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Emerging materials and methods in CONCRETE CONSTRUCTION

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President's Message

Indian construction sector and its extended value chain (viz. material and equipment manufacturers, construction and service companies) constitute a very large activity contributing to around 10% of the GDP. But meaningful research in the field of Civil Engineering in general and concrete construction in particular is woefully lacking not only in the academic institutions but also in most of the research institutions. There is an inequitable underfunding of research activities in the field of civil and construction engineering.

Although there is no denying that fundamental research is important, the need of the hour is research that can be immediately applied to the field in view of the tremendous construction activity that is in the offing. Construction industry in India is still not an organized sector and very few companies, be it in the construction sector or material sector, are willing to invest in research.

According to a study by management consulting firm Zinnov, engineering R&D market in India is estimated to grow at a CAGR of 14 per cent to reach US$ 42 billion by 2020, but the share of R&D in the field of Civil or Construction Engineering is dismal at this point of time. The scenario may improve to a small extent since several MNCs in the fields of construction chemicals, equipments, etc., have shifted or are shifting their research and development (R&D) base to India. Recent example is the BASF Innovation Campus in Mumbai.

Only in a few top ranking educational institutes, Civil Engineering faculty is actively involved in R&D and consulting activities with relevance to industry and society. Although there are a few dedicated research laboratories established by the Union or State Governments, the interface between such institutions and engineers on the field is lacking. The importance given by the professional bodies to research is also not significant.

There is a dire need to conduct an independent evaluation of the research needs by a team of experts drawn from the industry, research institutions, educational institutions, professional bodies like ICI, IE(I), ACCE (I), etc., as well as bodies like CIDC, and BMTPC. It is also advisable to have some experts from outside India in the committee. The committee should have a time frame within which they should not only identify the gaps but chart out a road map for research in various areas with priorities for research teams at various levels. They should keep in mind the upcoming trends in methods and materials which are appropriate for India as well as sustainability. This would make the research activities to be focussed, the results quickly implementable and thus contribute to the Indian economy as well as create a win-win situation for the builders as well as the users of the various facilities.

Dr. M. R. Kalgal
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Dr.R.N.Krishna, Former Secretary General, ICI received 9th CIDC Vishwakarma Award 2017 under the category "Achievement Award for Technologist" on 7th March 2017 at New Delhi

Strength Development of Self-Curing Concrete with Respect to Age Using Bio Materials as Admixtures

R.Malathy and M. Geetha

1. Introduction

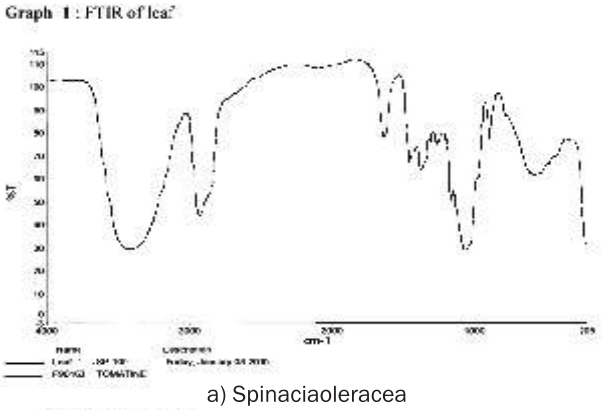
Over the last few decades, a great deal of interest has been shown in the study of making concrete better by the process of incorporating specifically engineered ingredients and simulating the methods of batching and mixing. Compared to traditional concrete, Modern types of concrete are highly advantageous in as much as they provide good workability in the fresh state, possess high strength and low permeability. However these types of concrete have also shown to be more sensitive to early age cracking than traditional concrete. High performance concrete, falling into the category of the so-called modern concrete, is essentially characterized by a cement matrix with low water/cement ratio (w/c), often including mineral additions like silica fume and the use of admixtures as super plasticizers[1]. One of the major problems with these mixtures is their tendency to undergo early age cracking. While this cracking may or may not compromise the compressive strengths of these concretes, it likely does compromise their long term durability. The phenomenon of early age cracking is complex and depends on thermal effects, autogenous strains and stresses, drying stress relaxation. Structural detailing and execution was dealt at length by Lura et al (2001)[2], Shah et al (1998)[3]. Curing is the critical period of fresh cement in the hardening process, in which concrete develops its fundamental characteristics under specific conditions[4]. A proper curing essentially involves the permanent availability of internal moisture to sustain the hydration reactions at moderate temperatures, and in the absence of external forces at early ages. High performance concrete is particularly sensible to curing problems and may undergo considerable early-age deformations and micro cracking development throughout the system, [4&5]. The dense microstructure of modern concrete rapidly develops capillary discontinuity in the still younger porous network. Thus the access of external water turns out unviable to assure continuous saturation of the total bulk volume [6]. The problem of shrinkage cracking within the plastic state of the cement matrix is mostly related to the rate of the water loss [7]. The latter consists of a water curing agent capable of enhancing cement hydration maintaining optimal curing conditions. Moreover, the selection of a specific curing method is highly dependent on the actual design constraints [8]. Therefore, the need to develop self-curing agents attracted several researchers [9]. The concept of using self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete [10&11]. As pointed out by Mather et al [12] and Bentz et al [13], earlier to the researches made on self curing concrete, several investigators asked the question whether there was a self-curing concrete. Concrete incorporating self-curing agents will represent a new trend in the concrete construction in the new millennium. When aiming for self curing concrete, light weight aggregates and chemical admixtures are gaining momentum towards research. From the earlier researches, eventhough there were more attempts made with light weight aggregates, the recent researches showed that there is a significant strength improvement with the incorporation of chemical admixture particularly Polyethelene Glycol (PEG) as self curing agent[14]. Polyethylene glycol is non-toxic, odorless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals. SCC with PEG-600 showed comparable strength improvement at 1% of PEG-600 was obtained at the end of 28 days[15]. Self-curing agent Polyethelene Glycol was more effective than light weight aggregates Leca. [16]. The optimum dosage of PEG-400 for maximum strength was observed to be 1%. It were observed that increase in dosage of PEG shows that also increases strength of SCC[17]. On the other hand, bio-materials like Calatropis Gigantea(CG) and Spinacea Oleracia (SO) are recently gaining attention since they have specific characteristic of holding water and releasing whenever it is needed as internal reservoirs like self-curing agents and their micro structural properties are resembling Polyethelene Glycol. From the previous studies it was found that these bio materials of small quantity of about less than 1% by weight of cement performing better than PEG and found to be cost effective and no need of water curing from the day one of concreting and achieving the required strength [18-22].

2. Materials and Mix Proportioning

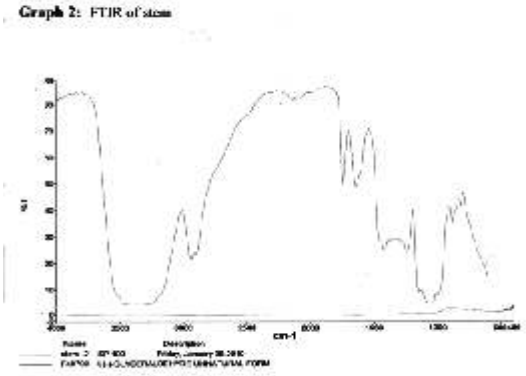
Ordinary Portland cement OPC 43 Grade confirming to IS: 8112 (1989)was used throughout the investigation. Locally available blue granite metal was used for preparation of concrete. Machines crushed locally available hard blue granite, well graded 20 mm and down size were used. Locally available river sand passing through 4.75mm sieve as per IS: 383 provisions confirming to zone II were used as fine aggregates.

Existing self-curing agent available in the market is Polyethylene glycol and its molecular weight is between 190-210. The specific gravity is 1.12-1.13. Hydroxyl value is 535-590 (mg KOH/g) and pH value is between 5 and 7.SpinaciaOleracea usually called as Palak greens in Tamil Nadu it is a type of green popularly consumed as food product. Curing agent was prepared from the filtrate extract of SpinaciaOleracea after it was ground well. Its specific gravity is 1.053 and pH value is 6.59. This extract base is added at the time of preparing concrete (i.e.) while adding water to the dry ingredients. Placing and compacting the fresh concrete is similar to the conventional concrete but without curing. The chemical structure shows that it contains (-O-) and (-OH) functional groups. As such the Spinaciaoleracea selected as internal curing agent possesses hydroxyl and ether functional group, which is also revealed in Fourier Transform Infra Red (FTIR) results[20].CalotropisGiganteais a waste plant which grows in fields and terrains without any special care or water. This milk is tried also as another curing agent. Its specific gravity is 0.9383 and pH value is found to be 5.17.Another curing agent used is Polyethylene glycol and its molecular weight is between 190-210. The specific gravity is 1.12-1.13. Hydroxyl value is 535-590 (mg KOH/g) and pH value is between 5 and 7. It is a liquid chemical available in the market and is just added to the concrete at the time of mixing water. Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H $(OCH_2CH_2)_nOH$, where n is the average number of repeating oxyethylene groups typically from 4 to about 180.The chemicals selected for lowering water loss from concrete were water-soluble polymers possessing either hydroxyl (-OH-) or ether (-O-) functional groups. As such the Spinaciaoleracea and Clatropis gigantean selected as internal curing agent possesses hydroxyl and ether functional group similar to that of Polyethelene Glycol, which is also revealed in Fourier Transform Infra Red (FTIR) results and shown in Figure 1.

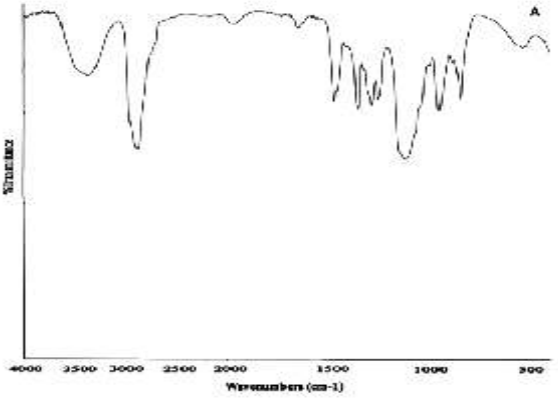
Extraction of Palak green essence and milk from Erukkam are shown in Figure 1. The mix proportioning as per IS 10262-2009 has been arrived and shown in Figure2.



a) Spinaciaoleracea



b) Calatropisgigantea



c) Polyethelene Glycol

Fig.1 FTIR test results

Fig.1 Extraction of Spinach (Palak green) and Calatropis Gigantea (Erukkammilk)

The dosage of self-curing agentsin liquid form was added with different water cement ratio of 0.54, 0.49 and 0.39 on M20 grade concrete and their workability and strength properties were studied. From the trial tests it was found

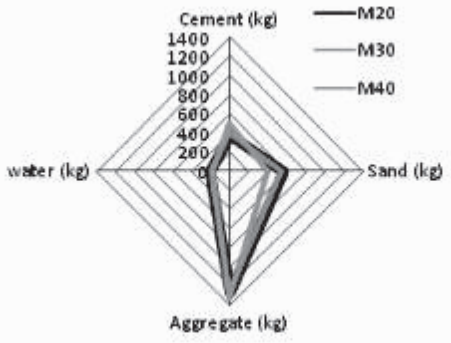


Fig.2 Mix proportioning of M20, M30 and M 40 concrete

that Spinaciaoleracea at 0.6% Calotroisgigantea at 0.24% and Polyethylene glycol at 0.3% by weight of cementadded to the mixes gave higher results. Hence those proportions were used for further study of strength and durability properties.

