

# Right Concrete, Right Way – Spreading ACI Concrete Field Testing Course in India through “Train the Trainer” Initiative

**Dr. S. K. Manjrekar**

*Principal Convenor - ACI Certification Course, India Chapter of ACI  
Past President - India Chapter of ACI (American Concrete Institute) (1998 - 2001, 2001 – 2003 and 2005 - 2008)*

*“If you are thinking a year ahead, sow a seed,  
If you are thinking ten years ahead, plant a tree,  
If you are thinking hundred years ahead, educate people”*

## Introduction

Today, India is one of the major concrete producing countries in the world. If one considers the per capita consumption of concrete in India, it will probably come next to the consumption of air and water. The construction industry has assumed a huge financial dimension of Rs. 400,000 crores per annum which means a staggering US dollars 80 billion. A substantial part of this expenditure is attributed to concrete. Hence, for durability and desired usability of these structures for a given service life and beyond, we need to look at the following aspects of concrete:

- a) General understanding about concrete as a material.
- b) Good understanding about the mechanism of hydration of cement.
- c) Awareness about good concrete practices
- d) Quality assurance and control measures of making good concrete.
- e) Testing of concrete in green state.
- f) Testing of concrete in hardened state for required performance.

## Concrete Field Testing Course of ACI

Unfortunately, none of the above requirements are considered in any of the contemporary engineering degree or diploma programs in India. As a result, engineers who join the industry have to acquire concrete related experience on site and through self motivation to excel in concrete related knowledge. Thus, there is a conspicuous need of a structured program which can train and certify concrete practitioners in various aspects of concrete and related activities. Such a structured program was devised by the American Concrete Institute (ACI, [www.concrete.org](http://www.concrete.org)) about 30 years ago in the form of the 'ACI Certification program'.

## Contents of the course and its technical relevance to concrete

- **Temperature** of Freshly Mixed Hydraulic –Cement Concrete.
- **Sampling** Freshly Mixed Concrete.
- **Slump** of Hydraulic-Cement Concrete.
- **Density** (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
- **Air Content** of Freshly Mixed Concrete by the Pressure Method.
- **Air Content** of Freshly Mixed Concrete by the Volumetric Method
- **Making and Curing** Concrete Test Specimens in the Field.

The above seven parameters influence the performance of set concrete. Hence, when these are measured properly as per uniform methodology, they can give very important information about the behavior of the set concrete. For example concrete temperature is one of the most important factors influencing the quality, time of set and strength of the concrete. Without control of the concrete temperature, predicting the concrete's performance is very difficult, if not impossible. Temperature can give us following indications about properties of set concrete.

- 1) A concrete with a high initial temperature will probably have higher than normal early strength and lower than normal later strength. The ultimate overall quality of the concrete will also probably be lowered.
- 2) Conversely concrete placed and cured at low temperatures will develop strength at a slower rate but ultimately will have higher strength and be of a higher quality.
- 3) The temperature of concrete is used to indicate the type of curing and protection that will be needed, as

well as the length of time the curing and protection should be maintained.

- 4) By controlling the concrete temperatures within acceptable limits, immediate and future problems may be avoided.
- 5) In today's context concrete temperature affects the performance of chemical admixtures, air entraining admixtures, pozzolanic materials and other additives and admixtures: The detailed explanations about the measurement of temperature of concrete gives the concrete practitioners insight into importance of other remaining six parameters dealt with in ACI Certification Course. Indeed these parameters give ample information about the probable behavior of set concrete.

ACI has been administering the “**Concrete Field Testing Technician Grade-I Course**” through local ACI Chapters and other organizations. About 5,00,000 concrete practitioners are working all over the world who now are certified by ACI and taking care of concrete knowledgeable. Amongst all the certifications, ACI Concrete Field Testing program has become so successful that it has virtually become the industry's standard entry-level qualification. The tremendous response to this course has been largely due to the cooperation received from industry stakeholders, in recognition of the fact that proper handling of concrete leads to fewer disputes and results in higher quality and on-schedule projects.

The India Chapter of ACI organizes this knowledge dissemination program as a local sponsoring group and currently the twentieth batch is in progress. As of date, there are more than 400 certified professional engineers in India.

