RMC TECH BEAT

Inside

Vol.3, No.3, July - September 2016

{For private circulation only}

Company News

Megacrete® for Innovative Structural Wall System

As the building heights are increased, provision of structural wall system (sometimes referred as core walls or shear walls) becomes a necessity for resisting vertical and lateral loads. The wall elements generally form the primary lateral load-resisting structural system for the buildings, resisting mainly the loads imposed by seismic and wind forces.

Usually, the structural walls are designed as reinforced concrete elements. However, for a tall building in Central Mumbai, a renowned structural engineering firm has designed the structural wall system with pre-stressed concrete elements. For this building the height is around 250m, the thickness of the structural walls varies from 300mm to 600mm. The designer specified M70 grade concrete with stringent requirements.

RMC Readymix (India) was chosen as the main concrete supplier for this project. The company supplied

Fig. 1 *Megacrete*® being placed in forms

Megacrete® of M70 grade which was pumped with the help of a powerful pump (Fig 1). The slump-flow requirement was specified as 450mm at pouring point. Post tensioning was done at every third floor. No cracking

(Continued on page no.7)

Growing Footprints in Infra Sector

Infrastructure sector is a big driver for the Indian economy. It enjoys intense focus from the government which is keen on creating world-class infrastructure in the country.

With a view to satisfy the need of providing quality concrete for the infrastructure sector, RMC Readymix (India) decided to extend its core business activity of ready-mixed concrete to this sector in 2009. For this purpose, a dedicated vertical called Mega Projects was created.

Since then the Company is proud to be associated with a number prestigious projects, supplying them quality concrete for the construction of roads, bridges, power plants, refineries, ports and jetties and urban Infrastructure. Some of the prestigious projects which are either completed or under execution include: IOCL - Paradeep, Tata Steel – Kalinganagar, Odisha, Bridge across river Ganga Bihar, Delhi Metro Rail Corporation (DMRC), BPCL Refinery – Cochin, MH PWD Wani Gugus highway – Chandrapur, Reliance Power Plant – Samalkot, CSEB Power Plant - Korba CG, Mahagenco Expansion – Chandrapur, NTPC UMPP - Mouda, Nagpur, MH, Kakrapar Atomic Power Station – Gujarat, ABG Shipyard - Dahej Gujarat, Tata Power - Mundra Gujarat, Tata Projects – Boisar Maharashtra, NTPC Gadarwara - MP and so on.

With a good track record created in this sphere, the Company has recently secured a few more infra projects. These include: Lucknow Metro Rail Corporation (LMRC), Varanasi-Azamgarh road project of NHAI, KPCL-Power Project at Bangalore, BWSSB-STP project at Bangalore and Indian Railways – Bihar.

Around the World

Tall Buildings : Concrete's Dominance Continues

The 2015 report of the Council on Tall Buildings and Urban Habitat (CTBUH) makes an interesting reading. CTBUH reports that 106 buildings of heights greater than 200-m were completed around the world in 2015 – setting a new record for annual tall building completions. During the past 15 years, the number of 200-m tall buildings increased from 265 (2000) to 1040 (2015) – an increase of nearly 392%!

In the "Supertall" category (building with heights greater than 300 m) 13 buildings were completed in 2015, thus taking the number of "Supertalls" in the world to 100! During the past one-and-a-half decade (2000-2015), the number of Supertalls has exactly doubled – from 50 to 100.

Since the year 2000, the centre of gravity of tall building construction has shifted from North America to Asia and Middle East. The latest data by CTBUH indicates that Asia has outperformed the other regions. Out of the 106 tall buildings completed during the year 2015, 81 were from Asia, representing 76% of the total stock.

Fig. 1 Shanghai Tower : Second tallest building (632m) in the world

Shanghai Tower (Fig 1) was the tallest building completed in 2015. This 632-m tall building is now the second tallest in the world. Another landmark tall building completed in 2015 was the 432 Park Avenue in New York. This building has the distinction of being the tallest all-residential building in the world.