3. Experimental Program

On fresh concrete, slump test was carried out as per the IS : 1199 – 1959 specifications to measure the workability.For cube compression testing of concrete, 150mm cubes were used. For each trial mix combination, the cubes were tested at the age of 1 day, 3 days, 7 days, 14 days, 28 days and 56 days after casting and tested as per IS 516-1959 specifications .Cylinder compressive strength test, Splitting tensile strength test and Flexural strength test were also carried out as per same IS 516-1959 specifications. All the specimens were demoulded after 24 hours. The cube specimens for conventional concrete are water cured for 1 day, 3 days, 7 days, 14 days, 28 days and 56 days and tested in saturated condition, after wiping out the surface moisture. The specimens mixed with self-curing agents are air cured for 1 day, 3 days, 7 days, 14 days, 28 days and 56 days and tested for compressive strength. The specimens for split tensile strength and flexural strength are tested after 28 days of water curing (conventional concrete) or air curing (self-curing concrete)

4. Resuts and Discussion

4.1 Workability

The test results of workability of this present investigation are given in Figure 3. From the test results, it is observed that the workability of concrete mixes for all the combinations of the internal curing agents is 4 to 8% lower than the conventional concrete. Even though the slump is less for self-cured concrete when compared to conventional concrete, it is found that concrete with all the curing agents (SpinaciaOleracea, Polyethylene glycol and Calotropisgigantea) satisfy the standard of minimum slump 50mm. The slump loss in self cured concrete may be due to the reason that the quantity of water added to concrete at the time of mixing the concrete is the value after deducting the liquid quantity of self curing agent and also the water holding property of those admixtures.

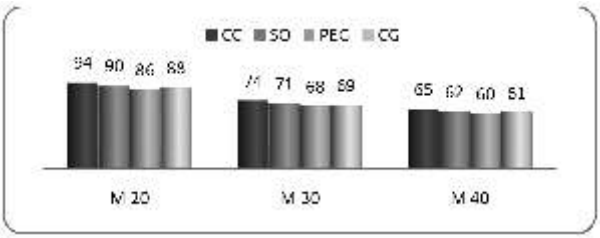


Fig. 3 Slump in mm for M20, M30 and M40 grade concrete

4.2 Compressive Strength

The cube compressive strength results of M 20, M 30 and M 40 grade mixes at 3 days, 7 days, 14 days, 21days, 28 days and 56 days with different curing agents were noted. The compressive strength results of M 20, M 30 and M 40 concrete at different ages with different curing agents are shown in Figure4. Table 1 to 3 depicts the compressive strength of different grades of concrete with respect to age.

Table 1 Compressive Strength of M20 Concrete with respect to age

Type of curing with respect to age	Compressive strength in MPa					
	3 days	7 days	14 days	21 days	28 days	56 days
Conventionally cured concrete	14.73	19.84	23.41	25.80	27.6	30.38
SipnaceaOleracea mixed self cured concrete	14.97	20.36	25.12	27.49	29.2	31.84
Poly ethelene glycol mixed self cured concrete	14.687	19.784	24.64	27.11	28.6	31.35
Calatropis Gigantea self cured concrete	14.81	20.67	22.71	25.69	27.9	30.39

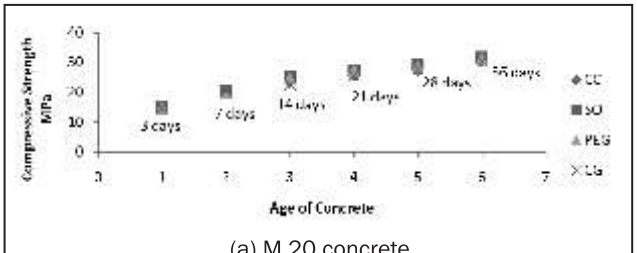
Table 2 Compressive Strength of M30 Concrete with respect to age

Type of curing with respect to age	Compressive strength in MPa					
	3 days	7 days	14 days	21 days	28 days	56 days
Conventionally cured concrete	19.21	29.4	29.79	32.936	39.2	41.35
Sipnacea Oleracea mixed self cured concrete	21.59	29.75	32.83	37.381	40.2	42.54
Poly ethelene glycol mixed self cured concrete	20.47	29.29	32.78	35.628	39.6	42.12
Calatropis Gigantea self cured concrete	19.64	27.41	28.29	32.169	39.3	40.48

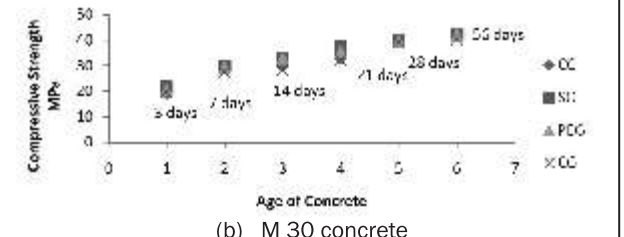
The compressive strength proves to be the highest with the curing agent Spinacia Oleracea, whereas the performance of Calotropis Gigantea, is almost equal to the conventional concrete. The performance of Polyethylene Glycol is lower than the Spinacia Oleracea

Table 3 Compressive Strength of M40 Concrete with respect to age

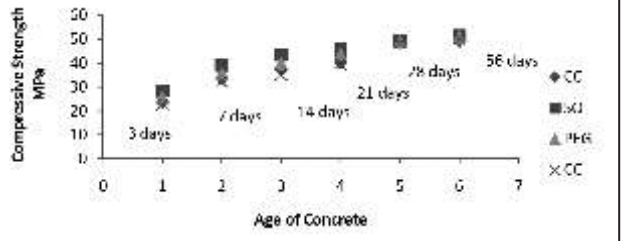
Type of curing with respect to age	Compressive strength in MPa					
	3 days	7 days	14 days	21 days	28 days	56 days
Conventionally cured concrete	23.64	33.60	37.35	40.34	48.50	49.25
SipnaceaOleracea mixed self cured concrete	28.38	39.29	43.64	45.74	49.60	51.40
Poly ethelene glycol mixed self cured concrete	25.72	35.32	39.89	43.72	48.90	50.94
CalatropisGiganteaself cured concrete	22.81	32.37	35.19	39.80	48.61	50.03



(a) M 20 concrete



(b) M 30 concrete



(c) M 40 concrete

Fig. 4.Cube Compressive strength Development with age

curing agent but higher than the conventional method. Spinacea Oleracea attaining the required strength earlier than conventionally cured concrete for example, in M 20 concrete, self-cured with Spinacia Oleracea, the strength of conventional concrete at 14 days is achieved in 11 days, 21 days strength is achieved in 16 days and 28 days strength is achieved in 22 days. Due to the strength achievement at earlier time, there are savings in the form of time, energy and money. Also the strength is higher when compared to the conventionally cured concrete.

5.3 Splitting Tensile Strength

The splitting tensile strength results of M 20, M 30 and M 40 grades of concrete at the age of 28 days were observed. The splitting tensile strength at the age of 28 days is plotted in the form of graphs and shown in Figure 5.

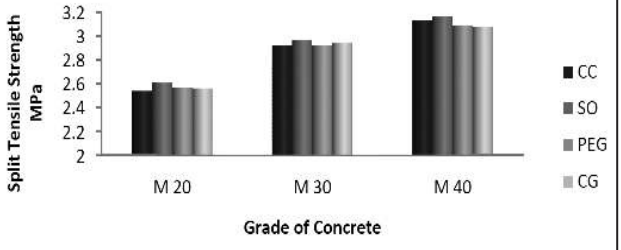


Fig.5 Splitting tensile strength at 28 days

It is seen that the splitting tensile strength for M 20 concrete was gradually increasing from 2.5 to 2.67MPa, indicating the lowest value of 2.5 for conventional concrete and the highest value of 2.67 for the concrete cube with Spinacia Oleracea with initial curing of one day were observed. For M30 and M40 concrete also splitting tensile strength is more for Spinace Oleracea added concrete when compare to conventionally cured concrete. Other two self-curing agents attained strength same as that of conventionally cured concrete in M30 grade and slightly less in M40 grade concrete.

5.4 Flexural Strength

The flexural strength results of M 20, M 30 and M 40 at the age of 28 days are plotted in the form of graph and shown in Figure 6. It is observed that the flexural strength of concrete was about 8 to 11% of cube compressive strength.

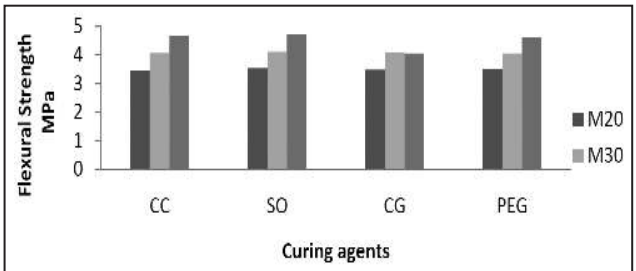


Fig.6 Flexural strength at 28 days

Conclusion

From the test results, the strength development of self-cured (air cured) concrete is more than the conventionally cured (water cured) concrete. Out of three self-curing agents namely SO, CG and PEG, SO is attaining higher strength at early ages and strength activity index is more than the conventionally cured concrete about 11 to 17%, for PEG it is less than 10% and for CG it is less than 5%. These bio materials are cost effective and eco friendly and hence can be tried in concrete road pavements without further maintenance of water curing.

Acknowledgment

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Modern Trends in Bridge Design & Construction

Vinay Gupta

A. General

Bridge technology has taken a giant step of innovations. There are numerous types of bridge technologies, used world over. Few of the latest bridge superstructures types include:

- Arch bridge
- Cast-in-situ RCC/PSC Solid Slab
- Cast-in-situ RCC/PSC Voided slab
- Cast-in-situ RCC/PSC Beam-Slab
- Precast RCC/PSC beams with in situ slab.
- Cast-in-situ RCC/PSC Box Girder
- Precast PSC Segmental Box Girder
- Cable supported bridges such as Cable Stayed/ Suspension/Extradosed Bridge

Segmental Box Girder types include Epoxy Jointed and Dry Joint Box Girder, Internally Prestressed and Externally Prestressed etc. All these technologies have their own intricacies. Specific issues include construction materials, construction technology, matching designs, specific quality control requirements etc. Now India has a code (IRC:SP:65) to cover up design and construction aspects of various types of Segmental Bridges.

Selection of structural form depends on various factors. These include:

- Aesthetics
- Functional need
- Speed of construction
- Economics
- Innovation etc.

B. Aesthetics

Present day constructions in urban environment demand aesthetically pleasing structures. Our mind set doesn't permit us to accept a structure that does not have adequate aesthetic appeal. For this reason, some of the bridge projects have been awarded to architects as the prime consultants and structural engineers have worked as associate consultants to the architects. One of the world famous bridge architects is Santiago Calatrava of Spain.

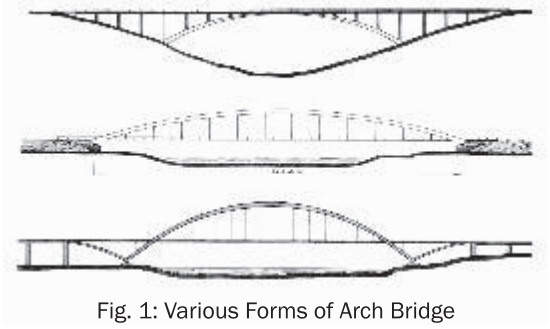

Fig. 1: Various Forms of Arch Bridge

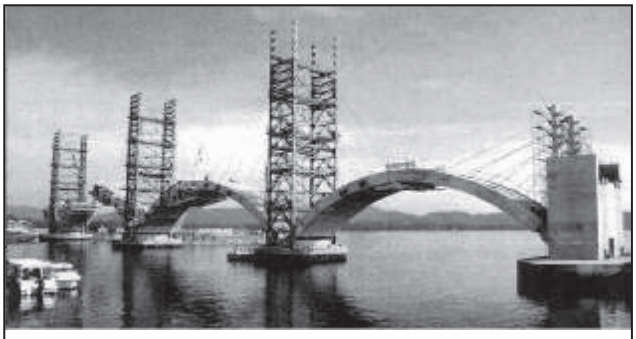

Fig. 2: Sungai Ding Ding Arch Bridge

Fig. 3: Jia Bridge, Himachal Pradesh

Fig. 4: Rottwel Bridge, Germany

Various forms of arch are depicted in fig 1. Sungai Ding Ding Arch Bridge in Malaysia (fig 2) was constructed using Stay Cantilevering Technique, using about 7m long cast-in-situ Arch Segments. Lateral thrust of adjoining arch ribs is majorly counter balanced by neighboring arch ribs. Fig 3 depicts 120m span Arch Bridge constructed by Stay Cantilevering Technique. The suspended deck slab was constructed using hanging formwork. Fig. 4 depicts another innovative technique in arch construction, wherein after constructing the arch rib by Stay Cantilevering Technique, the deck slab was constructed by Incremental Launching (also known as Push Launching) Technique.