## History of ACI Certification in India

**‘Twenty first century belongs to the Knowledge age, where acquisition, possession and application of knowledge is the most important resource.’**

Often, we have come across disasters that could have been avoided, if a structured program of quality had been implemented at site. To meet this need, late Mr. R. N. Raikar and I had been interacting with ACI International since the year 2003 to work out the possibility of implementing certification programs in the Indian sub-continent through the India Chapter of ACI as a local sponsoring group (LSG).

In fact, during the centennial ACI Convention, at Washington D. C., in 2004, I had detailed discussions with Mr. John Nehasil, Managing Director - Certification Programs of ACI and subsequently with Mr. Khaled Awad, ‘International Certification Committee Chair’ to work out the modalities and understand various procedural aspects of starting the course in India. In spite of having

recovered from very critical illness, John took keen interest and gave great guidance. Khaled Awad found time in his very busy schedule to actually visit India to give a detailed presentation and guidance during silver jubilee conference of the India Chapter in Mumbai. Thus, back up preparations and understandings were being created. However, the course was not taking off; the main reason being that, in India no one had hands on idea about the contents, mode of implementation of the course and how useful it would be in the Indian contexts.

The India Chapter of ACI, in consultation with ACI International decided that I should undergo the course. Eng. Khaled use to conduct this course in Qatar, where he invited me to attend it, as an observer or to undertake the certification. Hence, I decided to undergo the ordeals of taking the course and the field concrete testing certification exam in hot scorching weather of 50° Celsius. The examiner, Eng. Abdul Kader deserves compliments for not showing any sympathy towards my grey hair, old age of 58 years and a fractured index finger. He made me do all the practicals with total seriousness and integrity. I am greatly indebted to him, as my skills were honed due to this approach and the ‘no nonsense’ well defined ACI exam pattern. The India Chapter of ACI is extremely thankful to International certification committee chair, Khaled Awad as well as other committee members viz. Mario, Francois, Alejandro, Donato, Roberto, Jorge, Wally, Raul, Mostapha, Vinicio who continuously supported the motion of taking certification to India. At this juncture, I have to also acknowledge the exceptional interest taken in India's concrete Industry by ACI International Past Presidents notably, Anthony M. Fiorato, James R. Cagley, Thomas D. Verti, David Darwin, Luis E. Garcia and Florian G. Barth. Some of them have also visited India. Executive Vice President, Bill Tolley is the friend, philosopher and guide of the India Chapter for the last three decades. We first met in 1990 when, I was honorary secretary of the Chapter and he was Senior Managing Director of ACI, looking after international chapters. I distinctly remember him, telling me on 2<sup>nd</sup> Dec. 1990, in presence of then ACI President Dr. John Hanson, during the reception hours of the conference, that for India's concrete related problems the ‘certification program’ would be most ideal and not only ‘India Chapter’ but the government authorities also should look into it. As a result of the collective efforts over the years, ACI international passed a proposal at their Director Board meeting to send two ACI experts to India to propagate ‘Field Testing Certification’ course. It was going to be a modal run to asses whether such initiatives could be taken in other countries too. Professor Luke Snell and Mr. John Conn were deputed to India by ACI and their meetings were firmed up with engineers from Mumbai, Bangalore and Delhi by the ACI India Chapter.

And now comes the historic turn, M/s. Larsen & Toubro (L & T), the engineering majors of India takes great measures to improve the skills of their engineers on a continual

basis. As a part of the skills improvement initiative, 23 of their senior managers and regional heads were chosen to attend the certification training and undergo the exams. These engineers were from all over the country and some of them were from the Middle East as well. Mr. Vivek B. Gadgil – Sr. Vice President of L & T took a very learned interest in this path breaking initiative for L&T. He even attended part of training session held by Prof. Snell after inaugurating the same, at L&T's Manapakkam Complex in Chennai. L&T treated this course as 'Train The Trainer' initiative, thereby meaning that the successful certified senior Managers would in turn train their juniors who in turn would train their subordinates. This was a privileged batch to get the opportunity to take the training from Dr. Snell and also to get the distinction of being the maiden certified batch in India. All the engineers, though at very senior level did the course in total seriousness and all of them got through the examination with flying colours and joined international community of ACI certified personnel.

