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Manpower training for durable structures

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There is an urgent need of manpower training to keep pace with mechanisation in concrete construction. This is required not only to have a faster progress but durable and maintenance-free structures. There are cases where the post-construction scenario is quite painful as the structure has shown distress prematurely. There is a need to improve the quality of manpower involved in concrete construction to have better understanding of the constructional intrinsics from the laying of concrete till completion. Quality assurance can be better enforced with training and education of personnel involved in the field of concrete technology. Quality requirement needs to be attended to from the conceptual stage itself. The essence of training of personnel has been discussed in this paper for overall achievement of durable structures.

An aesthetically pleasing and durable structure is indicative of the human skill in design, construction and maintenance. There

has been sizeable refinement in the design process with the advent of computers and further development in software industry. Mechanisation of concrete construction in large projects has also delivered successful results, but there is still a need to improve the skill of manpower involved in small projects so as to impart quality finish and durability. In fact, attaining quality does not require any additional resources but deeper involvement of manpower. Concrete quality hinges on the selection of the quality of various ingredients in concrete followed by design mix. Most of the collapses that took place during the Bhuj earthquake of January 26, 2001 were due to faulty design and construction techniques. Improperly constructed buildings showed severe distress or collapsed partially resulting in large scale destruction and severe damage to human lives and structures. Badly constructed buildings showed severe distress, collapsed and killed few thousand people. It is heartening to note that structures built in the same area with proper attention to design and construction aspects had behaved well. Distress to building/structures and people can be arrested by implementing proper design and construction principles as per codal guidelines. In view of the

past experience where slackness has been observed, there is need to impart mass training to one and all who are involved in construction industry particularly in concrete construction in order to ensure durable and long lasting concrete structures.

Training imparts improvement in skill and enriches professional knowledge with better ability to perform on ground. The preconceived concepts of technocrats need rapid change. The basic aim of training is to update the professional ability of the technocrats who can keep pace with the latest design and construction practices prevalent in the country and the world over. In large projects where mass concreting is done daily using a mechanised plant and equipment, the utmost requirement is to conduct the field tests simultaneously at laid-down frequency to exercise proper checks and control and to maintain the required quality. In order to enforce qualitative measures in mass concrete work, there is a need to impart effective training to the concerned staff. The training can be imparted by displaying audio/video sessions and arranging lectures to update the professional skills.

Essence of training

The construction industry has large number of labourers engaged in work but this huge labour force is unorganised. Unfortunately, they receive only rudimentary training in construction practice. The need has been felt to conduct training for such workers to produce good quality concrete wherever it is used. This investment on training is likely to compensate suitably with its dividends in terms of good and durable quality. Personnel who are involved in the planning and maintaining process of concrete structures should also be trained. Considering the fast changes in concrete technology, following aspects related to training need immediate attention.

Aims of training

For any activity to proceed efficiently, the people concerned must have adequate knowledge and information to perform that activity in a systematic manner. They should also have adequate experience and ability to apply the same knowledge to access the information required. The aim should be to perform in the most efficient manner with state-of-art technology and be adaptive for transformation to the rapidly changing environment. After acquiring the desired educational qualification, the engineers enter their professional field where they gain experience with exposure in the field. The "training" has to improve his skill and knowledge continuously. Therefore both teaching and training need to attain harmony with the demands of professional skill while keeping pace with rapid change in technology. Basically the training of personnel involved for site activity, is to keep them abreast about the latest construction technique and design method. This is required not only to optimise the design requirement but also to produce the richer standard of concrete of desirable quality. The mindset of personnel needs to be changed; especially careless approach and casual attitude to be arrested forthwith. This can be done by imparting training on design and construction simultaneously. The ultimate aim of training is to make personnel think and act in order to achieve good durable concrete by following accepted design and construction practices prevalent in the country.

Mechanisation of concrete production is being followed in big cities where ready-mixed concrete (RMC) is available as per requirement and there is need to ensure quality and economy. This is required to be ensured by a comprehensive management

system. Equally important is the staging and shuttering arrangement for the concrete to ensure that desired concrete is laid at right place. This needs to be enforced vigorously. The training can be imparted by various methods, for example, classroom training, videotapes, poster, etc. Basically the concept of top management regarding the quality of concrete should be disseminated to the staff for implementation. After following all measures to educate/training the people, if some laxity is felt, following measures may be taken strictly.

- (i) bad quality work should not be accepted
- (ii) model room should be kept near to the project site to inspire the personnel concrete of desired quality
- (iii) top management should also ensure that all the facilities for testing and other activities related with concrete production are available
- (iv) there should be dissemination of case studies to impart the information about bad quality concrete vis-a-vis advantages of good concrete
- (v) a good motivation system should exist in the organisation to promote healthy working environment
- (vi) personnel carrying out any poor quality work should be properly educated.