Fig. 5: KLIA Bridges, Malaysia

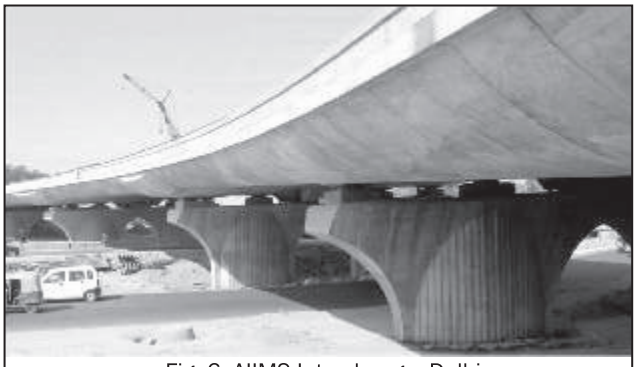

Fig. 6: AIIMS Interchange, Delhi

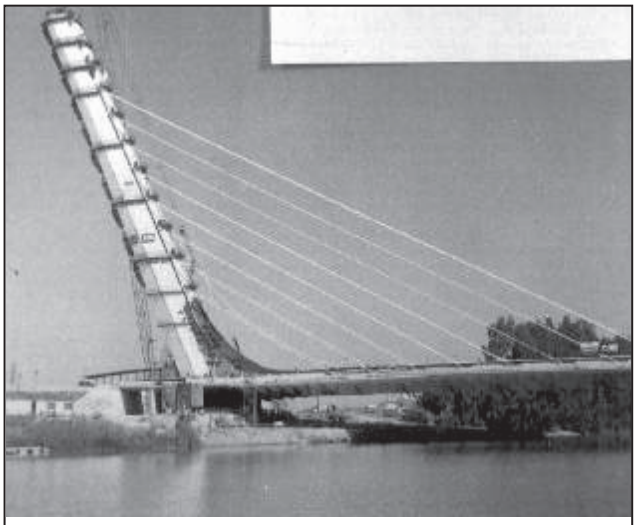

Fig. 7: Alamillo Cable Stayed Bridge, Spain

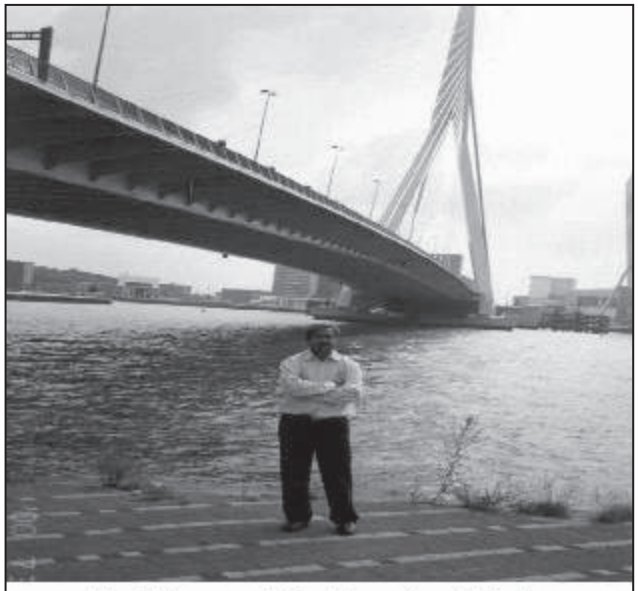

Fig. 8: Erasmus Bridge, Rotterdam, Holland

The bridges for Kuala Lampur International Airport, Malaysia depict elimination of pier cap and bearing between circular piers and voided slab deck. This Integral Bridge form has on unique aesthetic appeal, see fig 5. AIIMS Interchanged proved that a fat RCC deck can also look aesthetically pleasing, provided, the pier shapes are camouflaged with the deck, see fig. 6. Fig.7 depicts creation of the world famous

Architect Santiago Calatrava, wherein an unconventional cable stayed bridge has been made with inclined pylon and deck only on one side, to give it the shape of tail of an aircraft. The inclined Pylon was made in concrete to counter balance the weight of the steel deck. Similarly fig.8 depicts creation of Dutch architect Ben Van Berked wherein the unconventional Cable Stayed Bridge has been given the shape of a ship. Here, the steel Pylons have been provided with Back Stays anchored to the rocky substrata behind. The deck was made in steel and wearing course in Polyurethane to reduce the weight.

C. Functional

No bridge can be successful if it does not serve the intended purpose. The usual problem of traffic flow during construction in urban areas is solved by providing 3 span obligatory span module, wherein one and a quarter span from either side is first constructed on ground supported staging. At this time the traffic flows with the help of signalised junction, in the central span. Subsequently, central part is constructed. At this time the traffic flows using outer two spans to form an ovalised rotary, see fig 9. Fig 10 depicts the Millennium Bridge overt river Tyne in UK. The 105m span steel pedestrian bridge is lifted up by rotation through pivots mounted at base, so that boats/ships in the river can pass.

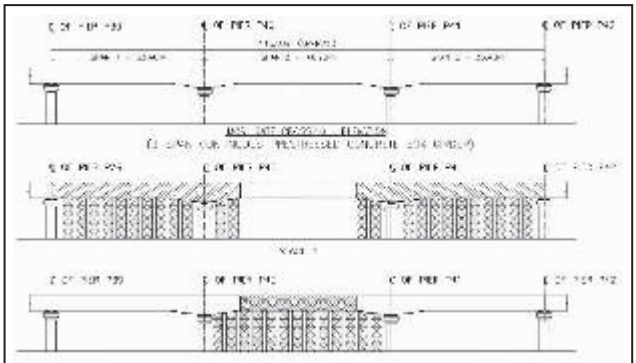

Fig. 9: Flyover Construction in Urban Areas

Fig. 10: Millennium Bridge, UK

Fig. 11: BBB Expressway, Bangkok

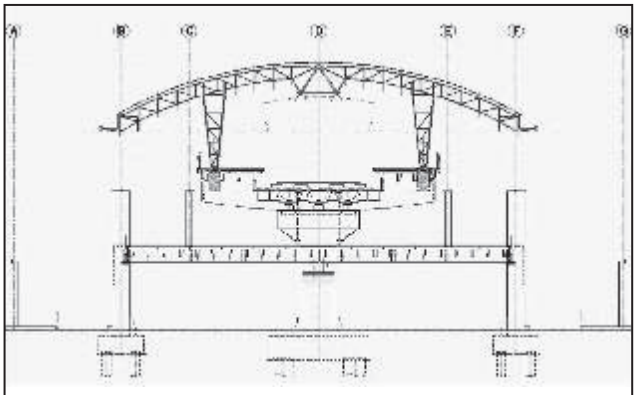

Fig. 12: Overhead Precast Stations for DMRC, Delhi

Fig 11 depicts an innovative BOT project of Thailand, wherein a 6 lane wide 57km long elevated expressway was constructed between 1995 and 1999, using Dry Jointed, Externally Prestressed, Precast Segmental box girder. The 27m wide segments comprise single cell box with concrete inclined struts. Fig 12 depicts an innovative solution to solve the problem of running traffic on the dual carriageway road below, while the construction of elevated station over the road is taken up. The concourse and platform levels comprise Precast Post Tensioned L-beams in transverse direction, Precast Pretensioned Double Ts in longitudinal direction, topped with cast-in-situ deck slab. The track level comprises 3 nos parallel Precast Pretensioned U- beams topped with RCC deck slab to carry up track and down track, finally the roof in steel.

D. Speed

In todays world of high speed computers, high speed of construction has become imperative.

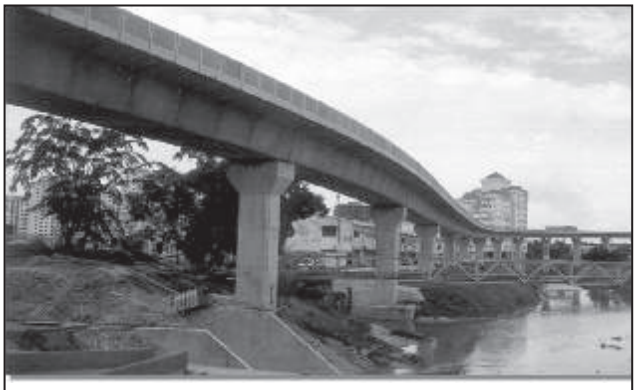

Fig. 13: Light Rail Transit system 2, Malaysia

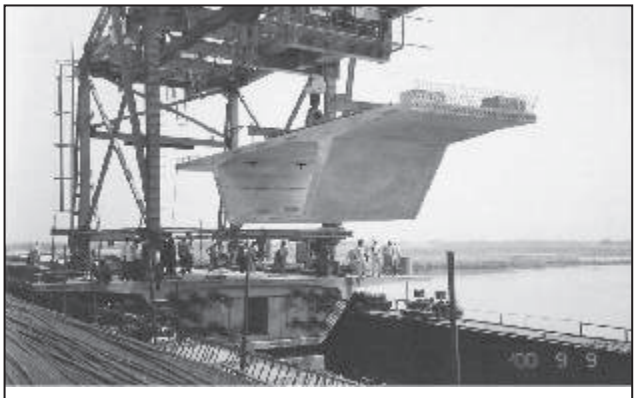

Fig. 14: Delhi-Noida Bridge

26 km long Light Rail Transit (LRT), Kualalumpur, Malaysia was constructed in aggregated period of about 2 years. This was made possible by the use of Dry Joint, Precast Segmental, Externally Prestressed box girder superstructure, see fig. 13. Similarly, fig. 14 depicts Delhi-

Fig. 15: Bangalore-Hosur Expressway

Fig. 16: Dubai Metro

Noida Bridge, which incorporates 16m wide, Epoxy Jointed, Externally Prestressed box girder superstructure, continuous for its complete length of 552m. Fig. 15 depicts the 10km long elevated viaduct of Bangalore-Hosur Expressway, that incorporates Epoxy Jointed, Internally Prestressed, Precast Segmental twin cell box girder launched using wireless remote controlled Launching Girder. This way the construction speed of superstructure of as fast as 3.5 days per span could be achieved. Fig. 16 depicts Dubai Metro viaducts, wherein apart from using Precast segmental box girder superstructure, the pier caps incorporated Precast Concrete Shell and they were transversely prestressed to achieve a sleek structure.

E. Economics

Economics is an integral part of any design planning of a project, especially in a developing country like India. As a matter of fact, a very careful selection of technology needs to be made, that oplimises between speed and cost of a project. This oplimisation depends upon the type of project. In a BOT project, where tolls have to be collected, an over all economy may necessitate faster construction, which may not be the cheapest structure.

Some times, cost of formwork may be exorbitantly high for a tall structure. Fig 17 depicts construction of bridges for Jammu-Udhampur Rail Link (JURL), wherein the 71.4m+102m+71.4m span superstructure has been constructed using cast-in-situ Balanced Cantilever Construction Technique, not requiring any supports from the ground. It may be noted here that the piers are as tall as 70m, almost equaling the height of Qutub Minar. Similarly, fig 18 depicts construction of 40 nos. of 30m Span Precast PSC Box Girders of a viaduct of JURL, wherein complete 30m span box girders, each weighing 400T were launched, based on the consideration of speed and economy.