### Progress of ACI Certification in India:

**'We make a living by what we get, but we make life by what we give.'**

Enthusied and energized by the initial success of L&T, India Chapter of ACI decided to take this initiative to benefit other organizations throughout the country. In the initial stages, the resources in terms of trained and devoted expert faculty to train the candidates on a sustained basis, as well as the laboratory facility becomes the key to popularize the course. In order to complete the long cherished mission of the chapter and ACI international, I took up the task of training the candidates as a social responsibility and in a structured manner taught concrete to the candidates from all over the country. The sessions are conducted in my office conference room with proper audiovisual arrangements.

Importantly, M/s. Structwel Designers, offered laboratory facilities both for a full day practice session as well

as for written and practical examination for which the question papers were sent and assessed directly by ACI International, Detroit USA. Availability of free lab facility, along with trained manpower, has resulted in offering the certification course at a much subsidised cost, compared to contemporary international costing of the course.

### Direct Advantages of ACI Certification

The first success story of L&T in Chennai, along with subsequent passing out of ten batches brought out the following conclusions which are accepted universally and also applicable to the Indian concrete scenario:

- i Everyone involved in a construction project benefits from the use of certified technicians to perform the field tests on freshly mixed concrete.
- ii Proper performance of the tests improves the reliability of the test results.
- iii It aids in quality control of the concrete and can minimize costly delays resulting from a lack of confidence in the test results.
- iv Most importantly, proper field testing assures accuracy in the identification of good quality concrete and sub-standard concrete.
- v Complete and accurate records filed by the certified technician are essential in the event of a dispute.
- vi The increasing use of 'end result specifications' is another reason for having trained certified technicians on construction projects.
- vii Substantial penalties and the possibility of required removal and replacement of concrete with low strength results make it essential that the fresh concrete tests be properly performed, and that the technicians employed possess the confidence of the project managers.
- viii This initiative can avoid the errors and mishaps by introducing "Field Concrete Testing" culture in or as a "third party quality implementation and monitoring."

### Train the Trainer initiative

**'When learning is purposeful, creativity blossoms; When creativity blossoms, thinking emanates; When thinking emanates, it transforms into knowledge; And when knowledge is shared, economy flourishes.'**

Initially to spread this light of knowledge and than to share it further, we need as much support, in terms of dedicated trained brainpower. Who else could be this team of dedicated trained brainpower but the trained certified personnel from the last eleven batches? This course is taught and conducted as "**TRAIN THE TRAINER**" initiative. Trained and qualified engineers alone can spread this light when they are certified themselves. Hence, extraordinary importance is given to teaching about cement concrete





hydration and good concrete practices along with inbuilt ‘Field Testing’. This value addition, not only gets the candidates enchanted, enthralled and enlightened during the course, but they definitely get inspired to train and educate their peers, juniors and fellow engineers by disseminating the knowledge that they acquired. There have been several such heartfelt feedbacks from the successful certified engineers. This indeed is ‘**TRAIN THE TRAINER**’ initiative as envisaged and it proved to be successful. Several private, public and government organizations have participated in this program benefitting the cause of quality for their organization and thus serving the national cause of producing durable structures. All these organizations and heads of the institutions have a vision to create a better tomorrow. Hence, they participated in the program with total conviction.

### **Vision and Leadership is key to Quality**

I must cite here, an outstanding example of training and certification of a contingent of HUNDRED senior engineers of Maharashtra Housing and Area Development Authority (MHADA). All of us know MHADA as the only organization which deals with construction of houses in masses, for masses, throughout Maharashtra.

