stringent and application specific. This has resulted in many countries to modify/introduce new specification codes for rebar of higher quality. This has also been driven by the fact that the demand for a guarantee on minimum life span of structures has gained momentum which in turn necessitated adoption of modern design concepts, construction practices and usage of right quality of input materials including rebar.

Reinforcement bars although is one of the most crucial inputs, difficulty arises really to assess quality of supplies of every batch especially at the construction sites. Since the evaluation process involves critical tests but limited facilities are currently available for the same at sites. This is more true for the individual house building segment where most of the common users are not even aware of the basic quality requirements and the impact of bad quality of rebars on the safety and durability of the buildings. As a consequence, we find at the marketplace, a disturbing scenario of presence of sub optimal quality of rebar in a country like ours.

Essential quality requirements for Rebars

While the functional quality requirement of rebar is to withstand designed static and dynamic loads of various nature under various conditions for entire life span of the structure, it translates into basic property requirements in terms of chemistry, mechanical properties , bonding characteristics with concrete, ease of bending / re bending and corrosion resistance. Also extremely important feature is the consistency of property from batch to batch and bar to bar. Like the strength of a chain lies in its weakest link, any weak point like lower strength in any part of the rebar renders the entire length sub standard for its intended application. In addition, the rebar needs to posses certain other properties like weld ability, impact and fatigue resistance. This properties are being more relevant today because of the change in the environment , increase in vehicular and railway traffics which cause more ground vibration etc. The other requirement which is becoming important is the earthquake resistance particularly in a country like ours which has more than 50% of her land in high seismic zone.

Technical specification of rebar – global trend

As pointed earlier, lot of advancement has taken place in identifying specific in- service needs of reinforcement bars for the RCC structures which has triggered a shift towards better and better technologies and controls in the manufacturing process of rebars. The evolution from plain mild steel bars to today's quenched and

tempered and even forward looking micro alloyed rebar aim for increasingly demanding quality parameters w.r.t. the functional requirements of not only withstanding the live and dead loads but also unwarranted and severe strains arising from hazards like cyclone, earthquake, fire, explosion etc. Most of the advanced countries in the globe have come up with newer and upgraded version of codes for rebars in the recent past. Unfortunately in India, we have not been able to fully fall in line with the global trend although the need is no less because of our vulnerability to natural hazards. Recent earthquakes in Bhuj, Kashmir etc. have proven to be so fatal w.r.t. casualties and economic losses mainly due to collapse of buildings. While our national code BIS 1786 has been upgraded in 2008 with introduction of new "D" class of rebar with restricted chemistry and higher ductility and is definitely a superior quality, but this modification did not come as a replacement of earlier grades but allowed to exist simultaneously. Further, specific mention about the superiority of "D" category in the modified code perhaps could have helped consumers better to select the right category amongst the various grades . Comparison of the Indian as well as international standards as shown in Table 1 exhibits that we are still somewhat lagging to codify rebar which are application specific.

The latest international standards focus broadly on the following areas:

Chemical composition – Steel is basically iron with controlled amount of alloying elements like carbon, manganese, silicon etc which are added to impart certain properties. These alloying elements are intentionally added during steel making. However there are certain elements like Sulphur, Phosphorus etc which are present incidentally originating from iron ore/ scrap etc and deteriorates certain properties of steel which are critical for its functional quality. Keeping this in mind and in line with the advancement in steel making technology enabling better control over such impurities, up gradation of rebar chemistry was focussed on. While carbon content was restricted to a lower value, detrimental elements like S/P have been re-designed to lower limits. This ensures better ductility, fracture toughness and in particular fatigue property of rebar which is considered to be an important criteria today. Effect of high phosphorus in steel resulting in deterioration of ductility at low temperatures has been recognised and the limit has been reduced. Incidentally, the bad effect is not revealed when mechanical properties/ductility are tested at ambient temperatures but it may drastically loss its ductility and be even brittle when exposed to low temperature. Similarly, presence of high sulphur in the form of inclusions, known to enhance corrosion and acts as a favourable site for initiation of fatigue crack. The British Standard even introduced restriction on gas content like N2 and guarantee on minimum fatigue resistance which was never considered earlier as important parameters for rebar application. Fatigue property of rebar is a new dimension and is becoming relevant due to changes in the urban scenario where ample number of roads and fly over's being built with increasing number of railway/vehicular traffics which induce fatigue loads on nearby structures. Our Indian Standard in its last revision tried to induce part of such changes which are aimed towards better functional behaviour of rebar under various service conditions.

Strength/Ductility- Other than the gradation based on characteristic strength, various codes are now designating rebar as per their ductility classes and high grade rebar with higher ductility and shock absorption capacity for use in seismic zones have been introduced and clearly codified. Some examples in this regard are rebar grades conforming to ASTM A-706 (Gr.60), AS-NZS: 4671 (Grade 500 E), BS4449 (Grade 500C) etc. These performance driven rebars have a higher UTS/YS ratio of more than 1.15 and even up to 1.25 (ASTM A706 code) and therefore more work hardening and shock resistance capacity critical to resist catastrophic building collapses during earth quakes. Usage of such rebar in

RCC constructions under seismic zones started long back by countries like USA/Newzealand/Japan and have now been made mandatory in many countries. This is to be noted that this need was felt even recognising the fact that seismic structural design guide lines were being practiced in such countries already. Such superior quality rebar would for sure enhance the structural safety, reduce incidences of building collapses and consequent casualties during earthquake. The recent earth quake at Christchurch, Newzealand in September, 2010 when the intensity of the quake was reported to be higher than 7 on the Richter scale, there was only limited

damages(Fig1) and incidences of catastrophic building collapses and loss of human life not reported so far. On the contrary, the quakes at Bhuj(2001), Kashmir(2005) and China (2008) (Fig 2) are recent examples of devastating collapses of structures and loss of human lives. Keeping this in mind, we should think to modify our codes further not only to introduce such superior grade of rebar but also perhaps restrict the base quality to "D" category only and remove the other categories. This will enhance the general rebar quality and structural safety which is very important for a country like India having a high population density and vulnerability to natural hazards.

The other point to note is that rebar with characteristic yield strength of 500 Mpa is gaining popularity over lower strength rebar to the extent that for some national codes, lower strength rebars have been abandoned. This is quite obvious for the fact that higher strength rebar offer various benefits starting from lower consumption and reduction of congestion which in turn results in cost savings and better quality of concrete casting. Moreover with advancement of technology, today higher strength rebars can be produced with a combination of higher ductility suitable to support ductile design. In India, though higher strength rebar like Fe 500 are available plenty now but it is understood that in many cases, the design is continued based on Fe 415 kind of strength and thereby the full advantage of this higher strength cannot be extracted. This may wastefully increase the rebar cost by more than 10% which is a huge loss in a country like ours. However the fact remains that Fe500 category from various supply sources are not so reliable as well.

Bond Strength with Concrete-This is a very vital property for a steel rebar. The bonding with concrete is mainly influenced by the design , area and uniformity of ribs and also surface condition of the bar. In some international codes, specific guidelines for rib geometry etc are incorporated. However there does not seem to have a good guide line for compatibility of different strength grade of rebar with various strength grades of concrete.

Learning from engineering disasters-

Historical engineering disasters can be a good eye opener to understand the importance of generally neglected but yet critical parameters of steel. A case in example was the Titanic mishap. The luxury cruise was built in Britain in early 20th century with the best of chosen engineering design and steel, was a benchmark of its class and proudly declared as one which is unsinkable. Who could imagine that this bench mark piece of engineering would turn into one of the greatest engineering failures of all time? The ship just broke into pieces and sunk helplessly after colliding with just an iceberg (Fig 3). It was a mystery for a long time to really understand the root cause of such failure till a series of investigation was carried out after several decades by some Engineering Universities with modern techniques after collecting broken pieces of steel from the wrecks of Titanic that was still lying in the Atlantic. The investigations broadly pointed out that the steel plates lost its all ductility and just became brittle as the temperature reached sub zero level at that part of the ocean and broken into pieces after colliding (Ref 1). One of the reasons pointed out was the presence of higher phosphorus, sulphur and lower manganese which induced brittleness at low temperature for the steel which otherwise was tested to be ductile at ambient temperature.

Investigation on several catastrophic bridge failures (Fig 4) analysed due to fatigue failures and sulphide inclusions are known to initiate such fatigue cracks (Ref 2). Unfortunately not many failure investigation on the structural steel available under Indian context and it is necessary that we look into such investigations seriously which will help us to design/select our steel in a better way.

Rebar for the Future-

We have seen the technological advancements and up gradation of rebar for past few decades starting from low strength plain rounds to cold twisted deformed bars with higher strength but reduced ductility/ corrosion resistance and then thermo mechanically treated rebar (TMT) with a better combination of higher strength and ductility. The journey did not stop and research for even better quality rebar is on. Quest for better quality indicates importance of rebar as a structural component in RCC construction. After 9/11, there has been a serious thought to stress on RCC construction rather than steel intensive one to have a better safe guard against hazards like fire. While building design concepts and concrete technology are witnessing various changes, new breed of rebars are being developed aiming at better functional performances.