Fig. 17: Balanced Cantilever Construction

Fig. 18: Launching of 30m Span Precast PSC Box Girder

F. Innovations

Lastly, any country would be interested in establishing records. When it comes to records in the field of bridges, it is the largest span that matters. Largest span is created with the help of cable support technology. Cable Stayed bridge technology, has given spans over 1000m and Suspension bridge technology has given spans in the range of 2000m. The basic difference between the two technologies is that in a Cable Stayed Bridge, each cable is anchored to the Pylon and it supports its share of length/load of the superstructure, see fig 19. Since, inclination of each cable is important, Pylon height tends to be higher. Whereas, in the case of a Suspension bridge, two main cables, acting as catenary, are supported on the

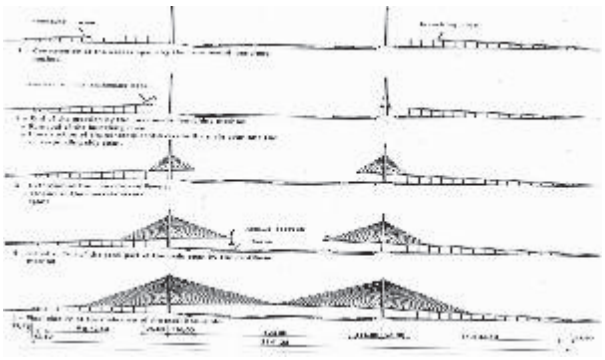

Fig. 19: Cable Stayed Bridge

Fig. 20: Suspension Bridge

Pylons and the deck is suspended through auxiliary vertical cable hangers, see fig 20. The required Pylon height is comparatively smaller, for obvious reasons.

G. Conclusions

A carefully selected bridge technology leads to desired results. The desired result may be aesthetics, functionality, speed, economics or anything else. Some of the above examples have helped designers, constructors, owners etc to have a structure suiting theirs needs. In addition to the above issues, another major issues that crops up is Constructability under the given circumstances, which also needs careful considerations.

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Launching System
(A Case Study)

K Ramesh

Preamble: The extension of MRTS – Phase – II from Velachery to St. Thomas Mount for MTP Railways, Chennai constituting of proposed elevated superstructure of PSC box girders, "U" type PSC deck slabs and other RCC works, protective coating to PSC girders over already constructed substructure between ch.19.750 and ch.23.350- a stretch of 3.6 Km for up and down lines which valued up to 77.60 Cr between the years 2009 and 2012.

The project is the extension of the already existing railway track of MTP Railways. The work was commenced initially by casting in position PSC girders approach spans and some of the 22.5mtr spans in position using cup lock staging, trusses and structural supports.

Subsequently when sufficient fronts i.e sub structure were made available by the Railways, the need for launching girder was initiated and it was decided to manufacture launching girder with a new technology to launch the PSC box girders simultaneously for both the tracks.

Client : MTP Railways, Chennai
Contract Value : Rs. 77.60 Cr-2009 to 2012

Scope of the Work : Casting of PSC superstructure from Ch. 19.750 to Ch. 23.350, 3.6 Km for up and down lines **(Twin tracks)**

Salient Features:

1) Spans:

a) 12.85 Mtr Span 'U' type (semi through) PSC slabs	- 17 Spans	–	34 Nos.
b) 13.5 Mtr PSC Box Girders	- 2 Spans	–	4 Nos.
c) 18 Mtr. PSC Box Girders	- 6 Spans	–	12 Nos.
d) 20 Mtr. PSC Box Girders	- 2 spans	–	4 Nos.
e) 22.5 Mtr. PSC Box Girders	- 125 Spans	–	250 Nos.
f) 27.00 Mtr. PSC Box Girders	- 3 Spans	–	6 Nos.
g) 40 Mtr. PSC Box Girders	- 3 Spans	–	6 Nos.

2) Concrete quantity : 23,482 Cum.
3) HTS 12.7mm dia : 632 MT
4) Reinforcement : 3,217 M

Launching Girder:

1) Design: The design part of the launching girder was entrusted to Sri. B N Sreedhara, an eminent structural steel designer from Bangalore. He was assisted by Dr. Sanath Kumar Rajamane.

Assembly of Launching Girder in Progress

2) The Salient Features:

The launching girder consists of the following.
a) Portal Frame (Self propelled)
b) Main Girder – 53 Mtr built up section made of plates
c) Front end column
d) Counter weight at the rear with steel frame and concrete blocks
e) Launching Trolleys – Mobile launching trolleys mounted on the top of the launching girder with hollow strand jacks imported from Spain 85 T capacity 2 Nos. mounted on each trolley (self propelled).

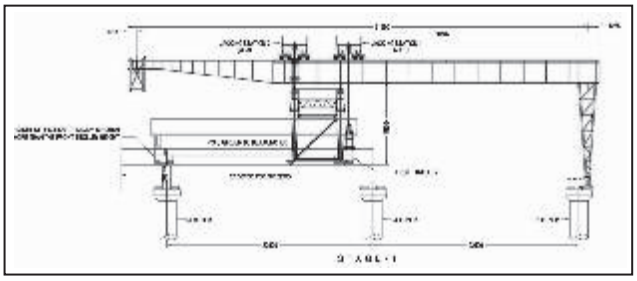
In addition to the above 2 Nos. of 125T capacity goliath crane (self propelled) with 4 Nos. of 100T jacks jack mounted on each goliath were also fabricated.

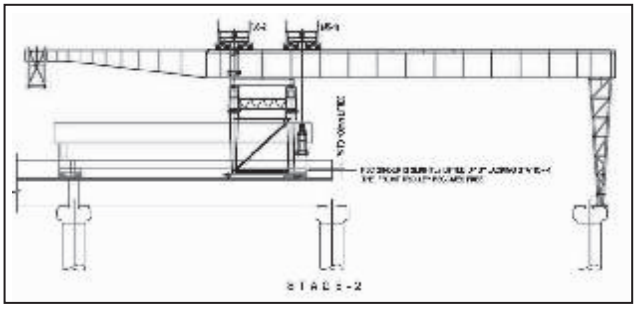
Two transfer trolleys, one self propelled were also manufactured.

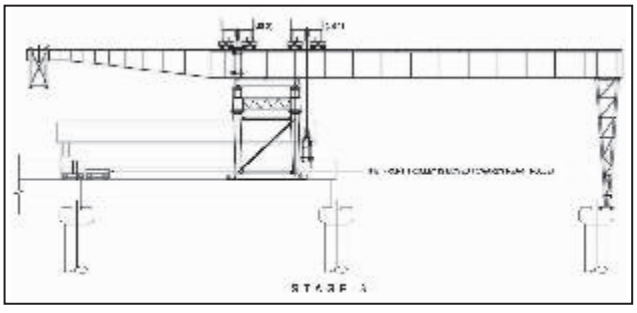
The launching girder was fabricated at site including the end columns. The under garage of the portal along launching trolleys and the transfer trolleys were

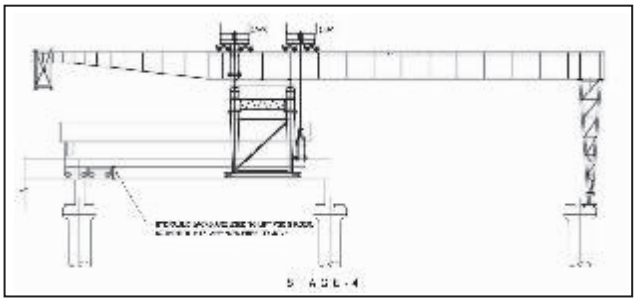
manufactured in a factory at Chennai. The goliath cranes were manufactured at Pune.

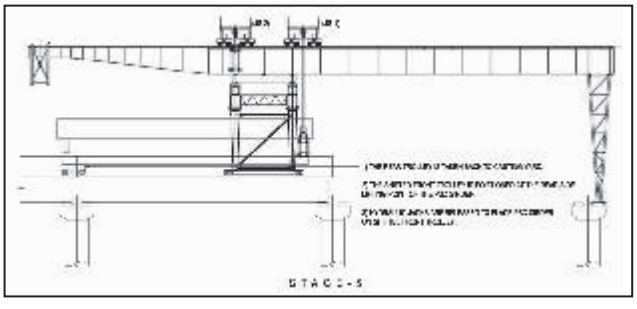
3) Rails: 50 MT
4) Strands: 15.2mm dia 7 Nos. each lifting point
5) Sequence of operation:
   a) A schematic diagram showing the various stages of launching can be seen below.

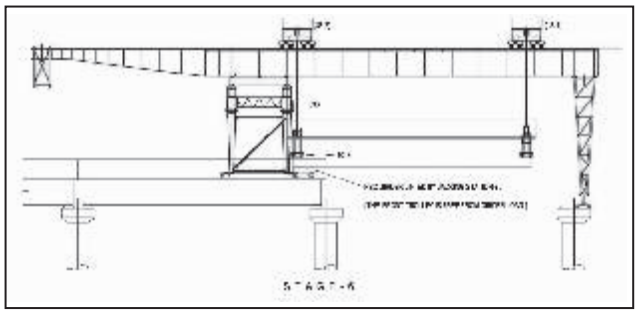


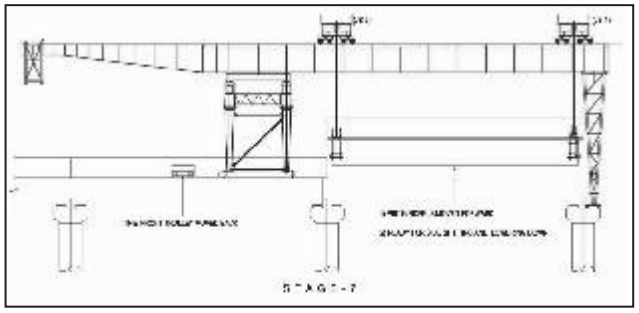


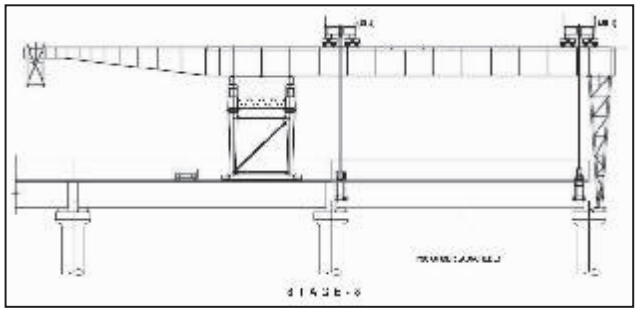












b) The girders were cast centrally over the launched spans. On completion of curing time, the girders were lifted by the goliath cranes and marched approximately 1 to 2 Kms and fed to the transfer trolleys. The front trolley which was self propelled, moved the box girder up to the portal (see stage.1) for hooking to the launching girder trolley no.1 subsequently the 2nd launching trolley was moved to the jacking station two as the jacking station one moves over the launching girder (stage stage.6)

Goliath Cranes Marching with the Box Girder

There after the girder under suspension (hanging) was moved over the span where it had to be placed and on reaching near the end column the girder was lowered and

launching girder alone along with the end column was side shifted using Teflon pads and horizontal jacks.

The unique feature of this launching system is the girder was not side shifted which is the normal practice after placing the girder over pier caps and then pushed to position with large frictional resistance which is time consuming.

Casting yard with Goliath Cranes on the background

In this case the launching girder along with the end column (portal being stationary and supported with screw jacks there by releasing the load from under garage) was side shifted using 4 Nos. of horizontal jacks.

The entire operation of leading and launching was completed within 2 days.