China has been the leader in tall building construction. The number of 200-m-plus tall building completed in China during 2015 was 62. Out of the 29 Chinese cities with 200-m-plus tall building completions, Nanjing, Nanning and Shenzhen had the most with five each.

In the sphere of material of construction, a perceptible shift from steel to concrete was evident since the year 2000. It is interesting to note that 2015 saw a spike in the number of buildings completed with concrete – 52 out of 106 (49%). This is a dramatic increase over 2014, when only 39 out of 99 were completed (39% of total). All-steel towers were very scanty in 2015, with only three 200-m-plus completions around the globe.

Accolade for Mahape Plant

Mahape plant of RMC Readymix (India) located in Navi Mumbai recently received "Excellent" safety Rating certificate from the Ready Mixed Concrete Manufacturers' Association (RMCMA).

RMCMA has developed a Safety Rating System jointly with the National safety Council (NSC) and a detailed manual containing a comprehensive check list was prepared. The RMCMA-NSC System on occupational health and safety (OH&S) of a ready-mixed concrete plant evaluates rating of the plant based on eight key areas. RMCMA employed an independent expert auditor to assess the OH&S of various plants belonging to leading RMC companies in the Mumbai region. After a detailed audit by the independent auditor, the Mahape plant scored 89.1% marks and was given "Excellent" Rating.

Based on auditor's assessment, RMCMA issued "Excellent" safety rating certificate to the Mahape plant of RMC Readymix (India).

Forum

Interview with Dr. Himanshu M. Raje

Q. Your association with RMC Readymix (I) dates back to around the year 2000. During the past one and a half decade, we have supplied ready-mixed concrete to a number of projects with which you have been associated with. What are your general observations on the quality of concrete and technical services offered by our Company?

A. I always prefer concrete from your Company and recommend it to my clients as in-depth technical service is available from your Company. We also observe transparency in the documents furnished by your Company. Quality is excellent and consistent.

Q. You have been closely associated with the construction of some high-rise buildings in Mumbai. For one such project, we had supplied M70 grade concrete, and pumped it at higher levels. What is your experience about the technical ability of our Company in delivering high-strength concrete?

A. We have not faced any quality issue in high-grade concrete at our project sites. Our clients were also happy with the consistency in quality of concrete. The required resources for high strength concrete are available with RMC Readymix (India) and these are helpful in assuring the quality of concrete.

Q. In the near future, high-rise building construction is likely to get a boost, especially in metropolitan cities. This will necessitate the use of even higher grades of concrete, up to M100 or so. Would you be willing to specify such higher grades? What support you will need from our side as far as development and testing of such concretes are concerned?

A. Yes, I would appreciate the developments done by your Company in the mix design and the production process for supply of high strength concrete. I would recommend high strength concrete of grades M80 and M90 in our projects.

Here, I would like to highlight the fact that the site teams do not possess the required awareness about handling of the high strength concrete. Therefore, it is essential for companies like RMC Readymix (India) to provide adequate guidance to the site teams for proper execution of high strength concrete. Sometimes it has happened that the concrete quality was good but due to the adoption of improper sampling procedures, incorrect curing regime and faulty testing regime, the test results were not satisfactory, sending unnecessary alarming signals to the client. I would therefore suggest that in addition to providing general guidance to the site team, your Company should depute one technical person from your end to site whenever high-strength concrete pouring is scheduled.

Q. The use of supplementary cementitious materials such as fly ash and GGBS improves a variety of properties of concrete including its long-term durability. What are your views on this?

A. I always prefer supplementary cementitious materials in concrete like GGBS. At my project sites I had used GGBS as a replacement of OPC to the extent of 55% in M20 grade concrete and achieved

(Continued on page no.4)

Dr. Himanshu M. Raje, a brilliant structural consultant from Mumbai, is the Director of Raje Structural Consultants and proprietor of Raje Associates. He has received masters in structures from V.J.T.I. and Ph.D. from IIT Bombay. He is a chartered engineer and a license holder for constructing multi-storeyed buildings.