Aspects of training in concrete

There is a saying that "a stitch in time saves nine". The training of manpower may appear to be a costly exercise but this will certainly produce rich dividends at a later date. Concrete technology is a very vast topic which covers all facets of concrete starting from selection of ingredients till concrete is hardened. The fact remains that good quality concrete can only be produced when good quality of raw materials is used. Mix design based on particular material available vis-a-vis strength requirement is also a important point in this. After preparation of concrete, transportation and laying are the important activity necessary to have a durable structure. The testing facility of green concrete at site is also an im-

portant event. Concrete quality and durability aspects are amply covered in the IS 456:2000'. In fact, the aim of training is to familiarise with the concept, material, workmanship, inspection and testing as per the following details.

- (i) Materials for concrete
- (ii) Grade of concrete and properties of concrete
- (iii) Durability of concrete which includes working environment, mix proportion and minimum cement content, etc
- (iv) Concrete mix proportioning, wherein the following information is necessary:
 - type of mix (design mix or nominal mix concrete)
 - grade of concrete
 - minimum nominal size of aggregate
 - minimum cement content
 - maximum water/cement ratio
 - workability
 - mix proportion (for nominal mix)
 - exposure condition
 - temperature of concrete at the time of placing
 - method of placing
 - degree of supervision
- (v) Production of concrete: This covers quality control measures, batching and mixing
- (vi) Form work: This includes cleaning and treatment of formwork and stripping time
- (vii) Assembly of reinforcement: This includes placing of reinforcement and need for joints/mechanical joints, if any
- (viii) Transporting, placing, compaction and curing.

Table 1: Short term training module

No	Name of training subject	Tentative period, days	Personal category	Remarks
1	Concrete and raw material for concrete aggregate cement, admixture and water	2	C&D	Should be 8 hours training programme with sketches and video picture.
2	Mix design and preparation of concrete (including batching)	1	D	This should be covered with working example
3	Staging and shuttering arrangement	1	C&D	
4	Quality and curing control	1	D	
5	Maintenance and rehabilitation of structures	2	C&D	

Note: A - Executive involved in design and management aspect of the project in totality, B - Executive involved only in construction aspect of project, C - Personnel involved in construction activities at site, D - Personnel involved in preparation mixing and transportation of concrete.

- (ix) Sampling and strength of designed concrete mix
- (x) Acceptance criteria
- (xi) Load test for flexural members.

The tests and instruments used for evaluation of hardened concrete should also be discussed in the training of personnel. This is basically to diagnose the distress in concrete, if any, and these are:

- (i) ultrasound pulse velocity (UPV) test
- (ii) rebound hammer test
- (iii) pull out test
- (iv) cover meter
- (v) carbonation measurement techniques
- (vi) core tests
- (vii) X-ray diffractometer
- (viii) corrosion monitoring techniques
- (ix) concrete permeability measuring techniques
- (x) endoscopic equipment to measure crack width

Training of manpower

Each organisation has to identify the manpower directly or indirectly involved in the

concrete construction activities and should accordingly — based on the growth of department, from all angles — chalk out a programme for training of a particular group based on the hierarchy set up in any system. There is an urgent need to keep the system vibrant and dynamic which is compatible with regular training of manpower. People involved in different trades need to be identified along with the content of material being planned to be disseminated. A typical short-term training module is given in Table 1. Depending on the equipment of organisation, modifications can be made in the module.

The topics described in the module should be covered lucidly to refresh and update even while imparting training. Further, the test facility for the various raw material should also be covered. This will induce deeper thinking in the minds of executives for better results. In order to achieve good results, it is very essential that all facets of concrete as stated above are to be covered in the training programme in an exhaustive manner.

Training of unskilled workers

The construction industry in India employs a large workforce, mainly comprising of unskilled workers. NICMAR has estimated this workforce to be of the order of 10.66 million or so². Training of such cast unskilled personnel is a gigantic task. Some of the major problems in training these personnel are:

- (i) the number is vast
- (ii) level of education is low
- (iii) workforce is migratory
- (iv) employer not usually interested in training, as his margins are usually low
- (v) there is very little direct benefit to the worker for undergoing training.

In spite of these problems, it is essential to conduct regular training programmes for unskilled workers in the interest of achieving good quality.

Audio visual presentations would make a telling impact; lecture sessions coupled with demonstrations would reinforce the basics. Interactive workshops should be held rather than classroom training.

The language of communication also plays a very important role. The training given in the local language is effective and preferred by the work force.

Conclusion

Rigorous training of personnel in concrete construction will pay rich dividends if implemented in letter and spirit as per the codal provisions. Once the concept of quality is inculcated in the personnel involved in concrete production, placement, curing, etc, durable and quality structures will be easier to construct. In fact training of all personnel should become a pre-requisite in any project. Regular training will keep the staff abreast of the latest developments in the field and will certainly inspire them to produce good quality and durable concrete structures.

Reference

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