Launching of Box Girder 200 T

The auto launching was facilitated by the under garage of the portal propelled by motor. The capacity of the launching girder of 230 T and can launch up to span on 22.5 Mtr. This can be suitably augmented with minor modifications up to 250 T and 30Mtr span.

By adopting this launching system the progress had increased by 40% .

In these days of enormous labour shortage this highly mechanized launching system was highly advantageous considering the cost and time over run .

Auto Launching in Progress

This method of launching with usage of strand jacks and side shifting the launching girder itself has been successfully done for the first time in India.

I was associated with the construction firm Vijay Nirman Company, Pvt Ltd., for Pre-stressed concrete technology transfer, launching systems concept, design coordination, fabrication, assembly and launching girders.

This system was well appreciated by MTP railways.

A Long view of the Launching Girder

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Effect of Alkaline Activator to Binder Ratio on the Compressive Strength of Ternary Blend Geopolymer Concrete

N. Ganesan, P.V. Indira and V. Sathish Kumar

Abstract

The primary motive for the development of inorganic Geopolymer in civil engineering is to find an alternative for Portland cement. Production of Portland cement liberates an equal amount of Carbon dioxide into the atmosphere which leads to the Global warming. It is necessary to reduce the discharge of carbon dioxide by identifying an alternate for Portland cement. This paper describes the utilisation of silica and alumina rich geo-based material like fly ash (FA), Metakaolin (MK), Ground Granulated Blast Furnace Slag (GGBS) as a ternary blend source material in Geopolymer concrete. The aspects that govern compressive strength like the proportion of source material and Alkaline activator to binder ratio (AL/B) were investigated. The Geopolymer concrete samples were oven cured at 60C (140F) for 24 hours and kept at room temperature before testing. The compressive strength of the Ternary blended Geopolymer concrete cubes were measured after 7 days and 28 days. The result reveals that compressive strength of ternary blend containing 60% FA, 25% GGBS and 15% MK with Alkaline activator to binder ratio of 0.3 produces the maximum strength of 63.74MPa at 28 days.

1.0 Introduction

Cement is the only factory manufactured product used extensively in concrete. Portland cement is not considered sustainable due to energy intensive process and high CO_2 generation [27]. Despite the fact that use of Portland cement is still unavoidable, developing an alternate binder for concrete for a sustainable environment is necessary. Prof.Glukhovsky first introduced Geopolymers during the 1950s and named it as 'Soil Cement' [30]. Prof.Davidovits commenced the similar work in the 1970s by calling these materials as 'Geopolymers.'

Keywords: Ternary Blend; Compressive Strength; scanning electron microscope; Geopolymer concrete; Alkaline activators.

Geopolymer concrete (GPC) results from the reaction of source materials that is rich in Silica and alumina with alkaline liquid. High early strength gain is a characteristic of GPC when heat cured or steam cured [23]. Recent studies on fly ash based GPC emerged as a promising choice for cement in the construction field. The properties of GPC are subjected to the type of source material and the type of alkaline liquid used. In India, more than 100 million tonnes of fly ash is generated, and only 20-25% is utilized efficiently [17]. CO_2 emissions by GGBS production is only 3-5% when comparing with the portland cement production. MK is Eco-friendly since the manufacturing process requires very low calcining temperature and releases 80-90% less CO_2 than the Portland cement. Hence utilizing these industrial by-products efficiently will result in the sustainable green environment.

In the present paper, the effect of Alkaline activator to binder ratio with different proportions of the source material (FA, GGBS & MK) were studied. The GPC cubes were cast with three different Alkaline activator to binder ratios of 0.3, 0.35 and 0.4. The molarity of NaOH was kept constant as 14 and also the ratio of Sodium Silicate to sodium hydroxide as 2.5. It was reported that the use of sodium silicate to sodium hydroxide ratio of 2.5 gave the maximum compressive strength of 56.8 MPa, whereas the higher ratio of 0.4 produced a low strength of 17.3MPa [12].

2.0 Research Significance

Geopolymer concrete possess greater advantages than the ordinary cement concrete. Many industrial by-products such as fly ash, GGBS, Slag, Clay, etc., may pollute the environment and these industrial by-products can be effectively used in the production of GPC. It has high resistance to Heat, Cold and chemical attack. The properties of fly ash based GPC was already reported in numerous research studies. This research focuses on ternary binders in GPC and to optimise the local waste material. Depolymerised aluminous and siliceous structures with raw materials in FA, GGBS & MK will have

greater dissolution rates under high alkalinity conditions. Therefore, synthesis of these materials will enhance the properties like strength and durability in GPC.

3.0 Materials

Fly ash: Low-calcium Class F fly ash confirming to the requirement as per IS 3812:2003 [14] collected from Mettur Thermal Power Station, Tamil Nadu was used as a primary Binder for the GPC. It is mainly composed of Al_2O_3 (27.75%) and SiO_2 (55.36%). It is Dark grey in colour and has a specific gravity of 2.30. The average size of the particle is 75 microns. Figure 1(a) shows the SEM image of the Fly ash having fine and spherical shape particles.

GGBS: GGBS, confirming to BS 6699:1992 [5] was also used as a binder. It mainly consists of 77.36% of combined CaO, MgO and SiO_2. The colour of GGBS is off-white and has a specific gravity of 2.88. The mean size of the particle is 30 microns. Figure 1(b) shows the SEM image of the GGBS having an irregular particle size larger than MK.

Metakaolin: MK with a specific gravity of 2.56 and has greater than 92% of combined SiO_2, Al_2O_3 and Fe_2O_3 elements was also added in the ternary blend. The MK has an appearance Creamish Ivory powder. The average particle size is 2-3 microns. Figure 1(c) shows the SEM image of the MK. The MK particles are irregular in shape.

Ternary Blend: Ternary blend with different proportions of FA, GGBS and MK were used as binder for the GPC. Figure 1(d) shows the SEM image of the ternary blend used in this research. It may be noted from the SEM image that the FA, GGBS and MK can be easily blend together without affecting the morphology of the individual binder and can produce a denser material.

Fine aggregate: Locally available Crushed stone (M-Sand) passing through 4.75 mm IS sieve confirming to Zone II of IS 383:1970 (reaffirmed 2002) was used. The specific gravity and the fineness modulus of the fine aggregate were 2.39 and 2.92 respectively.

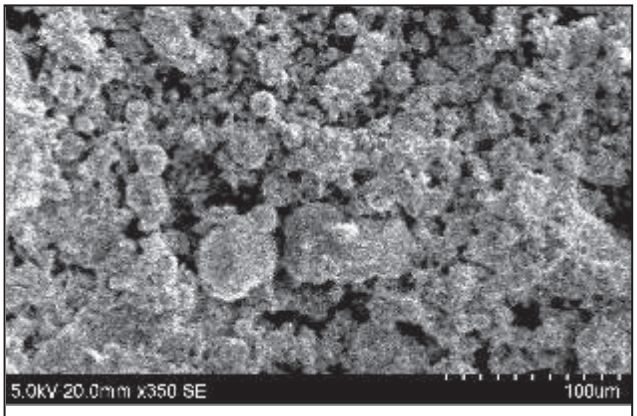
Coarse aggregate: The maximum size of the coarse aggregate used was 12.5 mm with a specific gravity and a fineness modulus of 2.78 and 6.92 respectively.

Alkaline activator: Sodium Silicate and Sodium Hydroxide was used as an Alkaline liquid. The Sodium Hydroxide was in pellets form with 99% purity. The sodium silicate solution consists 8% of Na_2O, 28% of SiO_2 and 64% of water by mass.

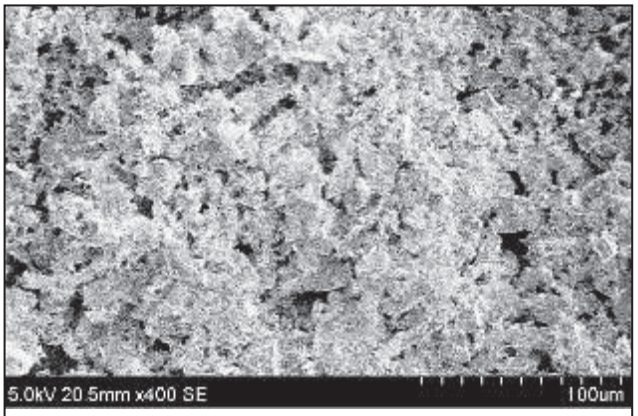
Superplasticizer: Conplast SP 430 a naphthalene-based superplasticizer with a specific gravity of 1.2 was used for the better workability of the concrete.

4.0 Mixing of Concrete

The molarity of NaOH and the ratio of Na_2SiO_3 to NaOH was maintained constant in all the mix proportions of the concrete. In this work, various Alkaline activator to binder ratio (0.3, 0.35 and 0.4) were used [2]. The mixture proportions of Geopolymer concrete arrived at in this study is based on the recommendations given by B.V.Rangan [22]. The ternary binders were mixed based on volume proportion. Seven combinations of binders were made. The fly ash was replaced with GGBS and MK by 35%, 30%, 25%,20%,15%, 10%, 5% and 5%, 10%, 15%, 20%, 25%, 30%, 35% respectively. Superplasticizer was added to the mix by 1.5% to the weight of the binder. Water to binder ratio was fixed as 0.2 for all the mix proportions for better workability. To prepare 14M concentration of NaOH, 560 grams (Molarity x molecular weight) of NaOH pellets was dissolved in water and makeup to 1 litre. The NaOH thus prepared was mixed with Na_2SiO_3 solution one day before mixing the concrete to ensure the reactivity of the solution. A summary of Mix proportions is given in Table 1.



(a)



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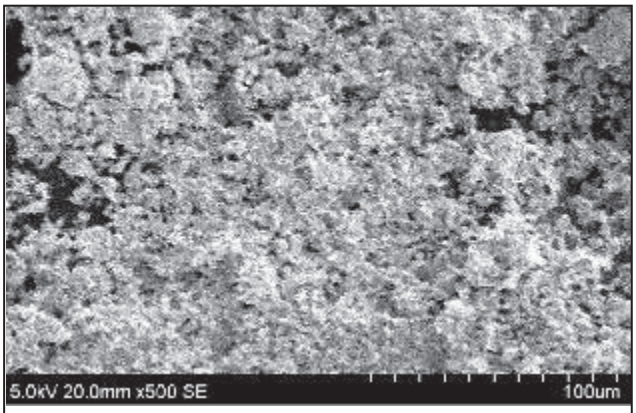
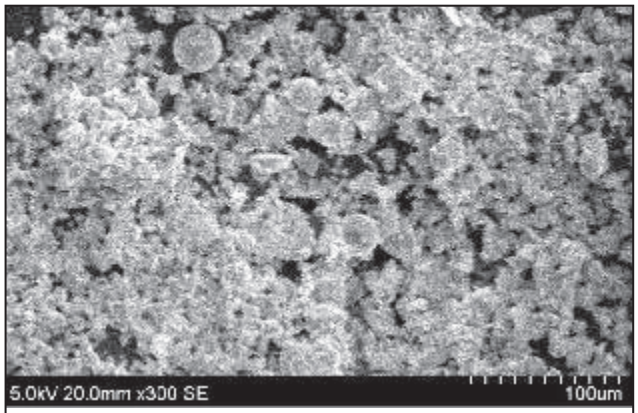


(c)



(d)

Fig. 1. Scanning Electron Microscopy (SEM) images of (a) Fly ash; (b) GGBS; (C) Metakaolin; (d) Ternary Blend