Micro-Alloyed rebar- TMT rebar , although good from strength and ductility point of view, has some area for improvements if we look at life cycle of a structure. This kind of rebar gathers strength through a process called controlled quenching after hot rolling, through which the surface, up to certain depth acquires higher strength compared to its core .Therefore the strength is not so uniform throughout the section. Such rebar when starts corroding in the concrete environment with time, although at a delayed stage than CTD rebar, it is the high strength portion at the surface which is affected and as a result, the loss of strength is rather

higher. Some have the opinion that this kind of rebar is not so perfect from welding point of view and fire resistant should also be improved. From these view points, people started thinking on how to improve these properties even better without sacrificing the strength and ductility properties and in this line, a new product called "High Strength Micro Alloyed" rebar is developed. This kind of rebar gathers strength not through the process of TMT but through micro alloying with some specific elements like vanadium, niobium etc and produced through normal air cooling after rolling. As a result, this rebar has uniform strength from surface to centre, has a better corrosion resistance and more importantly loss in strength due to corrosion is rather low. This safeguards the structural member to retain its strength for a much longer period and thereby increasing the life cycle of the structure. Moreover micro alloyed rebar possess much higher ductility, better weld ability and fire resistance. In countries like USA, China, Japan etc, micro alloyed rebar is increasingly getting importance for RCC construction and in particular in seismic zones. However the cost for this new rebar is higher by around 10% compared to TMT rebar. In India, such rebar is likely to be produced shortly following the global trend.

One new process which has very big potential is plasma coated rebar. This is a very sophisticated process where very thin metallic coating like zinc etc can be deposited on the surface through plasma treatment

Corrosion Resistant Coated rebar- To address the problem of corrosion of rebar in a better way which is one of the biggest drawback of conventional rebar, newer type of cost effective and higher corrosion resistant rebar being developed. One new process which has very big potential is plasma coated rebar. This is a very sophisticated process where very thin metallic coating like zinc etc can be deposited on the surface through plasma treatment. The beauty of the process is that with a very thin coating, it retains its strength fully and does not affect the bond strength at all, the corrosion resistance is increased many fold. Such rebar, as it is understood, has started production in USA at the moment. This may come as a new generation rebar for the future. The cost is likely to be only 10-15% more compared to 30-40% for galvanized rebar.

Fire Resistant Rebar- Fire is a common accident hazard often encountered anywhere. In many cases, it takes long time to extinguish fire and evacuate the building. It is more so for high rises and congested buildings. Unfortunately as the temperature rises due to fire, and the rebar inside the concrete gets heated up, it gradually start losing its strength and therefore load bearing capacity. In case the fire is prolonged and the rebar continues to get weaker, a sudden collapse of the building is often encountered. This is true for general structural steel and one glaring example is the collapse of WTC.

Rebar with higher fire resistance with special alloying elements in the basic steel has been developed and being used .The aim is to retain its strength to a large extent and reduce the rate of loss of strength at higher and higher temperatures. Research is going on for further enhancement of fire resistance so that it can retain a large part of its strength at least till 2 hours.

Blast Resistant Rebar- This has been conceptualised recently and research is in an advanced stage to develop rebar which can absorb and withstand the great impact of a blast so that the structure does not collapse. The recent incidences of terrorist attacks in many establishments and attempt of blasting with explosives have triggered this idea. It is expected that such rebar would be a

Comparison of Rebar Standards

Country	Australia/ New Zealand				UK			USA				JAPAN					INDIA						
Rebar Standards	AS/NZS 4671-2001				BS 4449-2005			ASTM A615			ASTM A706	JIS G 3112-2004					IS 1786-2008						
Grade	300E	500E	500N	500L	500A	500B	500C	Grade 40	Grade 60	Grade 75	Grade 60	SD 295 A	SD 295 B	SD 345	SD 390	SD 490	Fe415	Fe415D	Fe500	Fe500D	Fe550	Fe550D	Fe600
% C max	0.24	0.24	0.24	0.24	0.24	0.24	0.24				0.33		0.27	0.27	0.29	0.32	0.30	0.25	0.30	0.25	0.30	0.25	0.30
% Si max	NS				NS			NS	NS	NS	0.55	NS	0.55	0.55	0.55	0.55	NS						
% Mn max											1.56		1.50	1.60	1.80	1.80							
% S max	0.055	0.055	0.055	0.055	0.055	0.055	0.055				0.053	0.050	0.040	0.040	0.040	0.040	0.060	0.045	0.055	0.040	0.055	0.040	0.040
% P max	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.075	0.075	0.075	0.043	0.050	0.040	0.040	0.040	0.040	0.060	0.045	0.055	0.040	0.050	0.040	0.040
% [S+P] max	NS				NS			NS			NS	NS					0.110	0.085	0.105	0.075	0.100	0.075	0.075
% N max					0.014												0.012						
% Ceq max	0.45	0.51	0.46	0.41	0.52	0.52	0.52				0.55	NS		0.50	0.55	0.60	0.42	0.42	0.42	0.42	0.42	0.42	0.42
YS min [Mpa]	300-380	500-600	500-650	500-750	500	500	500	280	420	520	420-540	295	295-390	345-440	390-510	490-625	415	415	500	500	550	550	600
UTS min [Mpa]	NS				NS			420	620	690	550	440-600	440	490	560	620	485	500	545	565	585	600	660
UTS/YS ratio min	1.15/1.50	1.15/1.40	1.08	1.03	1.05	1.08	1.15/ 1.35	NS			1.25	NS					1.10	1.12	1.08	1.10	1.06	1.08	1.06
Total Elongation [%] min	NS				NS			12	9	7	10-14	16,17	16,17	18,19	16,17	12,13	14.5	18	12	16	10	14.5	10
% El at maximum Stress	15	10	5	1.5	2.5	5	7.5	NS				NS					NS	5	NS	5	NS	5	NS
Remarks [NS- Not Specified]	1. E- High ductility 2. N- Normal ductility 3. L- low ductility 4. Total Elongation abandoned. 5. Concept of %Elongation at maximum stress introduced.				1. Only one strength grade similar to Fe500. 2. Total Elongation abandoned. 3. Concept of %Elongation at maximum stress introduced. 4. Additional stipulation- Rebars shall survive 5 million fatigue cycles			1. ASTM A706 introduced with controlled tensile properties and high UTS/YS ratio.				1. Most of the categories are of lower strength.					1. D category included with restriction in C, S & P with higher %Elongation, UTS/YS ratio and introduced stipulation on %Elongation at maximum stress. 2. N2 limit introduced in all categories inline with International specification.						
Application	* Steel reinforcing bars. * High ductility E-series rebars [high UTS/YS ratio] for seismic application.				* 500C grade [high UTS/YS ratio] rebars for seismic application.			* ASTM A615- Steel bars for concrete reinforcement. * ASTM A706- Steel bars for seismic application.															

great leap forward for RCC structures to remain secure against such blasts.

Cryogenic Rebar- This kind of rebar has been developed already for very special applications at cryogenic conditions. Many structures are built which are exposed to sub zero temperatures of a great degree. Plants producing liquid nitrogen or oxygen need to withstand temperatures up to minus 150 degree Celsius under which conventional rebar would be as brittle as an egg shell. New cryogenic rebar having specific alloying elements have been developed after intense metallurgical research and in use for such structures.

How to Choose Right Quality of Rebar for Construction As per the estimate, nearly 17-18 million tonnes of rebar is consumed in the country which indicates a construction of over 5000 million square feet area per year. This is quite big a number to ignore from its structural safety point of view which in turn is related to the base quality of the rebar. A study (Ref 3) on large number of rebar producer and supplier in the country revealed that the existence of sub optimal quality of rebar in the market is just a realty. The fact that reliable testing facilities for rebar is not so easily available, encourages flow of low cost sub standard material and many users do use the same in good faith without even knowing the associated risk. If we look at the production process of rebar in the country, the reason becomes quite apparent. Earlier studies (Ref 4) also indicated the effect of steel making process on the quality of rebar.

There are two broad process of manufacture for rebar followed in our country which are popularly known as integrated and secondary route. Though no sharp definition exists, integrated route production starts from iron ore which is first converted into liquid pig iron in blast furnaces followed by conversion into steel through basic oxygen process which is integrated with extensive refining facilities to have a precise control over not only the base chemistry but also impurity elements like sulphur and phosphorus originating from the ore and other inputs. As a result of this refining process during steel making, compliance to specified chemistry can be easily met and the impurity elements can be brought down to a very low level.

The other notable feature of this process is that the batch size of steel making is quite large and often more than 100 MT which means that a large quantity of rebar can be produced from such process with close range of consistent properties. On the other hand, secondary route generally employs induction furnace as the steel making process with inputs like direct reduced iron and scrap. But the major difference in this process is that no major refining is practically possible to eliminate impurities like phosphorus and sulphur and control other elements within close range. As a result, there is always possibility of non compliance to desired chemistry and hence end properties. Moreover such furnaces are generally of low batch size of less than 10 MT and therefore probability of variance of properties over a small quantity is high. Plus point of this process is however its low cost of production. Such process of steel making to produce rebar which is a safety critical item is not adopted in advanced countries. Incidentally over 60% of rebar produced in India today is manufactured through induction furnace route. Once rolled, it is very difficult to distinguish between good and bad quality rebar by its look and feel. Looking into above aspect, there is an increasing trend to test the rebar before use and this should not only continue but ideally should be made mandatory. However point of caution is that the same to be done through reliable laboratories and the chemical results other than mechanical properties should also be criteria for acceptance since deviation in chemistry can prove to be fatal even if mechanical properties are okay.