It all began in 2008 on ‘Engineer’s day’ celebration of MHADA where I had an opportunity to be the keynote

speaker. I initiated a dialogue about this certification course with the dynamic Vice-President & Chief Executive Officer, Mr. Gautam Chatterjee (IAS). Mr. Mohan Jacob, Past President of India Chapter who has been closely associated in the efforts of bringing ACI certification to India, further deliberated with Mr. Gautam Chatterjee about how this initiative can bring about “skills improvement” and enhancement of concrete related knowledge in MHADA engineers. Mr. Chatterjee is so deeply involved in the betterment of skills of his engineers and the qualitative output of MHADA as an organization, that he readily nominated a block of 50 Engineers for this training. These engineers were divided into five batches and attended the course with other engineers from the diversified background of organizations in the Industry. This created a healthy blend of engineers and the sharing of knowledge became still more valuable. For example along with MHADA engineers, others from reputed organizations like BG Shirke & Co., MIDC, K Raheja Corp., B. E. Billimoria, Lafarge Ready Mix, RMC Ltd., Ultratech RMC and Sunanda Speciality Coatings Pvt. Ltd. Professors from colleges, engineers from consulting firms like Satish Dhupelia & Associates, Shirish Patel & Associates, Structwel, Shashank Mehendale & Associates, SP consultants, Nina Industries and others completed this course successfully to benefit their organizations.



*ACI International then President & then Vice President for giving certifications. [3<sup>rd</sup> & 4<sup>th</sup> Sept. 2010]*

**'Concrete Field Testing Technician Grade - I encouraging popularity of recently launched training and certification course by India Chapter of ACI, as local sponsoring group'**

**Gratifying experiences and impressions of a teacher**

Now, I must share with you my pleasant experiences with training of the candidates in last fifteenth batches of concrete engineers. I have had the pleasant privilege to impart the learning to all the cadres of engineers from Chief Engineers, Deputy Chief Engineers, Executive Engineers and their junior colleagues. I was always convinced in my mind that if the learning comes to any educated personnel in the form which is extremely interesting, connected with day to day operations and if the teaching is, involved and full of concrete expertise, at any age engineers find themselves absorbing involved. Even at the end of a tiring day, which is full of administrative hassles, engineers get reinvigorated and tuned to their channel of knowledge. My experience was absolutely reassuring. Some of the engineers, typically seniors came up to the course with lots of apprehension. However, as the concrete got more and more demystified and simplified in front of them, it was a pleasant metamorphosis into a serious and sincere student wanting to know more about concrete. Their zeal and enthusiasm to excel in the course enhanced by every learning session was a gratifying experience. For me, an equally tired man at the end of the day, to teach every new lecture with added information and enthusiasm, session after session was possible, only due the matching willingness from the candidates to learn. In all the students, the discipline and eagerness to absorb more and more, even at a mature stage in life and higher organizational position in engineering career was exemplary. I give the entire credit to bring out these qualities of the department's engineers to progressive outlook to visionaries like Mr. Gautam Chatterjee. MHADA structures are in the safe hands of, learned and trained concrete practitioners and posterity will remember the likes of Mr. Gautam Chatterjee.

MHADA and other organizations have acknowledged the fact that **'Tomorrow's world would be one which would recognize knowledge in its most comprehensive form and add further value to products through innovative knowledge and these knowledge products would largely contribute to the growth of nations'**. And in order to make this growth all pervading and sustainable in India more and more organizations and Government departments like PWD, CPWD, Irrigation, Railways, MES, etc will have to undertake this training. I am confident that the example of MHADA will become a leading light to all other government departments to emulate and spread the movement of creating healthy and durable concrete structures through certified quality control personnel.

Another example is of the doyen of engineering fraternity, Padmashree Dr. E. Sreedharan who is now leading Delhi Metro Rail Corporation (DMRC). He has seen the potential in ACI training and requested me to take the introductory sessions to ACI certification in Delhi. This course was taken by about 55 engineers in Delhi on 21<sup>st</sup> & 22<sup>nd</sup> August 2009.

Some of the engineers have already stopped the wrong practices which were up to now considered normal (due to ignorance) like using reinforcement bar for rodding the cubes, taking wrong samples from the first portion of concrete as it comes to the site, not taking temperature at all or taking it wrongly, rotating the slump cone etc. to name a few. Even if these small things are taught to rank and files of the department by the 200 plus certified trainers, it would in a year reach to 2000 concrete related manpower all over India at the rate of 20 men per person trained by these **TRAINERS**. One can only imagine the cascading effects of this **"TRAIN THE TRAINER"** initiative in subsequent years reaching to safety of 10000 structures at the conservative estimate of 10 structures/ year.