Table 1. GPC Mixture Proportions adopted in this study

Mix proportion (%)	Alkaline activator to binder	Fly ash	GGBS	MK	Aggregates		NaOH Solution	Na_2SiO_3	SP	Water
					CA	FA				
		Kg/m^3								
F60-G35-M05	0.30	234.15	169.25	21.21	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	225.48	162.98	20.42	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	217.43	157.16	19.69	1293.60	554.40	45.06	112.65	5.91	84.92
F60-G30-M10	0.30	235.80	146.10	42.72	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	227.07	140.68	41.14	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	218.96	135.66	39.67	1293.60	554.40	45.06	112.65	5.91	84.92
F60-G25-M15	0.30	237.47	122.61	64.53	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	228.68	118.07	62.14	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	220.51	113.85	59.92	1293.60	554.40	45.06	112.65	5.91	84.92
F60-G20-M20	0.30	239.17	98.79	86.66	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	230.31	95.13	83.45	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	222.09	91.73	80.47	1293.60	554.40	45.06	112.65	5.91	84.92
F60-G15-M25	0.30	240.89	74.62	109.10	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	231.97	71.86	105.06	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	223.69	69.29	101.31	1293.60	554.40	45.06	112.65	5.91	84.92
F60-G10-M30	0.30	242.64	50.11	131.87	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	233.65	48.25	126.98	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	225.31	46.53	122.45	1293.60	554.40	45.06	112.65	5.91	84.92
F60-G05-M35	0.30	244.41	25.24	154.97	1293.60	554.40	36.40	90.99	6.37	84.92
	0.35	235.36	24.30	149.23	1293.60	554.40	40.89	102.22	6.13	84.92
	0.40	226.95	23.44	143.90	1293.60	554.40	45.06	112.65	5.91	84.92

5.0 Casting and Curing

A total number of 126 concrete cubes of size 100mm were cast. 3 cubes were tested for compressive strength after 7days and 28days in each proportion. The materials were mixed in a horizontal concrete mixer shown in Figure 2 (a). The GPC was then placed in the cube mould and vibrated using table vibrator. The cube moulds were covered using polythene film to lower the water loss during curing is shown in Figure 2 (b). The specimens were cured inside the hot air oven at 60C for 24 hours. After curing, the moulds were removed and the samples were left to cool to room temperature until testing.

(a) (b)

Fig. 2. (a) Horizontal concrete mixture
(b) GPC cube moulds covered with polythene film

Figure 3. GPC cubes in Hot air oven for curing

6.0 Testing

The GPC samples were tested for compressive strength in a Compression testing machine. The mean compressive strength of three cubes was reported for each ratio. The GPC cube density was also reported as a mean of three cubes for each mix proportion. The compressive strength and density of GPC cubes having different alkaline activator/binder ratios and different proportions of ternary source material are tabulated in Table 2.

Table 2. Compressive strength results for various GPC mixtures

Mix proportion (%)	Alkaline Activator to binder	Average compressive strength (N/mm²)		Density (kg/m³)
		7 days	28 days	28 days
F60-G35-M05	0.30	50.17	56.87	2485
	0.35	49.03	57.04	2475
	0.40	43.97	54.42	2460
F60-G30-M10	0.30	52.46	58.82	2480
	0.35	51.32	58.34	2470
	0.40	49.52	59.82	2456
F60-G25-M15	0.30	59.33	63.74	2513
	0.35	54.43	63.09	2452
	0.40	47.89	56.88	2390
F60-G20-M20	0.30	45.60	50.50	2465
	0.35	42.49	48.87	2428
	0.40	38.25	45.27	2436
F60-G15-M25	0.30	31.54	36.93	2438
	0.35	43.80	51.98	2433
	0.40	32.19	40.86	2400
F60-G10-M30	0.30	30.24	34.16	2480
	0.35	29.91	36.61	2462
	0.40	23.70	31.54	2455
F60-G05-M35	0.30	23.21	27.14	2495
	0.35	17.33	22.55	2472
	0.40	14.38	19.45	2405

7.0 Results and Discussion

The Alkaline activator to binder ratio and proportion of the ternary binder affects the compressive strength of GPC. The maximum compressive strength of the GPC was found to be 63.74 MPa which contains 60% FA, 25% GGBS and 15% MK with an Alkaline activator to binder ratio of 0.30 on 28th day of testing. Almost 80-90% of the compressive strength of GPC was achieved in 7 days. The lowest compressive strength was found to be 14.38 MPa which contains 60% FA, 05% GGBS and 35% MK with an Alkaline activator to binder ratio of 0.40. This could be due to the activator content does not provide sufficient alkalinity for the dissolution of metakaolin to produce a highly stable co-existing Geopolymer gel [4]. Figure 2 shows the effect of MK and GGBS on compressive strength of GPC for various Alkaline activator to binder

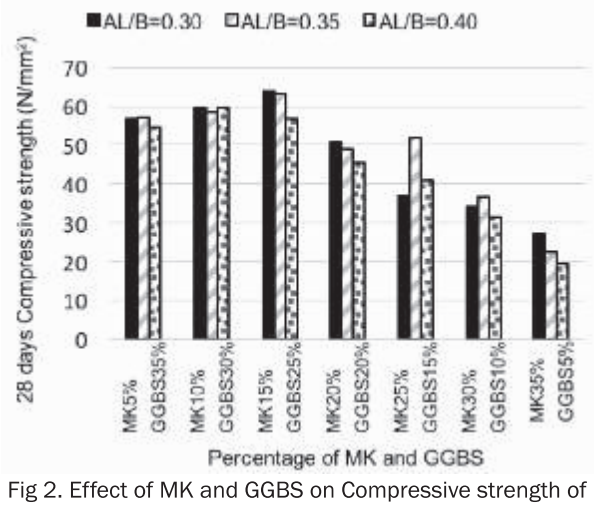


Fig 2. Effect of MK and GGBS on Compressive strength of GPC for various Alkaline activator to binder (AL/B) ratio

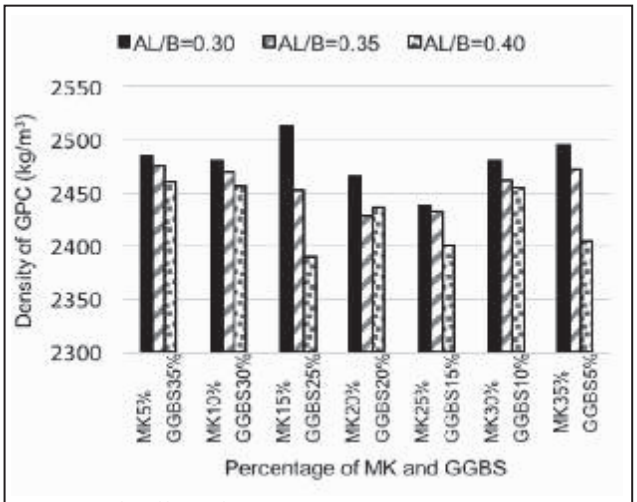


Fig. 3. Effect of Alkaline activator to binder (AL/B) ratio on Density of GPC

ratio. It may be noted that decrease in alkaline activator content improves the compressive strength of the GPC because lower alkaline content results in denser concrete. Figure 3 shows the effect of Alkaline activator to binder ratio on the density of concrete. It may be seen that he density of the concrete samples was in the range of 2400 to 2500 kg/m^3. Higher the binder content in the mixture results in denser concrete.

8.0 Conclusions

This study on the optimisation of FA, GGBS and MK as a binder in the development of GPC produced significant conclusions. Based on the test results, the following conclusions may be derived:

i. The addition of GGBS up to 25%, MK up to 15% with 60% FA resulted in maximum compressive strength among the other.
ii. The compressive strength of GPC increased with the addition MK up to 15%, while further replacement of MK resulted in degradation of strength.
iii. The maximum compressive strength was achieved with Alkaline activator to binder ratio of 3.0. The Increase in Alkaline activator to binder ratio decreases the compressive strength.
iv. It was observed that 80-90% of 28th day compressive strength of ternary blended GPC was achieved within 7 days.
v. The density of the GPC concrete varies from 2400 -2500 kg/m^3. It was also noted that the increase in Alkaline activator to binder ratio decreases the density of the concrete in most of the specimens.
vi. It can also be concluded that combined FA, GGBS and MK can be utilised effectively for the development of Eco-friendly Geopolymer concrete.

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CONCRETE CONSTRUCTION

Date : 29th April 2017 **Venue: Green Park Hotel, Arcot Road, Vadapalani, Chennai**

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News From Centres

ICI-Bengaluru Centre

Concrete Panorama & Deminar 2017

Indian Concrete Institute – Bengaluru Centre conducted its annual flagship event "Concrete Panorama & Deminar 2017" on 1st & 2nd March 2017 at NIMHANS Convention Centre, Bengaluru. The 8th Edition of Concrete Panorama & Deminar was a two-day International Event and the theme of the year was "Myriad Manifestations of Concrete" showcasing the latest developments in India and abroad pertaining to the World of Concrete.

The Deminar is a unique feature of "Concrete Panorama", wherein live demonstrations of application of Concrete were carried out, simulating field conditions, which was beamed live to the audience in the seminar hall. In addition, the event also includes an exhibition, portraying various materials and technologies pertaining to the field of concrete.

Dr. Justin Kim, General Manager, Fosroc International Ltd., was the Chief Guest for the Inaugural function and the function was presided by Dr. Manamohan R. Kalgal, President, Indian Concrete Institute. The Guest of Honours for the function were Er. Vivek Naik, President-Elect, ICI; Er.K.Jayasankar, Vice-President (South), ICI; Er.M.Ravishankar, G.C.Member, ICI; and Er.R.Radhakrishnan, Secretary General, ICI. The Welcome Address was given by Dr. Aswath M.U., Chairman, ICI-Bengaluru Centre. Dr. Manamohan R. Kalgal gave the Presidential Address. Vote of thanks was proposed by Er. Kaushik Hajra, Secretary, ICI-Bengaluru Centre.

There were about 920 delegates including Applicators, Structural Consultants, Building Material Manufacturers, Decision Makers from Govt. Agencies such as BBMP, Bangalore Metro, Bangalore Development Authority, CPWD, PWD, BWSSB, KRDCL, KUIDFC, etc., across India and abroad. There were 38 Exhibitors in total.

Dignitaries Lighting the Lamp

Dignitaries on the Dais

Souvenir Release

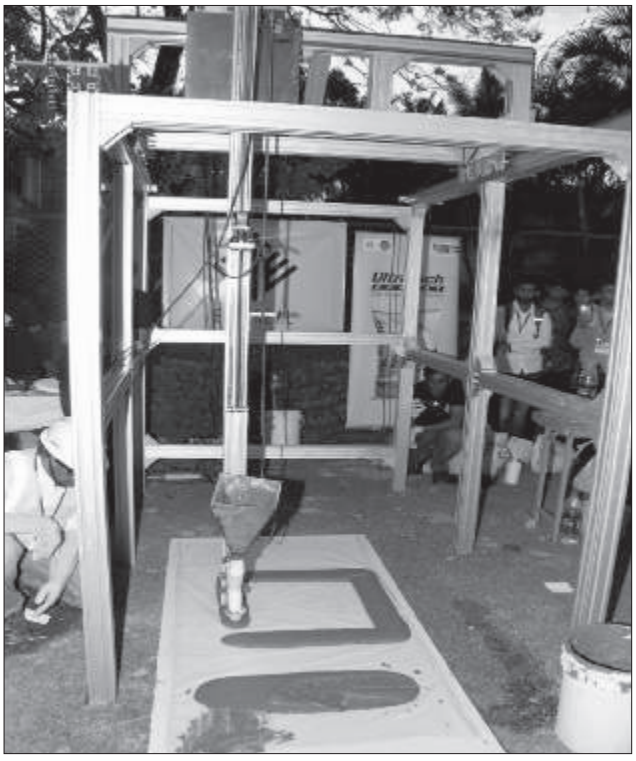
Felicitation to Dr. Justin Kim

Welcome Address by
Dr. M.U. Aswath

Dr. Justin Kim

Inauguration of Exhibition

Demonstration of an Ultra-High Strength Concrete
by Er. Prakash Srinivasan & Team
M/s. RMC ReadyMix (India).