With efforts and awareness from all involved in the construction business, Indian rebar quality must be brought up to the international standard and an honest approach and uncompromising attitude only can make it possible

Construction sector and in particular practising structural and civil engineers who are the most affected fraternity in case of any structural failures, need to play a pivotal role of not allowing any suboptimal rebar in any parameter to be used for construction. After all in this crucial phase of fast pace development in the construction sector, the entire country looks to them for building safe and reliable national assets. With efforts and awareness from all involved in the construction business, Indian rebar quality must be brought up to the international standard and an honest approach and uncompromising attitude only can make it possible.

The basic quality requirements must be adhered to for a safe construction and rebars should be considered as a safety item of the first order.

Conclusion-

Proper selection of rebar is important for safety, durability and cost of RCC structures. Construction sector and in particular practising structural and civil engineers need to recognize that reinforcing bar is an engineering safety item rather than a commodity and should play a pivotal role to influence usage of only quality reinforcement for structural safety. This is critical for a country like our which is prone to natural hazards, has a large population and in the growth path witnessing boom in construction. It is also important to keep a watch on the technological advancements which is happening on the of rebar quality making it more and more customized and performance oriented so that the same can be judicially and gainfully utilized in future. ■

Mr. B N Sen, Sandip Talukdar & Ashish Anupam M/s Tata Steel Ltd.

Interview

Dr. S.P. Ghosh,
Sr. Advisor, Cement Manufacturers Association

1. Why has cement become an important construction material?

The history of mankind traced through its ancient civilizations and the traced record of the past two millennia will show that Man had been using different types of materials for dwellings to provide him shelter from sun, rain and wind and a home for his family. The building materials used from Stone Age to the Bronze Age in the progressive march of human civilization ranged from stone or wood, cemented with mud or any other naturally occurring cementing materials (volcanic ash – pozzolan of Italy, natural tuff – Trass of Germany, diatomaceous earth and many other naturally occurring binders in different countries), and also semi-processed materials like lime, burnt clay. With the march of civilization, better binding materials like plastic clay, lime in combination with natural gypsum or in combination with sand (lime mortar), burnt clay (surkhi), burnt gypsum (Plaster of Paris) and naturally occurring powdery rocks like volcanic ash came to be used in different places. But all these binding materials were not adequate to provide high strength and long term durability in construction. There are overwhelming advantages of using cement as a binder in comparison to any other materials. The details are provided in the reply to the next Question.

Consequently, Portland cement has emerged as a leading binding material and continues to enjoy its pre-eminent position among the various cementing materials to this day. Cement ranks second in volume among the industrial products manufactured in the World. The annual global production of cement in 2008 had been 2835 million tonnes.

2. What are the advantages in use of cement as a construction material?

There are a host of reasons in favour of cement's irreplaceable role in contemporary human society.

(a) Unlike all other non-brittle materials for construction (wood, steel, aluminium, etc.) cement is a low-cost but high-performance product.

(b) It can be used as a binder with almost any hard material.

(c) It can be used both as a building block (hardened cement mix) and as a binder of building components (bricks, stone blocks, sand, rock fragments or any other hard material).

(d) Most building materials are prone to decay and loss of property with time, whereas properly made and cast cement concrete gains strength progressively with ageing.

(e) With substitution of very small quantities of cement by other reinforcing materials (steel, polyester, varied sorts of fibers) or chemicals (epoxy resins, plasticizers) its binding properties can be increased manifold to satisfy the performance needs of construction for different purposes (High Rise Buildings, Towers, Concrete Roads, Railway Sleepers, Dams, Reservoirs, Canal Lining, etc.).

(f) Cement and its derivative concrete have turned out to be an excellent medium for recycling varied types of industrial, agro-industrial and metallurgical wastes (fly ash, blast furnace slag, rice husk ash, etc.) providing thereby support to environmental protection.

(g) Cement manufacturing process can absorb a host or hazardous, obnoxious and toxic wastes (from petroleum refining, automobile, pharmaceutical, pesticides, textiles and many other industries) through their effective immunization through incineration in the cement kiln, providing dual benefits of energy conservation and waste recycling inter alia environmental protection.

3. How has cement evolved over the years and what is the way forward?

The patent on Portland Cement by Joseph Aspdin in 1824 introduced a new binding material for construction. Originally cement was used as binding material for construction (walls, partitions, flooring, roofing etc.) like many other binders like lime-mortar. The opportunities cement could offer in revolutionizing the construction practice was hardly known or realized. Subsequent developments from the later half of 19th century have resulted in the cements with wide range and versatility of its use, as we know today.

The presence of Portland cement as binding material led to the development of Plain Cement Concrete (PCC) and subsequently Reinforced Cement Concrete (RCC). It is now possible to construct high-rise buildings, skyscrapers, large dams, reservoirs with less consumption of building materials and much higher strength.

The use of RCC became very popular from the beginning of the 20th century. The advent of concrete, especially reinforced concrete, significantly replaced traditional construction materials, such as steel, stone, wood and bricks. This had made concrete as the most widely used man-made product and second only to water as the world's most heavily consumed substance. The widespread use of concrete, boosted cement demand spectacularly throughout the world during the last one hundred years. This in turn led to innovations in the manufacturing technology, storage, handing and distribution techniques, not to speak of the utilization of cement, thus giving birth to the modern cement and construction industries.

4. Is sufficient quality control exercised in the production, storage and use of cement?

Each bag of cement sold in the market has to comply with the provisions of Cement Quality Control Order, 2003 of the Indian Bureau of Standards.

Quality control plays a cardinal role in all activities concerning cement manufacture, from its manufacturing to ultimate use, because any defect or oversight may lead to disastrous consequences. The quality control of cement and cement-based products are monitored and regulated by the Bureau of Indian Standards (BIS) through the existing mandatory standards and codes of practice. BIS formulates standards for cement and concrete through expert bodies [with members drawn for consumers, manufacturers, Apex construction Agencies in Public and Private sector, R&D Institutions, knowledge bodies and concerned NGOs] grouped in 3 Sectional Committees under the Civil Engineering Divisional Council [CIDC], which is an umbrella Body for 57 Sectional Committees.

The standards evolved for cement by the Bureau of Indian Standards (BIS) cover all the conceivable aspects of cement manufacture and its applications with virtually nothing left for any arbitrary option. It starts with defining suitable types of raw materials for cement manufacture and their prescribed proportioning for the kiln feed to make cement clinker. The BIS Standards lay down the quality specifications for fuel to be used, the parameters to be maintained in the cement manufacturing process, in packaging, storage and handling of the finished product (manufactured cement). There are also standard specifications for quality check after laying of cement concrete in construction. BIS has in operation 14 Indian Standards for different varieties of cement, 8 Standards for raw materials and their sampling and testing, 5 standards for specification of fuel to be used and for pulverized fuel ash, 35 Standards for methods of cement sampling and testing and for apparatus for such testing, and, 7 Standards for testing of concrete made with cement, aggregates, admixtures etc.

All the BIS Standards related to cement, including those on its supply and storage, and those on cement based concrete, are aligned with corresponding International Standards (ISO Series of Standards for Cement). Also the calibration of equipments for testing the physical and chemical characteristics of cement are standardized for verification of their suitability for tests of cement and to match with specific cement Standards.

5. How does cement interact with others materials such as water, steel, aggregates, bricks etc.? What are the issues of concern and what is the way forward?

Among the host of solid or liquid binding materials, the Portland Cement and its derivatives are most friendly with other materials like bricks, steel, glass or aggregates of all sorts in compatibility and interaction. That is why cement concrete based constructions can extensively use sand, bricks, tiles, other building components or blocks, glass and steel in the erected structures.

There is hardly any chance of wrong use or misuse of these materials, if quality and quantity of cement and the materials used in any process follow the laid down specifications. For example, in massive construction like Dams and Reservoirs, one has to take note of the possible impact from reactivity of alkali in cement with certain types of aggregates used. Alkali-sensitive aggregates should therefore be avoided or cement with low (< 0.6% Na2O equivalent) alkali should be used with aggregates for such construction.

6. What are the unresolved issues and challenges with regard to use of cement and what is the way forward?

There is hardly any contemporary unsolved issue regarding use of cement in construction. Appropriate mix design for concrete is a primary pre-requisite for getting the prerequisite performance from the cement used. With the advances in manufacturing technology and construction techniques, the production of cement is getting more and more sophisticated, and the use of cement is becoming more versatile.

Cement varieties in use for construction are facing both contemporary and futuristic challenges. The escalating demands of modern construction - for erecting high rises, skyscrapers, complex structures and colossal edifices requiring more load bearing capacity of concrete-have been posing continuous challenges to cement. The cement for use as a construction material is consequently undergoing rapid changes with advent of newer types of cement based binders. Decades of pioneering research has led to invention of cement types, freeing it from its contemporary limitations of volume shrinkage, setting time, micro cracks formation, very long time durability, super-strength development etc. Most of these new cement types are based on different types of polymers and superplasticisers. A few notable among them are: Geopolymer Cement, DSP (Densified System of Phases), MDF (Micro-Defect Free) cement, Organo-cement Composites, Reactive Powder Concrete etc.