Dr. Raje now has around 35 years of hands on experience in structural designing. As a structural engineer, he has successfully handled a variety of complicated structures from cement factory to bridges and expressways, international airports and tall buildings. Thanks to his expertise and other rare qualities, Dr. Raje has built up an enviable association with top corporate houses like the Reliance Industries, Tata Group, L&T, HDIL, Godrej Realty, Mahindra Life Spaces, K Raheja Corp, Rajesh Life Spaces and the Government of India. Dr. Raje has strong links with the academics and is currently serving on the boards of various universities and colleges. He is also actively involved in the activities of professional bodies like the Institution of Engineers, Indian Concrete Institute, Practicing Engineers, Architects & Town Planners Association, etc. Recently, Dr. Raje was elected as Hon Secretary for MS IE(I).

Forum

(Continued from page no.3)

44 MPa strength at 56 days! RMC Readymix (India) needs to highlight the benefits of supplementary cementitious materials in concrete. It will certainly help the environment, future generations and improve the durability of structures. From the durability perspective the use of supplementary cementitious material is always beneficial and I have seen that RMC Readymix (India) is taking active part and supplying concrete by using fly ash and GGBS without lowering the quality of concrete. I would also advocate use of recycled coarse aggregate and recycled fine aggregate for concrete as this was research done 10 - 15 years by me at IIT, Mumbai.

Q. You are aware that Quality Council of India (QCI) has developed an audit-based quality scheme for the certification of RMC facilities. The scheme is a good tool in the hands of specifies in short-listing RMC producers. Will you be using this tool in jobs with which you are associated with?

A. Yes, I was part of the QCI and this scheme is really helpful for quality-conscious consumers of RMC. It is necessary to create good awareness about the scheme within our industry for using good quality concrete. The norms mentioned in the QCI manuals are really appreciated.

Q. We have brought in considerable innovations in developing a variety of our Special Concrete Products. These include *Megacrete*®, *Easycrete*™, *Foundationcrete*™, *Dyecrete*® with stamping, etc. Will you be willing to use our expertise in the field of special products?

A. Self compacting concrete, high strength concrete, high volume GGBS concrete were used in my projects and the results were excellent. I have used all these concretes in my projects; but frankly speaking, I am not so much familiar with the trade name you have mentioned.

Q. You have been actively associated with few professional bodies. What role these bodies can play in furthering the cause of quality concrete in India?

A I am associated with the Indian Concrete Institute (ICI) and actively involved in highlighting concrete developments in our country. I am also associated with other professional bodies like Institution of Engineers (I), Practicing Engineers Architects & Town Planers Association (India), Indian Geotechnical Society, Indian Society for Technical Education, ACI India Chapter, etc. Incidentally, I was recently elected as the Hon. Secretary of IE(I) Maharashtra State. I am also closely connected with a number of academic institutions. I use these forums to propagate good engineering practices, including use of good quality concrete.

• • • •

Participation in Big 5 brings Big Dividends

With an aim to showcase value-added concrete products and to grab the opportunity to have a one-on-one interaction with a larger section of buyers, RMC Readymix (India) participated in The Big-5 Construct India exhibition on the 28th, 29th and 30th of September 2016, organized at Bombay Exhibition Centre, Goregaon.

Garnering a footfall of over hundreds of visitors, the exhibit received a very good response from Architects, Consultants and Builders of various firms. The live models of Pervioscrete™ and Elitecrete™ were the major attractions that created a buzz amongst the people who visited the stall. Apart from working professionals, even engineering and architecture students who visited the exhibit were amazed with the advancements made by the Company in the field of Concrete Technology and its contemporary applications.

Concrete Innovations and Trends

UPV Technique for Determining Saw-cutting Time in Concrete Pavement

Concrete pavement is the best option for roads and highways as well as for floors required for a variety of applications such as warehouses, container yards, runways, industrial flooring, etc. Thanks to the advances in concrete technology, desired quality of concrete (for example, M40 grade and above) is now easily available, and whenever specified, fibre-reinforced concrete and self-compacting concretes are being used. Simultaneously, with the advancements in construction technology, especially involving the use of automated, laser-guided slip-form pavers, the speed of pavement construction has improved considerably. However, joint cutting in the pavement has remained a grey area in construction.