In conclusion, today Indian nation has more than 400 'Concrete Field Testing' ACI certified personnel. These trainers have been trained in last two years. Another 200 engineers are lined up for training. Together these 600 plus trainers would take this knowledge about good concrete practices to say 60,000 practitioners / field technicians. But is this number enough to reach the concrete of entire country?



*Dr. S.K. Manjrekar, Principal Convenor, IC-ACI with participants of Delhi Metro Rail Corporation (DMRC) at the introductory course on "Concrete Field Testing Technician Grade - I" held at New Delhi*





*Dr. Surendra Manjrekar teaching the engineers of the Delhi Metro Rail Corporation*

Obviously not. Hence this movement of “Concrete Field Testing” should percolate to nooks and corners and at the India Chapter of ACI, we are all determined to endeavor for the same.

### **The Scope of ACI Certification in India**

Thus, we come to the scope of concrete field Testing initiative. Like mentioned earlier construction sector in India is the second largest economic activity next to agriculture and employs 33 million people. This lack of skilled personnel / technicians substantially lowers the productivity and losses due to unforced errors. If the skilling efforts are not taken seriously, then in year 2022 when construction sector is expected to employ 83 million people situation could be alarming as substantial portion of 83 million will be in concrete and related fields.

As of today there is no established competency standard or training module at the national level. Hence, government of India has established National Skill Development Corporation Ltd., in 2008 as not for Profit Company licensed under section 25 of companies Act. NSDC has targeted to train 150 million people by 2022 out of an incremental demand of 240 million as estimated. Above data on amply underlines the need of several agencies / programs to cater to the requirement.

### **Can ACI Concrete Field Testing become an option?**

There are positives and also challenges in obtaining a leadership. Positives have already been discussed earlier in this paper. Now the factors which are challenging may be thought about as under: -

This would allow us to find the solution for the greater interest of the concrete. Some of the challenging points to be pondered over (which may increase in time to come) are as follows:

- a) ACI certification is based on ASTM standards. In India throughout the country Indian code BIS 456 is followed. ASTM has no acceptance or cross reference in Indian standard. This lack of choice confuses many specifiers / practitioners / consultants / Federal Departments... etc.
- b) The course is in English language and in India at technician’s level only local languages are medium of communication. Hence, the course cannot be taught and administered to technicians or field operators in English. Hence, Train the Trainer or certify the trainer imitative needs to be adopted.
- c) As far as the adoptability of the course throughout the targeted manpower of 2022 is concern strong efforts are required. ACI, India Chapter and local sponsoring group / s, need to collaborate and convince federal authorities. It will be good idea to discuss the initiative with NSDC. This is important.
- d) Subsequent to the limited success (due to qualitative nature of ACI course) organizations like NRMCA and others have started the similar initiative in India with the help of parallel concrete bodies. In fact this is a needed approach, for this huge country as many training, skilling on certification efforts are required.

As we travel along there will be more solutions in the skills improvement process to better the concrete in India.

#### **References**

1. [www.concrete.org](http://www.concrete.org)
2. Indian Construction, Vol. 45, Nov. 2012



### **Dr. S. K. Manjrekar**

Dr. Surendra Keshav Manjrekar, F.A.C.I., is Chairman and Managing Director of M/s. Sunanda Speciality Coatings Pvt. Ltd. He obtained his Ph.D. in 1977 from University of Bombay. He is a noted material scientist in the field of corrosion, concrete, waterproofing and construction chemicals. He has been conferred with the “Chapter Activities Award” by American Concrete Institute in 2003 in Vancouver Canada. He has been working on several technical and admin committees of ACI viz ; 1) Committee 364 (for Repairs and Rehabilitation), 2) Sub Committee on International Certification 3) International Partners/Publications Committee 4) International Committee (IC) 5) Chapter Activities Committee etc. In March 2008 at San Francisco USA he was invited to participate in ISO/TC 71 meeting which is a Joint initiative of ACI, ANSI & ISO. He was invited as a keynote speaker from India to address the international forum on Sustainability with special focus on BRIC Countries in Pittsburgh held on 23rd October 2010.

He teaches “Train The Trainer” ACI Certification course and is the “Principal Convenor”. He has published more than 100 papers in various national and international journals that have resulted in deeper understanding of construction chemicals and its application and widely lectured nationally and internationally.