The further challenges for cement lie in use of nano technology in cement manufacture – for lowering energy consumption in manufacturing, reducing cement consumption in constructions through enhancing its strength development.

7. How has admixtures influenced the use of cement?

The use of different types of admixtures has immensely enhanced the properties and performance of cement and concrete. The extensive functions of an admixture- ranging from increasing workability without change in water content, retardation or acceleration of setting time, control of expansion, improvement of pumpability and compactability – make the concrete highly user-friendly under different situations. This is an emerging area with promise of enormous possibilities for making concrete of

adjustable properties to match widely varying conditions of use and desired performance.

8. How has pre-stressing influenced the use of cement?

Prestressing has revolutionized the concept of construction. It has enabled constructions of concrete modules and members of any desired shape, size, design and architectural attributes. In fact, contemporary prestresing technology can make miracles with construction in creating spectacular architectural marvels. Contemporary examples are abundant in many countries - in the design of the Beijing Olympic stadium (2009 - in the form of a bird's nest), latest creativity, the renovated JLN Stadium for the Commonwealth Games in Delhi (2010).

9. What are the environmental concerns regarding the production and use of cement?

The environmental concerns of the cement industry are confined mainly to particulate emissions. The cement manufacturing process emits only suspended particulate matter (SPM) and carbon-di-oxide. No other harmful or hazardous emissions, nor any hazardous combustible is emitted in the manufacturing process. Cement plants in India have excellent record of environmental compliance. The emission levels (20 to 60 mg/Nm3) are always much below the prescribed Norms (100 mg/Nm3), and many modern plants are considered to be following the global "best practice" in pollution control.

On the other hand, cement manufacturing is energy-intensive because of its tradtional manufacturing process. The process comprises dissociation of limestone or the carbonate rock for release of lime [CaO] with release of carbon-di-oxide- a Greenhouse Gas. The manufacturing process also involves two stages of size reduction through grinding of (a) raw materials and (b) cement clinker. The burning of the raw materials involves use of fuel. The fuel consumption ranges from 672 to 850 K.Cal/kg of clinker. Production of one tonne of cement usually consumes 70 to 110 kwh/per tonne of cement. Thus production of one tonne of cement consumes 2.9 to 3.7 Gj of energy and emits 0.82 to 1.0 tonne of CO2.

The Indian Cement Industry has achieved major breakthrough in both reducing energy consumption and the GHG emission which is acknowledged as "World Class". At present large capacity modern plants in India consume on an average 715 K.Cal/kg of clinker and 92 kwh/per tonne of cement. These figures are comparable to "Best Practice" followed elsewhere in the World. Modernisation of manufacturing technology has enabled the industry to bring down GHG emission from 1.2 tonne per tonne of cement in 1990 to 0.825 tonnes per tonne of cement in 2007. This achievement has been recorded by the MoEF in its routine communication to the UNFCCC – an obligation under the Kyoto Protocol.

The cement industry consumes as alternative raw materials a host of industrial wastes – large volumes of fly ash, blast furnace slag, byproduct gypsum, red mud etc. It consumes more than 90% of annually recycled fly ash, (fly ash is generated as a waste from coal burnt in Thermal Power Plants). The industry also consumes the entire quantity of granulated blast furnace slag generated as waste from the steel industry. It also consumes a host of other industrial wastes as alternative raw materials or fuel. The industry, thereby, more than compensates the pollution due to emissions caused by the manufacturing process.

10. How can cement contribute towards the aesthetics of a structure and what is the way forward?

Creating aesthetics in a structure depends on the design of the structure and construction procedure followed. Cement being only one of the components in construction, it has very limited scope and role to play in this regard, which is primarily the domain of Structural Engineers and Architects.

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Issues of Concern Related to Quality of PLUMBING WORKS in Construction Industry

by : Sharatchandra V Rao,

The Plumbing Industry has registered a phenomenal growth in the last decade. The advent of high rise structures sixty storeys and above has added a new dimension to this aspect. With the economic growth looking upwards the impetus in the coming years is going to be remarkable.

The ambit of this trade is widening giving it the status of an industry but unfortunately the design and installation practices being followed leaves much to desire. Thanks to the import of international technology and materials the gap appears to be diminishing albeit at a slow pace.

The major encumbrance is the lack of formal education and training in this field, besides the absence of elaborate codal regulations. There is no form of certification or license issued in most parts of the country, allowing for incompetence to creep in leading to incorrect design and installation. An engineers years of study and education include very little plumbing knowledge. They emerge out of the institutes well equipped with knowledge about barometric pressures, static pressures and Hazen Williams equation etc but if asked to layout a bathroom group or vent a toilet, he will struggle.

Scope of plumbing

Two decades back, in majority of construction, plumbing was restricted to the use of Galvanized iron pipes for water and Cast iron/Asbestos cement pipe for drainage. The water supply pipes were laid exposed, so too the drain pipes except within the toilets, where they were laid in the sunken portion. In modern day plumbing everything is concealed, water supply pipes embedded in walls and drain pipes in ducts, bringing with it a host of other problems.

Allied services such as Fire Fighting, Rain Water Harvesting, Fuel gas and solar piping, Water Treatment Plant, Sewage Treatment Plant and Swimming Pool piping are also being included with in the scope of plumbing, making this field much more vibrant and dynamic.

Health Aspect of plumbing

Plumbing has always been important to health. Several ailments and diseases like cholera, jaundice, diarrhoea and malaria is linked to bad plumbing. The main cause of the health problems associated with inadequate plumbing are microorganisms such as bacteria and viruses. Malaria as we all know is due to stagnating water which breeds mosquitoes. Failure in plumbing system and improper connection lead to contaminated water being drawn into what ought to be safe supplies. Things like back siphonage where dirty water is sucked back into the clean water system, cross connection, leakages in drainage pipes and contamination of domestic tanks are simple problems which should never occur. The key issue is that these problems can be easily prevented and prevention is better than cure.

Cross connection and back siphonage are very common occurrence when the supply to piped distribution systems are intermittent. This is very much evident everywhere in our country which makes us more vulnerable to poor health conditions.

Consequences of Bad Plumbing

Some of the major faults witnessed due to improper plumbing are:

- Leaking pipe lines due to wrong choice of materials, jointing & workmanship
- Loss of Trap Seals due to bad vent/antisiphonage connection also resulting in bad odor.
- Curtailed supply & pressure conditions due to design inadequacy.
- Unplanned puncture and cutting of R.C.C structures

  Lack of gradient in sewer lines leading to blockages and unsanitary condition

Absence of colour coding identification for pipes. This is seldom being practiced leading to faulty connection. Today the emphasis is on recycled water for the non domestic use. In case the pipes don't have proper identification or tags a connection from a recycle line may be taken for drinking outlet, which can be a disaster.

Plumbing has always been important to health. Several ailments and diseases like cholera, jaundice, diarrhoea and malaria is linked to bad plumbing

Sewage treatment plant as water conservation measure is being installed, even in Residential Buildings. The quality of the recycled effluent depends on the treatment efficiency which again depends on correct design and good operation & maintenance of the plant. This seldom happens resulting in contaminated recycle water being supplied.

Green Plumbing wherein the emphasis is on reducing the use of water advocates the use of 'Low flow fixtures' for water closets, basins, showers etc. The design of the receptacle or bowl receiving this low flow should be commensurate with the fixture but this actually does not happen, resulting in unclean toilets and extra water consumption thus defeating the very purpose.

Corrosion of potable water line whether laid underground or above ground, influencing the water quality due to release of corrosion products.

Hazards associated with hot water scalding due to unbalanced pressure at mixer outlets.