Demonstration of 3D Printing of Concrete

"Best Student Model Making Competition" - 1st Prize was bagged by B.M.S. College of Engineering, Bengaluru and the 2nd Prize was won by Sri Jagadguru Chandrasekaranatha Swamiji Institute of Technology, Chickballapur. Consolation Prize was given to Cambridge Institute of Technology, Bengaluru.

"Skit & Presentation Making Competition" - 1st Prize was won by B.M.S. College of Engineering, Bengaluru and the 2nd Prize was by S.J.B. Institute of Technology, Bengaluru.

"Best Demonstration Award" was given to RMC Readymix (India) and Fosroc Chemicals India Private Limited and the "Jury Appreciation Award" went to UltraTech Cement Ltd.

"Best Exhibition Award" was bagged by UltraTech Cement Limited and RMC Readymix (India) and the "Jury Appreciation Award" was given to Talrak Construction Chemicals Private Limited, Bengaluru.

There was an interactive session with the Industry Experts at the end of the second day.

Programme ended with National Anthem.

ICI-Bhopal Centre

1.Technical Discussion

ICI-Bhopal Centre organized a Technical Discussion on "Measures to improve Quality of Concrete" on 8th January 2017 at S. V. Polytechnic College, Bhopal.

Renowned Academicians, Executive Engineers, Consultants, etc., participated in the programme. Dr. Ashish Dongre, Principal, S.V. Polytechnic College, Bhopal and Former Director, Technical Education MP; Dr.P.K.Jain, Professor & Dr. Rajendra Gupta, Former Professor, Department of Civil Engineering, MANIT, Bhopal; Er. Ajay Tiwari, Executive Engineer, MP Housing & Infrastructure Board; Dr.A.K.Jain, Lecturer, & Er.Sangeev Saxena, HOD, Department of Civil Engineering, S.V.Polytechnic College, Bhopal; Er.Sanjay Jain, MD, Vardhman Archi Tech Pvt. Ltd., Bhopal; Er.Apoorv Dhonde, Structural Engineer, Bhopal; Er.Siddhamuni Thombre, etc., contributed their thoughts on the topic.

Following are the recommendations received during the discussion in order to ensure durability of the infrastructure:

- Intensive Training Programme for masons and contractor shall be organized. They shall be given effective training to help them to understand their job, to understand common causes of deterioration of concrete and their remedies.
- Awareness programmes shall also be organized for Engineers and students of educational institutions.

Masons and other field workers shall be encouraged to develop a pride of workmanship.

- Efforts shall be made to encourage professionals and people associated with concrete making materials, etc., to join ICI by way of getting membership.

- More and more Educational Institutions shall be approached to open ICI-Students Chapter.

The executive committee showed its commitment to work on the recommendation to achieve the desired goals. Er. B. K. Joshi proposed vote of thanks. The event concluded with lunch.

2. Training Programme:

ICI-Bhopal Centre organized a training programme on 24th January 2017 at S.V. Polytechnic College, Bhopal. Nearly, 50 Contractors attended the Programme. Dr.A.K.Jain, Vice-Chairman, ICI-Bhopal Centre, briefed about the Programme and the objectives of ICI-Bhopal Centre and various activities performed by it during the year.

Er.B.K.Joshi, Secretary, ICI-Bhopal Centre informed about the importance of training programme in assuring better quality of construction in the industry.

Er.Sudhir Mishra, Manager-Technical, UltraTech Cement Ltd., Bhopal delivered a technical lecture and spoke about better construction practices used in construction field, especially, while preparing and using concrete.

Few contractors expressed their difficulties they are facing in the field and asked several questions related

to proper use of cement and concrete, precautions required to prevent early cracks on surface of newly placed concrete, etc. Their queries were well received and answered by Dr.A.K.Jain and Er.B.K.Joshi, to their satisfaction.

Participant contractors expressed their deep sense of gratitude towards ICI, S.V.Polytechnic College, UltraTech Cement Ltd., and supporting organizations for organizing this event and provided them an opportunity to attend an informative lecture. They requested to continue such programme for the benefit of their fraternity and other stakeholders of the industry.

Vote of thanks was delivered by Er.Kailash Meghwal and the event concluded with dinner.

ICI - Chandigarh Centre

1.Technical Meet:

Indian Concrete Institute - Chandigarh Centre in association with UltraTech Cement Limited organized a technical meet on 10th Feb, 2017 at Hotel Iqbal Inn, Patiala.

Er. Shashi Gaggar, Vice-President (Technical Services Ltd.,) UltraTech Cement welcomed the Guests. He said that such technical seminars are the platform, where members gather and have a technical presentation on any contemporary topic. He emphasized the advantages of such seminars as the Indian construction industry forms an integral part of our economy and a conduit for a substantial part of its development investment, and is poised for growth, on account of the special thrust by the Government, and people's rising expectations for improved quality of living.

Keynote Speaker of the function Ar. Jit Kumar Gupta, Former Director, College of Architecture, I.E.T., Bhaddal, Chandigarh made a very informative and interesting presentation on "Smart Cities – Concepts & Practices". He said smart city mission is an Urban Renewal and Retrofitting Programme by Government of India with a target to develop 100 cities making them citizen friendly and sustainable. Further, he emphasized on 8 concepts of smart city viz.; smart governance, smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare and smart citizens. He gave many global examples of cities like Mile-high Tower, Saudi Arabia; Pearl River Tower, China, etc.

About 110 Engineers, Architects, Builders & Govt. Officials attended the Function and everyone appreciated the presentation and the overall arrangements. Er. Hitesh Mogra, Secretary, ICI – Chandigarh Centre, proposed vote of thanks. Meeting ended with Dinner.

2. Concrete Day Celebration and Award Function

Indian Concrete Institute – Chandigarh Centre and UltraTech Cement Limited celebrated Concrete Day and Awards Function on 04th March 2017 at Hotel Holiday Inn, Chandigarh.

Concrete Day function started with lighting of lamp by Chief Guest Er.R.C.Singh, Chief Engineer, CPWD, Chandigarh; Guest of Honour, Maj. Gen. V.K. Bhatt, Technical Advisor to Chief Minister, Punjab; Sh. Kalpesh Bhatt, Keynote Speaker, Sh.Shashi Gaggar, Vice-President, UltraTech Cement Ltd., Dr.Sanjay Sharma, Chairman, ICI-Chandigarh Centre and Er. Hitesh Mogra, Secretary, ICI –Chandigarh Centre.

Dr. Sanjay Sharma welcomed all for the function and shared the significance of Concrete Day and his vision of ICI-Chandigarh Centre for the next two years and also highlighted the activities conducted by the Centre during the year.

Er. Shashi Gaggar said that Concrete day celebration has become an Annual ritual of the Centre and is the platform where, Technical Presentation is made on a contemporary topic.

Keynote speaker of the function Sh.Kalpesh Bhatt, Creative Director, BAPS Swaminarayan Sanstha gave a presentation on "Swaminarayan Akshardham – How an ordinary people created an extraordinary structural masterpiece". He talked about project management triangle and explained how such big project completed in 5 years period, when initially everyone estimating that this project will take 40 years to complete. He also described about the aesthetics of that project.

Ar. Pradeep Bhagat, Chairman of Jury introduced all the members of jury, who have put in their efforts for the selection of the Awardees. Memento was given to all members by Dr. S.K. Kaushik and Dr. S.P. Singh.

Er.R.C.Singh, Sh.V.K.Bhatt, Sh.Kalpesh Bhatt, Er.D. Shashi Gaggar, Dr.Sanjay Sharma and Er.Hitesh Mogra announced the winners in the following various categories of Awards.

Award categories were:

- Best Concrete Structure 2016 - Institutional Building
- Best Concrete Structure 2016 - Office Building
- Best Concrete Structure 2016 - Commercial Building
- Dream Home 2016 - Punjab (North & South)
- Dream Home 2016 - Chandigarh
- Best Ph.D. Thesis 2016
- Young Concrete Engineer 2016
- Outstanding Concrete Structure 2016
- Outstanding Concrete Technologist 2016

Photo Gallery

Sh.R.C.Singh appreciated the initiative taken by Indian Concrete Institute & UltraTech Cement Ltd., in organizing such educational & informative technical seminars. He said such type of function really needed in city like Chandigarh and group of engineers should work on smart city concepts for making Chandigarh City as one of the best in the world.

Er. Shashi Gaggar and Er. Hitesh Mogra gave away a memento to Chief Guest Er.R.C. Singh, Guest of Honour Sh.V.K. Bhatt and Keynote Speaker Sh. Kalpesh Bhatt.

More than 300 Engineers, Architects, Builders & Govt. Officials attended the Function. Sh. Santosh Dixit proposed vote of thanks. Meeting ended with Dinner.

ICI - Chennai Centre

One-Day Workshop

Geopolymer Concrete is an innovative and eco-friendly construction material and also an alternative to portlant cement. Numerous studies and researches are going on focussing deep in this greener and durable construction material. ICI-Chennai Centre comprehending the importance and need of Geopolymer Technology in the current scenario, organized an one-day Workshop on "Introduction to Geopolymer Composites Technology" in association with Indian Institute of Technology-Madras, Anna University, CSIR - SERC, SRM University and The Masterbuilder (Media Partner). The Workshop was held on 17th February, 2017 at Pari Arangam, Department of Civil Engineering, Anna University.

Dr.K.P.Jaya, Chairperson, ICI-Chennai Centre welcomed the august gathering. Dr.N.P. Rajamane briefed about the Workshop. Felicitation Speech was given by Er.R.Radhakrishnan, Secretary General, ICI and Dr.K.Nagamani, HOD (Civil), Anna University and Er.K.Venkataraman, Secretary & Treasurer, ICI– Chennai Centre. The Workshop was attended by more than 100 enthusiastic participants. The Workshop threw light on various topics listed below:

- Geopolymer Technology - An Overview
  - Dr. N.P. Rajamane
- Chemical Nature of GPCs and AAS
  - Prof. R. Jeyalakshmi
- Typical GPC Mixes and their preparation
  - Dr. P. S. Ambily
- Strengths, Statistical Nature, Bond, etc., of GPCs
  - Mr. M. Dhinesh & Mr. Baskar
- Durability aspects of GPCs
  -Dr. N.P. Rajamane & Prof. R. Jeyalakshmi
- Microstructure study with instruments
  - Ms. T. Revathi & Ms. Rinu
- Economics/Carbon Foot Print
  - Dr. N.P. Rajamane & Mr. Boopalan
- Applications
  - Dr. Geetha Kumar

Speakers


Dr. N.P. Rajamane


Er. R. Radhakrishnan


Dr. K. Nagamani


Dr. R. Jeyalakshmi


Mr. M. Dhinesh


Dr. P.S. Ambily


Dr. Siva Prasad


Ms. T. Revathi


Mr. Boopalan


Dr. Geetha Kumar


Er. K. Venkataraman


Panel Discussion

The Workshop witnessed lively panel discussion and concluded with vote of thanks by Er.K.Venkataraman. The active participation from the audience and speakers, and support from various organizations and institutions made the Workshop a successful one.

ICI - Hubballi Dharwad Centre

ICI - UltraTech Awards 2016

ICI-Hubballi Dharwad Centre and UltraTech Cement Ltd., jointly organised ICI-UltraTech Awards 2016 for the Outstanding Concrete Structures of North Karnataka region.

Awards were given under the following categories:

1. Residential Buildings
2. Public Buildings
3. Infrastructure Buildings

There were 175 entries from all the Districts of North Karnataka. Considering the large number of enthusiastic entries, the Jury decided to present the District Awards for Residential Buildings as "Well-Built Residential Building" for each District. This is being done to encourage Owners, Engineers and Consultants of North Karnataka. The Jury consisted of Eminent Engineers, Architects and People from Construction Industries and Academicians of Karnataka. This year the Award Ceremony was conducted in two places, on 19th November 2016 at Bellary and on 10th December 2016 at Vijayapura. The Awards have played a major role in creating awareness of using good quality concrete in construction.