During concrete pavement construction, the time at which the joints need be cut in concrete is not clearly defined in our codes and specifications. For example, the specification of Ministry of Road Transport and Highway (MORTH) on the provision of joint states, "Sawing operation could start as early as 5-6 hours after laying of PQC but not later than 18 to 20 hours depending upon the ambient temperature, wind velocity and relative humidity and the required maturity of concrete achieved for this purpose". The time window ranging from 5-6 hours to 18-20 hours is too large for the site-in-charge or contractor to decide the exact time of cutting the joints. Generally, such time is arbitrarily decided either by scratching the fresh concrete surface with a penknife or by observing the depth of the footprints, or purely on past experience. However, since these are subjective techniques, not based on scientific assessment, the results may be prone to errors. In case cracks occur in concrete, it is the ready-mixed concrete producer who is blamed and at times victimised, for no faults on his part.

The main purpose of cutting joints in concrete is to arrest the tendency of random cracking. Joints relieve tensile stresses induced by shrinkage and changes in temperature. Fig 1 shows a typical close-up of the joint.

It is observed that while cutting joints too early increases the risk of ravelling and spalling, cutting too late enhances the hazard of random cracking. Joints cut at appropriate time go a long way in reducing the need of replacing cracked panels on the one hand and improving the longevity of concrete, on the other. Rapid changes in

(Continued on page no.6)

Great Leap in QCI Certification

RMC Readymix (I) has been in the forefront in getting its commercial plants certified under the Quality Council of India's RMC Plant Certification Scheme (RMCPCS). This scheme provides third-party quality assurance to customers, based on well-defined quality norms. As of date, a total of 30 plants of the Company located in different parts of the country have been certified under the RMCPCS. The recent additions to the list includes Company's four plants located at Veersandra (Karnataka), Sarajapur Road, Sonipat and Surajpur (NCR).

During the year 2017, the Company is planning to obtain QCI certification for its additional 13 plants across the country. This is line with the Company's strong commitment to its customers to provide highest level of quality assurance for its products.

RMC Readymix (I) expands operations to Ranchi

With the growing demand for urban areas and rapid growth of cities, the demand of concrete has also increased at a rapid pace. Initially confined to the tier-I cities, ready-mixed concrete has slowly gained popularity with other areas as well.

Keeping the increasing demand of RMC in India, the latest city to be added to the ever growing list of the places served by RMC Readymix (India) is the Capital of Jharkhand, Ranchi. Located on Jamshedpur Road in Namkum Village, Sidraul, the plant has an installed capacity of 30 m^3/hr.

With the addition of Ranchi, RMC Readymix (India) now has 82 operational plants across 40 cities in India.

View of Ranchi Plant

Concrete Innovations and Trends

(Continued from page no.5)

environmental conditions affect the joint cutting time, which needs to be varied depending up on the variations in temperature, humidity, wind speed, changes in mix proportions, etc. Thus, the crucial issue is to determine the appropriate time of cutting joints, taking cognizance of a number of variable factors mentioned above.

Fig. 1 Typical close-up of a joint

The problem of predicting the exact time of saw cutting has been one of the important topics of research in recent years. Various techniques have been tried for this purpose. These included: use of calorimetry, finite element modelling, maturity meter, penetration resistance technique, thermography, etc. Although some of these techniques have proved successful, the need for a simple and practical technique was being felt for a long time. Recently, interesting work involving the use of ultrasonic pulse velocity (UPV) technique for predicting the saw-cutting time was done at the National Concrete Pavement Technology Center at the Iowa State University, USA, with encouraging results. Here, it would be appropriate to provide a brief account of this work.

It is well known that ultrasonic waves travel faster in solids than in a fluid. Based on this principle, the velocity of the sound waves passing through a fresh concrete sample would begin to increase when hydration products start to interact, which would indicate the beginning of the initial setting of concrete. Thus, if fresh concrete sample is monitored with UPV, sudden spurt in the velocities would indicate the exact time of initial set.