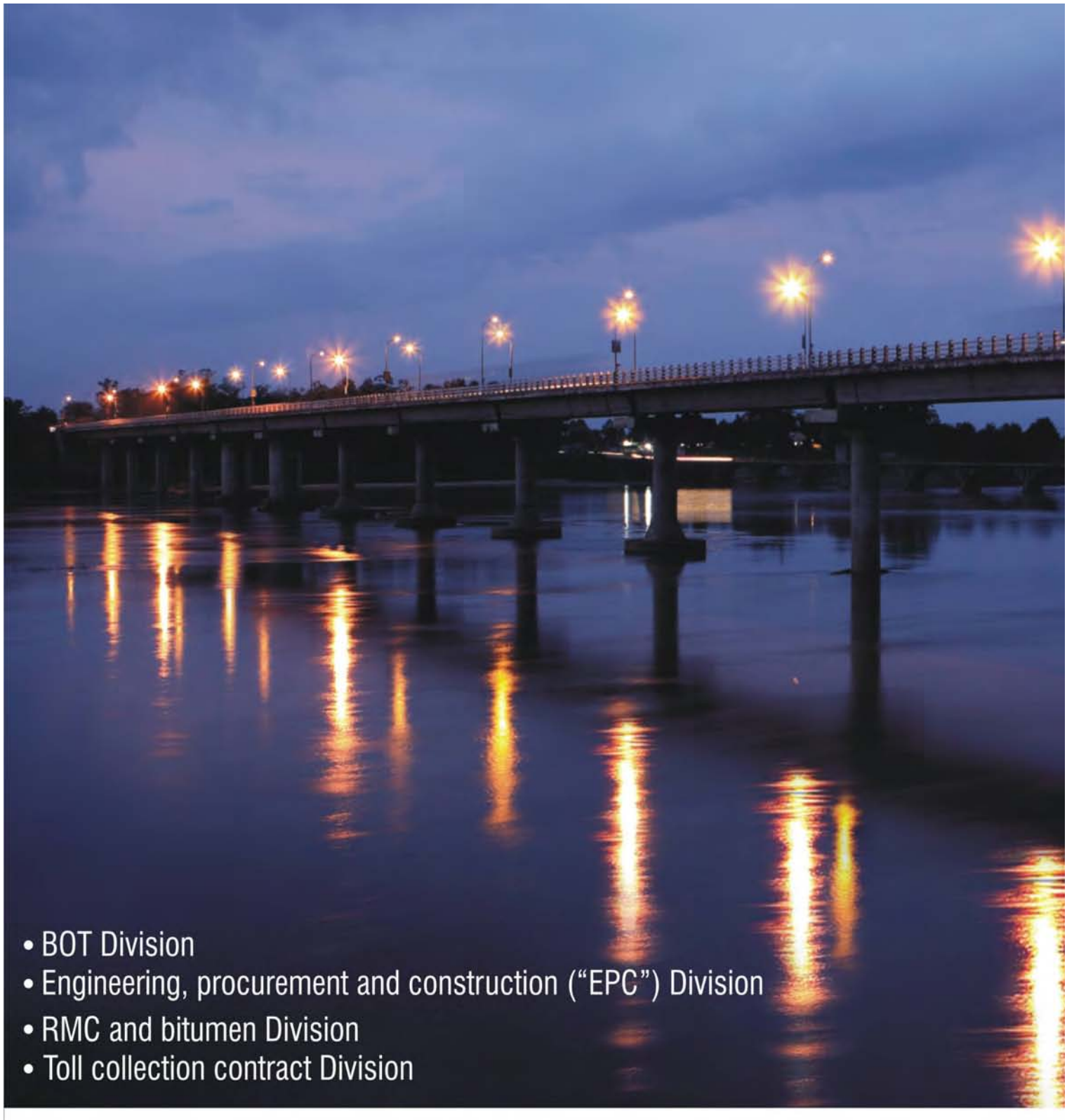
Suggestion and recommendation

- Impart formal education / training at all levels i.e. skilled plumbers, supervisor and Engineers.
- Elaborate codal regulation to be in place. At present NBC – 2005 is the only code available to the user.
- Recommended to have design and drawings in place before start of execution. At present several projects are left to the discretion of the skilled plumber.
- As built drawings to be prepared and records maintained
- Water tightness testing to be done diligently.
- Plumbing services to be taken up for planning at the inception stage of the project.

Conclusion

The time has come for every person connected with the building industry to heed the 'Wake-up' call and take this issue seriously. The Indian Plumbing Association (IPA) has opened up the window to advocate good plumbing. IPA along with International Association of Plumbing and Mechanical Officials (IAPMO) has been instrumental in publishing a comprehensive code - "Uniform Plumbing Code – India" (UPC-I). Although it is a recommendatory code, it will go a long way to improve the quality of plumbing in this country. Education Training is also being imparted through a program called 'PEEP' (Plumbing Employment to Educational Program). These are all positive signs, which will augur well for this important but neglected branch of engineering. After all "Good Plumbing means Good Health". ■

Mr. Sharat Chandra V Rao is Managing Director,
M/s Engineering Creators Public Health Consultancy Pvt. Ltd.



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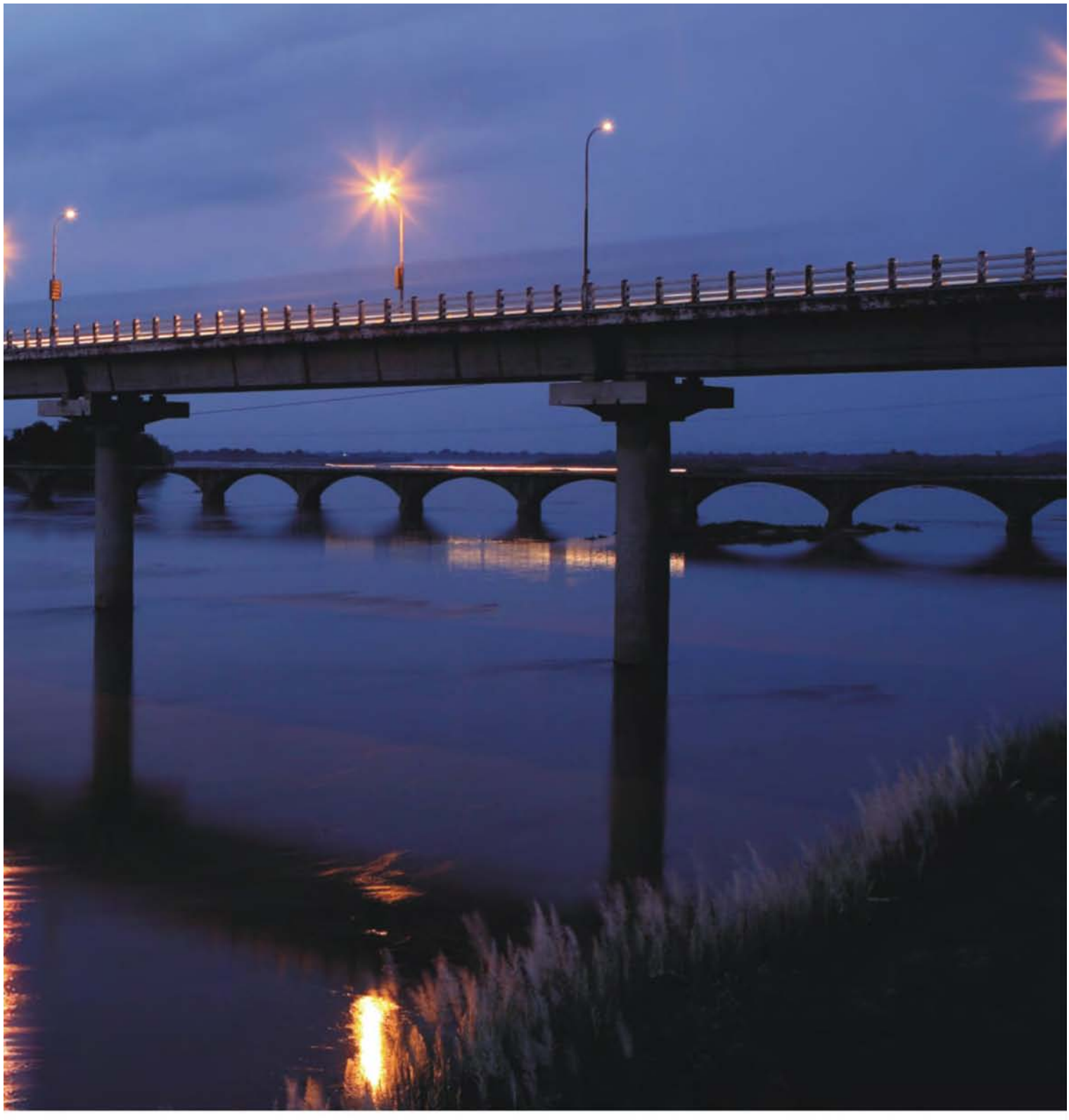

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Quality Management in Construction Projects: A SYSTEMS PERSPECTIVE

by S.K. Breja and G.C. Mishra

Introduction

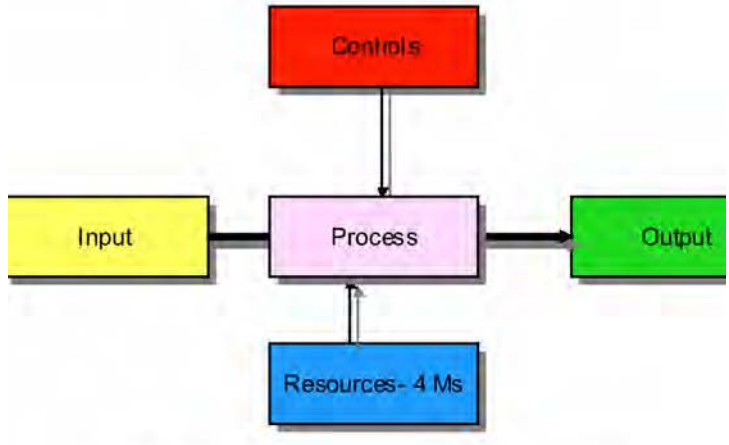
It is utmost important to maintain quality, and that includes safety; in construction projects…it is known! There are various critical factors affecting the quality of construction projects. However, from the sustainability point of view and also for safeguarding immediate interests of the society, it is also important to ensure minimization of environmental impact of construction activities. The work done by construction industry or the people coordinating construction works is open to public/media scrutiny, and lapse of any kind in construction activity becomes hot topic of discussion. This calls for adopting

Systems approach to managing construction activity.