Function at Bellary on 19th November, 2016.

Er.V.P.Udhihal, Chief Engineer (Retd), Irrigation, North was the Chief Guest and inaugurated the function at Bellary. Er.K.Jayasankar, Vice-President, UltraTech Cement Ltd., Bengaluru and Vice-President (S), ICI, presided over the function. Er. M.Narayan, Chairman, ICI-HUDC welcomed the gathering. He briefed about the activities of ICI and ICI-Hubballi-Dharwad Centre and also explained about the ICI-UltraTech Awards 2016. Er.K.H. Shrihari, Joint Secretary, ICI-HUDC introduced the Chief Guest to the audience. Outstanding Concrete Sturcture Award for Public Building of North Karnataka was awarded to Medical College Building at Gadag constructed by M/s B.G.Shirke & Company.

Inauguration of Award Ceremony

Er.Lakamanahalli, Er.Ashok Reddy & Er.Suresh Patil were present. Dr.Manoj Chittawadagi, Secretary, ICI-HUDC proposed vote of thanks.

Function at Vijayapura on 10th December, 2016

Capt. R.R.Doddihal, General Manager (Technical), KUIDFC, inaugurated the function at Vijayapura by lighting the lamp. Er.M.Narayan welcomed the gathering. He briefed about the activities of ICI and ICI Hubballi-Dharwad Centre and also explained about the ICI-UltraTech Awards 2016. Dr. Manamohan R. Kalgal, President, ICI, presided over the function.

Lighting of Lamp by Dr.Manamohan R Kalgal, President ICI ,

Felicitation of Er. S.B. Koimattur

Felicitation of Outstanding Infrastructure Awardees

Felicitation of Outstanding Residential Building Awardees

Presidential Speech by Dr.Manamohan R. Kalgal

Dr.V.Ramachandra, Functional Head (Technical), UltraTech Cement Ltd., Mumbai briefed about the selection of the Awardees. Er.K.H.Shrihari introduced the Chief Guest to the audience. Er.S.B. Koimattur, Vice-Chairman, Dam Safety Panel of Karnataka was felicitated during the function as Eminent Engineer of North Karnataka. Er. Dr. Manoj Chittawadagi proposed vote of thanks.

Concrete Day

ICI-Salem Centre

Concrete Day Celebration

Indian Concrete Institute-Salem Centre celebrated 'Concrete Day Celebrations' on 14th December 2016 in Hotel Cenneys Gateway at Salem. The event was supported by UltraTech Cement Limited. The concrete brethrens supported this ceremony by turning up in good number.

The celebration got off the mark with Welcome Address by Dr.R.Malathy, Chairperson, ICI-Salem Centre. Er.Pradeep Ghumare, Director, NOE Formwork India Pvt., Ltd., was the Chief Guest of the event. Er.R.Radhakrishnan, Secretary General, ICI, gave a brief note about ICI, its activities and the path it travelled so far. Er.K.Jayasankar, Vice-President, UltraTech Cement Ltd., ushered the gathering with a brief presentation on their products.

Chief Guest of the day, Er. Pradeep Ghumare gave a lecture on "Architectural Concrete" with the help of many samples he brought. He was enthusiastic in explaining the benefits of architectural concrete and its current advancements in staining, texture and formwork.

Recognising talents and efforts in the field of concrete, "ICI-Salem Centre - UltraTech Awards 2016" was celebrated along with 'Concrete Day' 2016. This year categories of Awards were broadened to motivate upcoming engineers and the engineering institutions in Salem, Namakkal, Erode, and Krishnagiri Districts. Life Time Achievement Award and Vocational Excellence Award are some of the prestigious Awards presented at the ceremony. The other Awards presented are Outstanding ICI-Students Chapter, Outstanding Thesis in the field of Concrete: Masters/Doctoral and Best Built

Er. Pradeep Ghumare delivering the lecture

Er.R.Radhakrishnan and Dr.R.Malathy honouring the Awardee

Er.K.Jayasankar honouring the Vocational Excellence Awardee

Er. Pradeep Ghumare and Dr.R.Malathy honouring the Outstanding Master's Thesis Awardee

Apartment/House. Er.N.Sanjay Kumar, Secretary-ICI Salem Centre delivering the vote of thanks.

ICI - Trichy Centre

Concrete Day Celebrations

ICI-Trichy Centre celebrated Concrete Day on 22nd November 2016 at Hotel SRM. Dr.C.Natarajan, Chairman, ICI-Trichy Centre welcomed the gathering. Er.K.Jayasankar, Vice-President (S), ICI, briefed about UltraTech Cement Ltd., and Er.R.Radhakrishnan, Secretary General, ICI explained about ICI and the forthcoming events. Dr.G.Dhanalakshmi, Treasurer, ICI-Trichy Centre introduced the Chief Guest, Er. Pradeep Ghumare, Director, NOE Formwork India Pvt. Ltd. He delivered a lecture on "Architectural Concrete".

Er. M. Shanmugam, Retd. Professor, NIT Trichy, received the Life Time Achievement Award for Engineers for his excellent contribution in Academic and Industry areas. Architect P.G.Sivakumar, received the Life Time Achievement Award for Architects. Vocational Excellence Award was received by Er.R.Ganesan, Trichy. All the three experts shared their experiences and the technical details of their outstanding projects.

Er. M. Shanmugam receiving the Life Time Achievement Award (Engineers)

Ar. P.G. Sivakumar receiving the Life Time Achievement Award (Architects)

Er. R. Ganesan receiving the Vocational Excellence Award

Best ICI-Students Chapter Award-
K. Ramakrishnan College of Technology, Trichy.

Dignitaries presented the ICI-UltraTech Outstanding Awards – 2016 under various categories for Trichy and Thanjavur region. All the Award Winners shared their experience and thanked the organizers. Finally, Dr. M. Sudhakar, Secretary, ICI-Trichy Centre thanked the Organizing Committee, Participants, Award Winners and other members who made this function a great success.

Indian Concrete Institute

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Email : ici4@airtelmail.in Website : www.indianconcreteinstitute.org

NOTICE FOR ELECTION OF OFFICE-BEARERS – 2017-2019

Notice is hereby given to all members of Indian Concrete Institute that the Elections 2017 will be conducted by postal ballot as per the time schedule indicated below :

Last date for receipt of nominations at HQ	:	23.05.2017 (1700 hrs)
Scrutiny of nominations	:	25.05.2017
Last date for withdrawal of nominations	:	09.06.2017
Despatch of ballot papers to be completed by (if there is contest)	:	24.06.2017
Last date for receipt of ballots	:	23.07.2017 (1700 hrs)
Counting of ballots and declaration of results	:	27.07.2017

Two members of the Governing Council from Chennai will scrutinize the nominations and ballots.

The electorate will be the valid members of the Institute as on 31st March 2017 as per the records available at HQ. Organisational members shall file their nominations/ballots with the signature of their representative as given in their membership application filed at the Institute. Any change in representation shall be notified to the Institute in writing, before filing the nominations/ballots.

The election shall be conducted to fill the following vacancies :

President (Elect) (from North Zone)	:	1 - To be elected by all members
Vice-Presidents (From - East, West, North and South Zones)	:	4 - To be elected by members from respective zones
Governing Council Members	:	14 **Four** to represent organizational members from among them elected by all members **One** to represent donor members from among them elected by all members. **Nine** to represent individual members from among them, elected by all members.

Nominations are to be filed in the enclosed proforma.

Nomination papers shall be put in a cover and superscribed "Nominations – Elections 2017" and sent to the Polling/ Returning Officer so as to reach him not later than 1700 hrs on 23.05.2017.

Indian Concrete Institute
Ocean Crest, 79, Third Main Road,
Gandhi Nagar, Adyar,
Chennai 600 020.

R.Radhakrishnan
Polling/Returning Officer
Elections 2017

P.S. : If members wish to table any resolution at AGM 2017, notice may please be given and resolutions made available to the Secretary General before 15.09.2017, duly proposed and seconded to enable circulation in advance of AGM 2017.

Indian Concrete Institute

ELECTIONS 2017-2019

NOMINATION OF OFFICE-BEARERS

1. Position (President-Elect/ Vice-President/ G.C. Member) : .....

   Name and Address of nominated person/organization : .....

   .....

   .....

   .....

   ICI Membership No. : .....

2. Proposed by : .....

   Name and Address : .....

   .....

   .....

   .....

   .....

   (Signature) ICI Member No.

3. Seconded by : .....

   Name and Address : .....

   .....

   .....

   .....

   (Signature) ICI Member No.

4. Nomination agreed to by the candidate : .....
   (Signature)

5. Nomination shall reach the Returning Officer* in a cover superscribed "Nominations Elections 2017" before 1700 hrs on 23.05.2017.

6. A short bio-data of the candidate strictly not more than 100 words highlighting the contributions to the profession and ICI should be enclosed.

   Use one nomination form per candidate per position.

* **Er. R.Radhakrishnan**
Polling/Returning Officer
Elections 2017
Indian Concrete Institute
Ocean Crest, 79, Third Main Road, Gandhi Nagar,
Adyar, Chennai 600 020.

Note : Organisational members should sign these papers through their authorized representatives as indicated in membership application form or as modified and notified to ICI Headquarters before filing the nomination.

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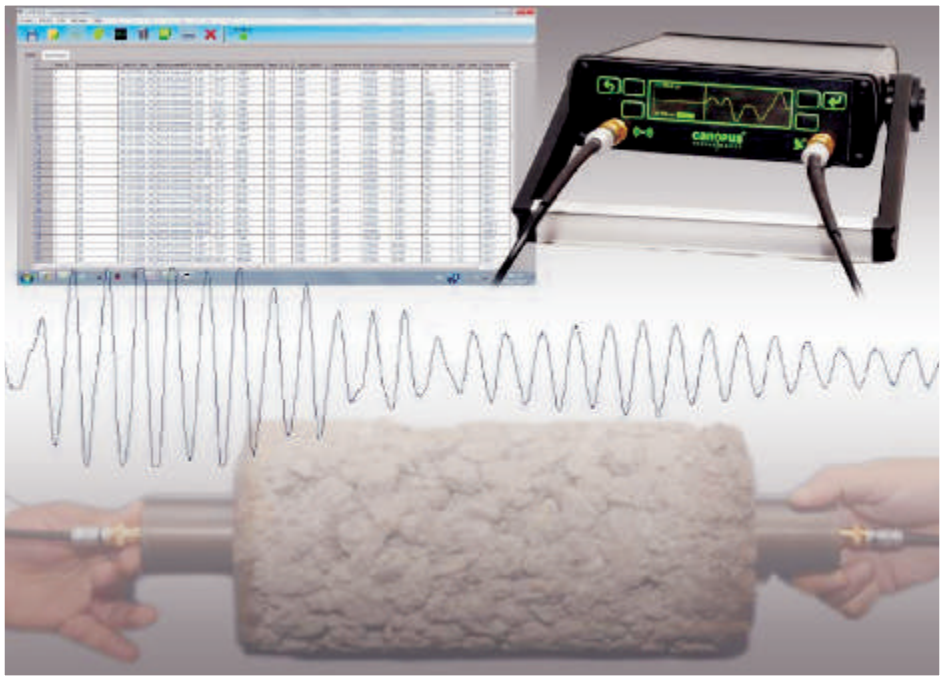

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Proud Moment

Indian Concrete Institute - Bangaluru Centre, received 9th CIDC Vishwakarma Award 2017 under the category "Achievement Award for Construction Skill Development" on 7th March 2017 at New Delhi

RNI No. TN ENG / 2000 / 1901 Rs.20/-

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