A pilot project was conducted in the USA from 2013 to 2015 when commercial UPV devices were used to track pulse velocities of field samples on more than 24 pavement construction sites[1]. At each site, a100 x 200mm test cylinder was filled with sample of concrete taken from a slipform paver. Standard sample preparation procedures were followed. The specimen was then placed in a wooden frame adjacent to the pavement slab, Fig 2[1]. This was essential to ensure that the specimen and the freshly constructed pavement slab are subjected to the same external environmental conditions. Initial setting times were recorded when there was marked increase in the velocity of ultrasonic waves.

Fig. 2 UPV test set up for a sample in wooden frame[1]

Simultaneously, calorimetric data were collected using a commercial semi-adiabatic device at various sites.

The UPV data collected from various sites were analysed. It was observed that once initial set is achieved as indicated by the UPV, conventional sawing should begin in accordance with the relationship (established from the large data) in the following equation:

$$\text{Saw time} = 1.24 \times \text{initial set time (UPV)} + 273.$$

The above equation is valid for specific conditions prevailing in the USA and concrete mixes used. The results from UPV data were cross-checked with results from calorimetric data and a good co-relation was observed.

As the experience of pilot studies done in the USA indicated, the use of UPV method for determining the saw cutting time seems promising. Since UPV is a simple technique and a number of professionals are already familiar with its use, we are sure to witness growing use of this technique in the near future.

In India, it will be a good idea to conduct initial pilot study on lines similar to those in the USA. For this purpose, it would be essential to undertake both lab and field studies. Although such work does not fall under the scope of work of RMC Readymix (India), the Company will be ready to extend cooperation to leading contractors, who will be ready to undertake the pilot study.

In the present context, when large jobs involving construction of concrete roads and industrial paving are being undertaken in India, it makes sense to assess the potential of UPV technique for saw cutting under Indian conditions.

References

1. Taylor, Peter C and Wang, Xuhao, Workability and setting time for slipform paving concrete mixtures, *Concrete International,* August 2016, pp. 41-46.

Company News

(Continued from page no.1)

was witnessed in the concrete after hardening and the finish was quite good. *Megacrete*® could also withstand the pre-stressing force easily without any adverse effects.

Megacrete® of grades M60, M80 and M90 were also supplied for this project.

Elitecrete™ application for Thermal Insulation

The crucial benefit of *Elitecrete*™ in providing thermal insulation in buildings is being increasingly recognized by customers. The fact that *Elitecrete*™ can effectively replace the conventional brick-bat coba was recently demonstrated at a prominent location in central India.

Initially, the customer was supplied around 18 m^3 of *Elitecrete*™, which was pumped on certain area of the roof (Fig. 2). After hardening of *Elitecrete*™ the local team of RMC Readymix (India) took temperature readings in the presence of the customer. Temperature readings were taken in two rooms, one covered with *Elitecrete*™ and the other without *Elitecrete*™ (Table 1).

Table 1: Spot temperature measurement with and without *Elitecrete*™

	Measured temperature at bottom surface of terrace, ^0C
With *Elitecrete*™	31.1
Without *Elitecrete*™	34.8
Difference in temperature	3.7

Fig. 2 *Elitecrete*™ being pumped on the roof slab

Once it was evident to the customer that the use of *Elitecrete*™ resulted in lowering the room temperature by 3.7^0C, he gave repeat order. A total of around 90 m^3 of *Elitecrete*™ has been supplied to the customer.

During the execution of the repeat order, the local team of RMC Readymix (India) took the initiative of inviting some leading builders and consultants to the project site, (Fig. 3). The local team received a good and positive response from the visitors.

Fig. 3 Demonstration of *Elitecrete*™ to local customers

Perviouscrete™ at Coimbatore

Perviouscrete™ is a special product of RMC Readymix (India), which has proved to be an effective tool for rainwater harvesting. *Perviouscrete*™ permits easy percolation of rain and storm water in the ground, thereby reducing the run-off and recharging ground water.

Recently, an old-age home in Coimbatore used this product for its pathway. On the advice of the architect, the client directed their contractor to adopt this special product in the construction of pathways, Fig. 4. The architect specially instructed to use lower size aggregate, i.e. 10mm down and have proper finish, so that people can walk on the pathway comfortably.