Like developed countries India also implements internationally accepted management standards in construction. In fact, Delhi Metro Rail Corporation (DMRC) is the first Metro Rail in the world to have got certification to ISO 14001, and it now has OHSAS 18001 certification too, covering a number of construction sites including the ones falling on Ashram-Badarpur line. However, international management systems pertaining to quality, environment and safety have been published separately, and are being implemented mostly as such. But today's pace of growth and need for coordination requires systematization in implementing systems also. This paper emphasizes the importance and the benefits of integrated implementation of various management system standards applicable in construction.

Factors Affecting Quality Performance in Construction

Quality in construction is assured through design creation, proper system of awarding tenders, documentation and quality workmanship including various other essential activities. Systems approach to project management includes systematic assignment of responsibilities, work planning and meeting the deadlines. There are numerous factors: ranging from commitment of the top management to training of workers and making food/shelter arrangement for them, which affect project success. It helps to identify critical success factors in construction management and ensure project success through focusing attention on crucial aspects.



Quality Management-Process Approach

There are basically three barriers, as identified by Loushine et al. (2006) through literature survey, to the success of quality management in construction projects: shoddy implementation; the nature of the construction work; and the industry itself. Jha and Iyer (2006) have identified: project manager's competence, top management support, monitoring and feedback by project participants, interaction among project participants, owners' competence as the key factors affecting quality performance of

construction projects. According to them, these factors represent 55 project performance attributes (not exhaustive by any means owing to fragmented nature of construction industry) which range from: authority to take day to decisions by the Project Manager's team at the site, positive attitude of Project Manager and project participants, effective monitoring and feedback by the project team members to: coordinating ability of Project Manager and commitment of all parties to the project. Then there could be various other factors relating to human resources which although might appear to be minor in the face of challenge of meeting deadlines, have tremendous impact on quality as also speed of construction. This calls for strategic management of quality and adopting systems approach.

Safety and Environmental impact

Safety of the workers and the structure are the prime requirements in construction. In today's age of speed, there is increased concern for environmental protection, along with workers' safety. This has led to advocating systems approach, and rightly so, to managing safety and environment, just like quality. According to Sharma and Rai (2009), lack of awareness is the biggest hazard for safety in construction. There are standards for managing safety and environment.

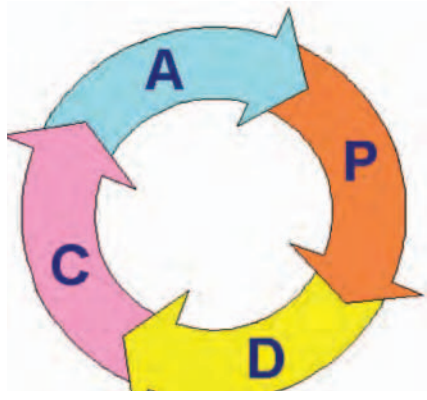
People Management

Training plays an important role in promoting consciousness towards adopting safety measures. Highlighting the importance of worker training on safety aspects during construction of Bandra-Worli Sea Link (BWSL), Sharma and Rai (2009), elaborate that primary safety hazards are related to engineering control, equipment, job methodology, material handling and emergency preparedness. The construction company, constructing the BWSL project, namely, Hindustan Construction Company (HCC) ensured proper training for each and every worker on safety related issues. It had to take care of psychological condition of workers including requirement of serving meals and tea, twice daily, to 2500 people working in the sea per shift at over 30 locations, and transporting people. HCC completed the project through well coordinated efforts and won the prestigious Golden Peacock Award for Safety, Health and Environment.

Systems Approach to Managing Quality, Safety and Environment

According to Bubshait and Al-Atiq (1999), a contractor's quality assurance system, which ensures consistent quality, is essential for preventing problems and their recurrence. In this context, ISO 9001 Quality Management System (QMS) was first introduced in 1987. Subsequently, this standard was revised in 1994, 2000 and 2008. ISO 9001 owes its origin to British Standard BS 5750. ISO 9001 standard in earlier version defined quality using 20 key elements that a firm must use to produce goods and services.

The purpose of the standard was to assure customers of quality consistency. In the 2000 version, ISO 9001 underwent a major change to respond to the needs of the customers to ensure their satisfaction on sustained basis; it specified a new architecture based on Plan-Do-Check-Act (PDCA) approach while including the earlier requirements in a new format. ISO 9001 in its 2008 (like 2000) version is based on eight quality management principles and requires process approach to implementation.



ISO 1400 Environment Management Systems (EMS) standard, first published in 1998, owes its origin to BS 7750.This standard was developed to help firms manage the environmental impacts generated by their activities. Prior to the introduction of the standard, formalized applications of environment management within the construction industry had been limited to a relatively small number of projects with high contract value and potentially considerable environmental risks (Griffith, 2000). Implementation of EMS standard, now 2004 version, can help to reduce harmful impact of any activity on environment. This expectation is based on three EMS requirements: articulation of an environmental policy; identification of significant environmental impacts, and delineation of objectives and targets.

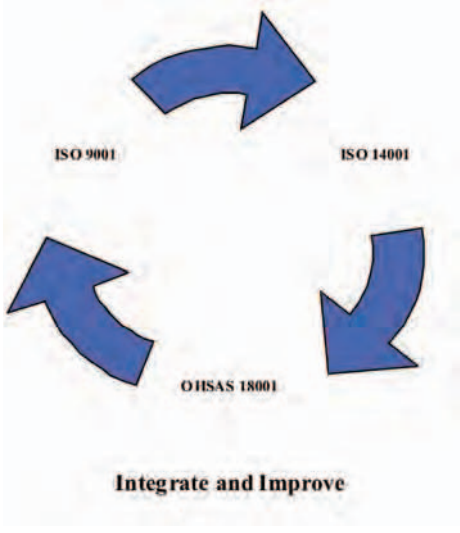
The OHSAS 18001 standard, first published in 1999 and revised in 2007, is applicable to an organization that wishes to: establish an occupational health and safety (OHS) management system to eliminate or minimize risks to employees and other interested parties who may be exposed to OHS risks associated with its activities. These are also applicable to organizations that wish to: implement, maintain and continually improve an OHS management system and/or assure itself of its conformance with its stated OHS policy. These are used for demonstrating such conformance to others and also certification/registration purposes.

OHSAS standard has been created by several national standards bodies. It is yet to be adopted by ISO, however. OHSAS 18001 is similar to ISO 14001 in its structure; although both the standards are self-regulatory these management standards treat compliance to the law as the minimum standard. The 2007 version of ISO 18001 is better compatible with latest version of ISO 9001 and ISO 14001. As with ISO 9001 and ISO 14001, documentation of key procedures is the prime requirement for certification. All the three standards: quality, environment and OHS management require PDCA approach to implementation and continual improvement.

Integration-Focused Implementation of System Standards

Quality today has assumed a very wide meaning. From an

earlier and much narrower focus on product characteristics, quality today is related to organization and business quality. The three management systems standards have different focus: quality, environment and safety, but the aim remains same, i.e. management of stakeholder interests through systems approach. It is only prudent that in the current times, unified focus is maintained though integration of the documents. The literature also supports the use of integrated safety and quality management in construction. According to Loushine et al. (2006), "Combining safety and quality management principles and methods capitalizes on the similarities between these two management concepts to create a single 'synergistic' management system for improving both safety and quality". Hence, it is opined that companies should identify the similarities in requirements and attempt to create a comprehensive management manual for focusing resources in achieving goals and objectives.



Studies are, in fact, being conducted which examine the costs and benefits of implementing integrated management system (IMS) and whether construction firms experience significant improvement upon IMS certification. One of the registration requirements in relation to Contractors Registry System (CRS) in Singapore for the top A1 and A2 categories is that these must achieve ISO 9001, ISO 14001 and OHSAS 18001 certification. In the study of construction firms in Singapore (Griffith, 2000), it was found that: larger firms reaped more benefits and incurred lesser costs of integration and most of the companies believed that the benefits of IMS outweighed its costs. IMS provides following benefits for the organizations:

Ease in understanding and implementation;

Integrated documentation and record keeping;

Reduction in time in designing and implementing IMS;

Reduction in maintenance (surveillance) costs ;

Manpower savings, and

Improvement in management efficiency.

Tools for TQM and Continual Improvement in Construction Industry

Pheng (2004) through case studies has shown that the concept of total quality management (TQM), like ISO 9000 can be implemented in construction (Breja, 1996). National Council for cement and Building materials has identified a set of quality improvement statistical and non-statistical tools (Breja et al., 2000) for quality improvement in cement industry and assisted major cement manufacturers in the application of these tools through workshops. Of these tools, the ones identified for using qualitative data are particularly important, and also suitable, for construction industry. These tools address quality, cost, time, delivery and improvement aspects of projects. The use of the tools in structured format leads to value addition and continual improvement which is a mandatory requirement in most of the management standards.

Enhancing the Effectiveness of Quality Management System

The effectiveness of the management systems implemented in construction organizations is enhanced by using services of certified inspection bodies. Inspection bodies themselves having certification to ISO 17020 can be expected to do their duty with more professionalism and integrity if these are certified to ISO17020:2004. This ISO standard lays down general criteria for the operation of various types of bodies performing inspection. Earlier ISO had a separate ISO 9003:1987 and 1994 model for final inspection and test; this standard was later suspended. The requirements of ISO 17020 are: Administrative requirements; Independence, impartiality and integrity; Confidentiality; Organization and management; Quality system; Personnel; Facilities and equipment; Inspection methods and procedures; Handling of inspection samples and items; Control of records; Inspection reports and inspection certificates; Subcontracting; Complaints and appeals; Cooperation with other inspection bodies. Construction companies should also get all samples and materials tested and calibrations performed through laboratories having accreditation as per ISO 17025: 2005. This standard lays down requirements for the competence of testing and calibration laboratories. In India, accreditation of testing and calibration laboratories is given by National Accreditation Board for Testing and Calibration Laboratories (NABL).

These tools address quality, cost, time, delivery and improvement aspects of projects. The use of the tools in structured format leads to value addition and continual improvement which is a mandatory requirement in most of the management standards

Further, in our opinion it is also going to be important for construction firms to implement SA8000 Social Accountability Management standard which is about workplace conditions. The standard may be a major boost for construction sector as far as safe worker conditions and workplace maintenance are concerned. It sets standards for: child labour, forced labour, health and safety, freedom of association and the right to collective bargaining, discrimination, disciplinary practices,

working hours and compensation. The organization seeking certification to this standard is required to implement social management system (SMS) to ensure compliance and delivery in relation to above aspects. The standard has the support of various sectors, industries and countries. Already 2151 factories, stores and farms have got certification to SA8000 by 31st march 2010.

Efforts by National Council for Cement and Building Materials

National council for Cement and Building Materials (NCCBM) has been supporting the efforts of cement and construction industry in quality management and improvement since its inception. It has NABL accredited (as per ISO 17025-2005) testing and calibration laboratories with wide range of facilities to cater to on-site and off-site testing, inspection, calibration and quality control needs of cement and construction industry. NCCBM develops certified reference materials for equipment calibration and quality assurance. With national and international linkages, NCCBM is the only agency of its kind in India which takes care of diverse quality control and manpower training needs of cement and construction industry, through its facilities at Ballabgarh and Hyderabad. It plays a central role in formulation of BIS codes of practice for cement and construction sector and has completed many a project of national importance.

NCCBM is an ISO 9001:2008 certified organization. In the past few years, various quality related projects including those relating to selection of appropriate TQM tools and techniques for cement industry; laboratory management and improvement scheme for cement industry, development of standard reference materials for physical properties of pozzolanic materials and many more have been completed by the organization. In addition workshops have been conducted to assist plants in application of statistical techniques for quality improvement and NCCBM plants assisted in NABL accreditation. It has also carried out 17 projects on inter-laboratory comparisons (ILC) and proficiency testing (PT) involving whole range of cement and raw materials as also cement mortar cubes. Some of these PT programmes have been conducted as nodal agency of NABL.

NCCBM has played pioneering role in creation of testing facilities for new building materials and designing codes for cement and building materials including concrete mix designing and IS 456:2000- Code of practice for plain and reinforced concrete. It regularly assists industry in energy conservation and environmental improvement efforts and operates scheme of National Awards for excellence in energy, environmental and quality management for cement industry. These annual awards are given away to the winners at biennial NCB International Seminar on Cement and Building Materials. Presently, NCCBM is directing its efforts to identifying emerging requirements of the cement and construction sector and gearing up to take up new R&D work in the field. To support industry's efforts for continual improvement, it has taken up a project on quality benchmarking for cement industry.

Conclusion

The paper has highlighted the importance of quality, safety and environment related issues in construction and emphasized the need for integrating efforts in addressing various issues, for resource saving and focused achievements. The views presented in the paper are supported with literature review.

Acknowledgement

Authors have freely drawn from NCB data bank. They thank DG-NCB for permitting publication of this paper.

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A panoramic view of CSIR-SERC campus

CSIR-Structural Engineering Research Centre (CSIR-SERC) located at Chennai, is a National Laboratory under the Council of Scientific & Industrial Research (CSIR), Govt. of India and has been conferred the ISO 9001:2008 Certification

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- **Structural Concrete and Engineering Technology**
- **Sustainable Materials and Composites & Retrofitting/Rehabilitation of Structures**
- **Computational Structural Mechanics for Analysis and Design & Software Development**
- **Transmission Line Towers, Metal Structure Behaviour & Fatigue and Fracture**
- **Structural Health Monitoring and Evaluation & Forensic Analysis**
- **Wind Engineering & Earthquake Engineering**

Activities

- **Basic and Applied Research**
- **Sponsored / Collaborative R&D**
- **Consultancy**
- **Advanced Testing**
- **Development of Construction methods, Concrete products and Computer Software**
- **Advanced Training**
- **Information Dissemination**
- **Technology / Knowhow Transfer**
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  - ⇒ **Structural Testing**
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CIDC News

Chittarangi Power Pvt. Ltd. CIDC to Provide Training of Project Affected Persons.

M/s Reliance Power Ltd (RPL) has entrusted the task of training of about 250 project affected persons in construction related trades to CIDC. RPL through Chittarangi Power Pvt. Ltd is setting up a power plant at Chittarangi, Madhya Pradesh. The training will be on construction related trades for a duration of three months. After completion of training the candidates will be provided with suitable jobs in the power plant itself. The 1st batch of students comprising of 40 candidates commenced their training on 1st October 2010. The candidates will be provided with extensive hands on training at the training facility established by CIDC at the proposed power plant.

Construction Industry Vocational Training Council (CIVTC) – Begins Training for a New Bach of Land Surveyors:

CIVTC has established a training facility in construction related trades at vocational level at Ghaziabad (U.P.). The response has been overwhelming and several candidates have been enrolling from 1st October 2010. Trained candidates are provided free of cost placement facility after completion of the course.

Vocational Level Training Programs Commenced at CIDC's Corporate Office "Vishwakarma Pratham" at Faridabad.

Candidates being imparted training in Lab-Technician Trade

CIDC has established its Corporate Office at Faridabad wherein facility for training in construction related trades at vocational level has also been created. The following course of three months duration have commenced:

- Building Material Lab-Technician.
- Land Surveyor.
- General Work Supervisor.
- Safety Inspector.
- Electrician.

Candidates being imparted training in Land Surveyor Trades

- Welder.

The candidates are provided with extensive hands-on training and are provided free of cost placement service by CIDC on completion of the training. CIDC is receiving excellent response from the nearby rural areas with the youth generally enrolling for the courses.

Candidates at Bhatinda (Punjab) Training Center

It has been found that the awareness regarding employment & training in construction industry/trades is very low. However with CIDC's efforts this will not be the case soon.

Rojgar Mela at Udiapur (Rajasthan)

Vocational Training Programme at Chennai and Cuddalore

CIDC-HMEL Training Institute at Bhatinda Receives Overwhelming Response:

CIDC in association with HMEL has established an excellent training facility at Bhatinda (Punjab). Training is provided for the rural youth in construction related trades for a duration of three months. At present 76 candidates are being trained in various trades. The response received by this training institute has been excellent with about 200 candidates applying for 40 sets for training in electrician trade. Counselling will take place on 9th October 2010.

CIDC Training at Udaipur:

CIDC has setup a training institute for vocational trades in construction industry. 47 students are currently receiving training in various construction related trades.
A Rozgar Mela was organized 27th June 2010 wherein trained candidates who have completed their training were provided placement in construction companies.

Vocational Training Programme - Chennai.

The Gov. of Tamil Nadu has entrusted he task of training candidates from Backward Community to CIDC in construction related trades at vocational travel. Consequently CIDC has established a training facility at Periyar Maniammai University, Periyar Thidal, 50, EVK Sampath Salai, Chennai for training candidates in Land Surveying, Supervisor(Civil), Laboratory Technician (Civil) and Bar Bender trades. Two batches have completed training till date and the 3rd batch comprising of 36 candidates commenced training in Land Surveyor trade on 15-07-2010 at the Chennai centre.

Rojgar Mela at Faridabad

Vocational Training Programme – Cuddalore

The Cuddalore District vocational training programme of Land Surveying Supervisor course was concluded on 07-09-2010. All the candidates have been provided with certificates and have been placed successfully.

Vocational Training Programme – Tanjavur District(TN)

The 2nd round of training, comprising of 120 students, commenced on 1st September 2010 at CIDC's training centre at Thanjavur in 3 trades. The centre has been established at Adenz English Excellence, JJ Plaza, 85, Court Road, Thanjavur.

Training in Construction Related Trades in Sothern Part (Chennai/ Tanjavur/Cuddalore) of India. The Land Surveyor has become very popular in the region.

Vocational Training Programme – Salem District(TN)

CIDC's branch at Salem District commenced raining program on 10-09-2010 at SRE Neural System, Athur Main Road, Gengavalli Taluk, Salem District with the strength of 40 students in the trade of Land Surveying Supervisor Course. The inaugural function was held on 10-09-2010. The course was inaugurated by Mr.Shunmugham, President,Town Panchayat, Gengavally Taluk in the presence

of Panchayat Councilors Mr.Elavarassu and Mr.Elango of Salem District.

Certificates Distributed to the 2nd batch (Chennai) of Land Surveying Supervisor.

Certificates to the 22 successful students were distributed by Prof. Sundararajalu, Dean, Periyar Maniammai University on 17-09-2010 for the 2nd batch vocational Training programme at Chennai.