Fig. 4 Laying of *Perviouscrete*™

A total of around 48 m^3 of *Perviouscrete*™ was laid. The client and the architect conducted the water percolation test at site (Fig. 5) and were happy with the final outcome.

Fig. 5 Testing of *Perviouscrete*™

Mail Box

Q. Why do we test cube samples by subjecting the cubes to 28-day curing, when the curing of concrete in actual structure is seldom done for 28 days ? Is it not appropriate to use field-cured samples which are subjected to the same level of curing as the structural element itself ?

A. For assessing the compressive strength of concrete, standard cubes need to be cast in accordance with the procedures outlined in IS 1199. The cube moulds need to be kept initially under moist conditions for a period of 24 hours, after which the cubes removed from the moulds are required to be stored in clean water at a temperature of $27^0C \pm 2^0C$ till the age of testing.

At the outset, let us understand one important premise - the test results of cubes represent the "potential" strength of concrete, rather than its actual strength in structure. This means that the cube results may or may not match the actual strength in structure. Yet, a standardised test procedure is essential, so that the results of the test conducted under the set procedure could be assessed under the specified acceptance criteria.

In spite of following all standardized procedures of testing meticulously as per IS 516 and 1199, we observe variations in test results. The sources of such variation are many; however, these could be grouped into three major categories: minor batch-to-batch variations of proportions and characteristics of constituent materials; variations occurring in the production, delivery, placing process; and variations in the sampling, specimen preparation, curing and testing procedures. Notwithstanding these variations, worldwide experience has indicated that the characteristics concrete strength can be estimated with reasonable accuracy when an adequate number of tests are conducted, strictly in accordance with standard practice and test methods.

You are correct in stating that curing of concrete is seldom done for 28 days. However, you will also agree that there has to be a standardised method of evaluation of the compressive strength, which happens to be a major part of the acceptance criteria of concrete. If field curing criteria of samples is to be introduced, one needs to take into account an abundant number of variables, the standardization which may be difficult to practice.

Incidentally, it may be pointed out that ACI 318 and ASTM C31 contain provisions for testing of field-cured specimens. However, these are used specifically to check the adequacy of curing and protection of concrete in the structure, which is generally the responsibility of the contractor. Further, when removal of formwork, re-shoring or back-shoring is based on concrete reaching a specified compressive strength, concrete is presumed to have reached this strength when test cylinders, field cured the same as the concrete they represent have reached the specified compressive strength.

Field-cured strength results are not used for determining the acceptance criteria. For determining the adequacy of curing, ACI 318 specifies that the strength of field-cured cylinders should be at least 85% of the companion standard (lab-cured) cured cylinders. However, if the strength of field-cured cylinders exceeds the specified strength by more than 3.5MPa, this requirement does not apply. In India, our codes and specifications do not specify field-cured specimen testing.

We trust we have answered your question satisfactorily. Kindly appreciate that there is no substitute to standardised testing procedures specified in the codes of practice.

Published by RMC READYMIX (INDIA) - A Division of Prism Cement Limited. (For Private Circulation Only)

Windsor, 7th floor, C.S.T. Road, Near Vidyanagari, Kalina, Santacruz (E) Mumbai-400 098 Tel: 26547000 Fax: 26547111/26547123 Website: www.rmcindia.com

Ahmedabad • Amravati • Bengaluru • Bhopal • Bhubaneshwar • Chennai • Coimbatore • Faridabad • Gadarwara • Goa • Greater Noida • Gurgaon • Guwahati Hyderabad • Indore • Jaipur • Kochi • Kolkata • Lucknow • Ludhiana • Mangalore • Mohali • Mumbai • Mysore • Nagpur • Nashik • Navi Mumbai • Noida Paradip • Pune • Raipur • Rajkot • Ranchi • Sahibabad • Sonepat • Surat • Thane • Thiruvananthapuram • Vadodara • Vizag

TOLL FREE NUMBERS : 180022 3454 I 09769801903