Testing & Certification Program for Skilled Workmen in Construction Industry:

CIDC Chennai office has already conducted the Testing & Certification of 702 candidates through Vazhndhu Kattuvom Project, Chennai along with self financing Testing for individual candidates conducted at Chennai Periyar Maniammai Premises. It is also planned to conduct Testing & Certification programme at Salem District and Tanjavur District shortly.

Diploma Programme with PMU

CIDC-PMU Distance mode Diploma programme in Mechanical Engineering, Civil Engineering and Electrical Engineering is being conducting by CIDC and Periyar Maniammau University, Tanjavur in different districts with the strength of 284 (2nd year), 199 (Lateral Entry) and 67 (new Batch) students.

CIDC-TAG(Tamil Nadu Advisory Group)

CIDC-TAG has recently conducted the following seminar in Chennai:

• Risk Management & Mitigation on 7-8, September, 2010 at GRT Grand Hotel, Chennai which was inaugurated by Mr.K.R.Ananda, Regional Director, Reserve Bank of India, Chennai.

CIDC organizes Rozgar Melas at CIDC Corporate Office "Vishwakarma Pratham"

In order to provide employment to candidates trained at various training institutes established by CIDC two number Rozgar Melas were organized on 08-09-2010 and 06-10-2010 at CIDC's newly constructed Corporate Office "Vishwakarma Pratham" at Faridabad. A total of 15 construction companies/builders and developers came to the Mela for selection of suitable candidates. All the employers conducted interviews and 180 candidates were offered jobs. Salary ranged from Rs 8000 to 12,000 per month depending on the performance of the candidates.

Rozgar Mela at CIDC's Corporate Office "Vishwakarma Pratham" at Faridabad

CIDC Establishes "Vishwakarma Dwetiya" at Ramshapur, District Sultanpur (UP)

CIDC has established a training facility at Ramshapur, Disrict Sultanpur(UP) with excellent infrastructure to provide state-of-the-art vocational training to rural youth and provide excellent employment to them.

CIDC started training program in this region in 2007 by establishing a vocational training facility at Tikarmafi. After receiving excellent response, CIDC decided to establish its own institute in the region. Consequently a plot of land measuring 3.5 acre was purchased by CIDC and construction work commenced on 2nd October 2008. The facility was made functional and inaugurated on 2nd October 2009 and training classes commenced immediately. Thereafter more construction work was carried out and the facility is now fully ready with state-of-the-art infrastructure. The facility has been named as "Vishwakarma Dewetya".

CIDC & GIDC sign a MoU to establish CIDC-GIDC Skill-Upgradation Centres in Gujarat

CIDC and GIDC & IC have entered into a MoU on 28-09-2010 in order to establish training facilities in construction related trades (at vocational level) in the entire state of Gujarat. The Govt. of Gujarat

"Vishwakarma Dwetiya" at Ramshapur, District Sultanpur (UP)

through its resolution dated 22-07-2009 seeks to enhance technical competency and facilitate employment generation in the state. Consequently CIDC, GIDC & IC will cooperate to establish training facilities in Industrial Parks, SEZs and other PPP projects in the state. An Institute Managing Committee (IMC) will be established for this along with an Advisory Committee. GIDC will provide rent free accommodation and other infrastructure for the training facilities. IC will provide Rs 100 lakhs for each centre for equipments and other assets for making the facility operational. CIDC will run the facility by admitting candidates and running classes. ■

CONSTRUCTION INDUSTRY DEVELOPMENT COUNCIL

Construction Cost Indices (New Series - Provisional)
Base - 100.00 October 2007.

S.I.		Roads	Bridges	Dams	Power Plants	Railways	Min. Plt.	Medium Indust.	Transmission	Urban Infrastructure	Maintenance	Buildings
A	**Delhi -**											
	June(2010)	115.47	116.24	115.47	114.54	114.78	113.29	115.47	116.58	116.87	116.5	116.87
	July	115.47	116.24	115.47	114.54	114.78	113.29	115.47	116.58	116.87	116.5	116.87
	August	115.47	116.24	115.47	114.54	114.78	113.29	115.47	116.58	116.87	116.5	116.87
	Sept.	116.47	117.54	116.54	115.47	115.47	114.25	116.58	117.58	117.58	117.58	117.54
	October	116.47	117.54	116.54	115.47	115.47	114.25	116.58	117.58	117.58	117.58	117.54
B	**Mumbai -**											
	June(2010)	115.87	113.92	115.47	113.25	113.25	114.58	115.04	116.54	116.54	116.35	116.54
	July	115.87	113.92	115.47	113.25	113.25	114.58	115.04	116.54	116.54	116.35	116.54
	August	115.87	113.92	115.47	113.25	113.25	114.58	115.04	116.54	116.54	116.35	116.54
	Sept.	116.54	114.25	116.54	114.58	114.58	115.24	116.58	117.54	117.58	117.58	17.56
	October	116.54	114.25	116.54	114.58	114.58	115.24	116.58	117.54	117.58	117.58	17.56
C	**Channai -**											
	June(2010)	115.98	115.41	115.97	115.47	115.31	116.84	114.87	115.09	116.89	116.87	116.57
	July	115.98	115.41	115.97	115.47	115.31	116.84	114.87	115.09	116.89	116.87	116.57
	August	115.98	115.41	115.97	115.47	115.31	116.84	114.87	115.09	116.89	116.87	116.57
	Sept.	116.87	116.47	116.87	116.58	116.57	117.68	115.98	116.87	117.56	117.24	117.32
	October	116.87	116.47	116.87	116.58	116.57	117.68	115.98	116.87	117.56	117.24	117.32
D	**Bangalore -**											
	June(2010)	115.47	119.87	115.47	113.57	116.87	115.47	115.87	114.58	115.54	115.87	114.86
	July	115.47	119.87	115.47	113.57	116.87	115.47	115.87	114.58	115.54	115.87	114.86
	August	115.47	119.87	115.47	113.57	116.87	115.47	115.87	114.58	115.54	115.87	114.86
	Sept.	116.25	120.01	116.54	114.25	117.54	116.54	116.54	115.24	115.65	116.54	115.74
	October	116.25	120.01	116.54	114.25	117.54	116.54	116.54	115.24	115.65	116.54	115.74
E	**Kolkata -**											
	June(2010)	114.47	115.74	114.57	114.57	115.24	114.57	114.54	116.54	114.04	114.58	115.54
	July	114.47	115.74	114.57	114.57	115.24	114.57	114.54	116.54	114.04	114.58	115.54
	August	114.47	115.74	114.57	114.57	115.24	114.57	114.54	116.54	114.04	114.58	115.54
	Sept.	115.72	116.54	115.87	115.87	116.54	115.54	115.57	117.25	114.57	115.54	116.54
	October	115.72	116.54	115.87	115.87	116.54	115.54	115.57	117.25	114.57	115.54	116.54
F	**Hyderabad -**											
	June(2010)	114.25	115.78	114.57	115.47	114.57	113.24	115.47	115.87	114.57	115.47	115.57
	July	114.25	115.78	114.57	115.47	114.57	113.24	115.47	115.87	114.57	115.47	115.57
	August	114.25	115.78	114.57	115.47	114.57	113.24	115.47	115.87	114.57	115.47	115.57
	Sept.	115.47	116.54	115.24	116.54	115.54	114.57	116.54	116.24	115.87	116.54	116.87
	October	115.47	116.54	115.24	116.54	115.54	114.57	116.54	116.24	115.87	116.54	116.87

Supervisor Development Programs (SDPs)

CIDC, the apex organization to promote the Indian Construction Industry, is initiating the Supervisor Development Programs (SDP) to provide training and certification of supervisory level staff working/entering the construction industry. It is focused at conducting different training modules to develop professional competencies in working professionals engaged at working sites. The modules shall be broadly addressing the following topics:

1. Construction Safety Audit
2. Construction Quality Control
3. Cost Estimating & Quantity Surveying
4. Store Keeping & Inventory Management
5. Construction Site Management
6. Bar bending Scheduling
7. Scaffolding Construction
8. Shuttering
9. Concreting
10. Construction Equipment operations supervision
11. Total Station operations
12. Construction Accounting
13. Structural steel construction
14. Personality Development & Communication Skills

Programs shall be of 2 Days, 3 days or 5 days with a course fee of Rs. 3000, Rs 4500, & Rs. 6000 per candidate respectively for Programs at CIDC training centre

Terms for sponsored training program at employer's work site shall be as under:-

1. CIDC shall provide the course contents;
2. CIDC shall depute the faculty members for the proposed training at construction sites;
3. Duration of the course shall be 2,3, 5 days depending upon the coverage desired;
4. The maximum batch strength for each program shall be 25;
5. Training fee shall be decided on a case to case basis.
6. Any equipment or material, if required for training purpose, shall be provided by the employer;
7. A lead time of two weeks to initiate the training shall be taken;
8. On receipt of in-principle acceptance CIDC shall develop the training program to suit employer's specific requirements;
9. CIDC shall be certifying the trainees at the close of the training,

As these courses shall be quite useful in construction works, CIDC invites interested organization you to commission such SDPs at their work sites in India. For overseas sites / specific domestic requirements, for CIDC can develop special tailor-made packages.

For commissioning such SDPs or further details please contact:

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